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**City and County of San Francisco  
PORT OF SAN FRANCISCO**

**AMADOR STREET INFRASTRUCTURE  
IMPROVEMENTS**

**CONTRACT No. 2852**

**FEDERAL AID PROJECT NO.  
MARAD FY 2022 PIDP Grant No. 693JF72344034**

**PROJECT MANUAL**

**VOLUME 3 OF 3**

**(DIVISION 2)**

**July 2024**

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Each Bid shall be enclosed in an envelope bearing the description:  
"BID FOR AMADOR STREET INFRASTRUCTURE IMPROVEMENTS  
(Port of San Francisco Contract No. 000000002852)".

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SECTION 00 01 10

TABLE OF CONTENTS

Section No.                      Section Title

**SPECIFICATIONS GROUP**

**DIVISION 02 – EXISTING CONDITIONS**

02 41 00                      DEMOLITION  
02 81 05                      NATURALLY OCURRING HAZARDOUS MATERIALS  
02 81 10                      ENVIRONMENTAL MANAGEMENT OF EXCAVATED MATERIALS

**DIVISION 03 – CONCRETE**

03 10 00                      CONCRETE FORMING AND ACCESSORIES  
03 20 00                      CONCRETE REINFORCING  
03 26 00                      DRILLED DOWELS  
03 30 00                      CAST-IN-PLACE CONCRETE

**DIVISION 05 – METALS**

05 12 00                      STRUCTURAL METAL FRAMING  
05 53 00                      METAL GRATING

**DIVISION 09 – FINISHES**

09 90 00                      PAINTING AND COATING  
09 97 23                      EPOXY COATING SYSTEM FOR SUMP AND VALVE BOX

**DIVISION 12 – FURNISHINGS**

12 93 00                      SITE FURNISHINGS

**DIVISION 22 – PLUMBING**

22 04 00                      GENERAL REQUIREMENTS FOR PLUMBING  
22 05 00                      COMMON WORK RESULTS FOR PLUMBING  
22 05 29                      PIPE HANGERS AND SUPPORTS  
22 05 53                      IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

**DIVISION 26 – ELECTRICAL**

26 04 00                      GENERAL REQUIREMENTS FOR ELECTRICAL  
26 05 00                      COMMON WORK RESULTS FOR ELECTRICAL  
26 05 19                      LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES  
26 05 26                      GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS  
26 05 33.26                      PVC COATED GALVANIZED RIGID STEEL (PGRS) CONDUIT AND SYSTEM

## COMPONENTS

26 05 43	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATION OF ELECTRICAL SYSTEMS
26 08 00	COMMISSIONING OF ELECTRICAL SYSTEMS
26 24 17	SUMP TERMINATION PANEL
26 27 00	LOW-VOLATAGE DISTRIBUTION EQUIPMENT
26 36 00	MANUAL TRANSFER SWITCHES
26 50 00	LIGHTING

## DIVISION 31 – EARTHWORK

31 23 00	EXCAVATION AND FILL
31 23 19	DEWATERING
31 23 33	TRENCHING AND BACKFILLING
31 23 34	PAVEMENT CUTTING AND EXCAVATION
31 23 36	EXCAVATION AND BACKFILL FOR WATER WORK
31 40 00	SHORING AND UNDERPINING
31 62 23.13	TORQUE DOWN PILES

## DIVISION 32 – EXTERIOR IMPROVEMENTS

32 01 16.71	COLD MILLING ASPHALT PAVING
32 01 90	LANDSCAPE MAINTENANCE LONG-TERM PLANT MAINTENANCE PERIOD
32 11 23	AGGREGATE BASE COURSES
32 12 16	ASPHALT PAVING
32 13 13	CONCRETE PAVING
32 14 43	PERMEABLE UNIT PAVING
32 17 53	ADJUSTMENT OF FRAMES AND CASTINGS
32 90 00	PLANTING
32 91 13	STRUCTURAL SOIL
32 91 19	PLANTING PREPARATION

## DIVISION 33 – UTILITIES

33 01 30.63	SEWERAGE SYSTEMS MORTAR REHABILITATION
33 11 00	WATER UTILITY DISTRIBUTION PIPING
33 11 41	V-BIO POLYETHYLENE ENCASMENT OF DUCTILE IRON PIPE
33 11 43	REMOVAL OF SFWD-OWNED VALVE BOX AND COVER
33 12 13	INSTALLATION OF SCREW TAPS, SADDLES, SERVICE PIPE AND FITTINGS
33 12 16.12	GATE VALVES
33 13 00	SANITARY WORK PRACTICES AND DISINFECTION OF WATER UTILITY DISTRIBUTION
33 33 00	SANITARY SEWERAGE UTILITIES
33 34 00	SANITARY UTILITY SEWAGE FORCE MAINS
33 41 00.10	REINFORCED CONCRETE PIPE
33 45 10	MAIN SUBMERSIBLE PUMPS
33 45 20	DEWATERING PUMPS

**DIVISION 40 – PROCESS INTEGRATION**

40 61 00	COMMON WORK RESULTS FOR CONTROL SYSTEM
40 61 21	PROCESS AND FACILITY CONTROL SYSTEM TESTING
40 61 96	CONTROL STRATEGY
40 70 00	INSTRUMENTATION FOR PROCESS SYSTEM
40 94 31	CONTROL PANEL CONSTRUCTION
40 94 45	PROGRAMMABLE LOGIC CONTROLLER WITH INTEGRATED HMI

**END OF SECTION**



## SECTION 02 41 00

## DEMOLITION

## PART 1 – GENERAL

## 1.1 WORK INCLUDES

- A. Perform all demolition work for concrete, asphalt, pavement, utilities, fencing, and related facilities as shown on the drawing and in accordance with this specification.
- B. Contractor shall complete and submit all necessary information to obtain required permits.
- C. Existing improvements will include, but are not limited to, asphalt concrete and concrete base roadway pavement, base rock, subgrade, concrete pavement, concrete parking strip, concrete gutter, concrete curb, concrete sidewalk, concrete curb ramps, and all other existing facilities or improvements as indicated on the Drawings and as described in these Specifications.

## 1.2 REFERENCE STANDARDS

- A. Standard Drawings of the City and County of San Francisco Department of Public Works, Bureau of Engineering (SSDPWSF), revised April 2007.
- B. Standard Specifications of the City and County of San Francisco Department of Public Works, Bureau of Engineering (SSDPWSF), revised November 2000.
- C. State of California Department of Transportation Standard Specifications (CTSS), dated July 2002.

## 1.3 RELATED SECTIONS

- A. Section 01 20 00 – Price and Payment Procedures
- B. Section 01 35 45 – Health and Safety Criteria
- C. Section 01 50 00 – Temporary Facilities and Controls
- D. Section 01 71 23 – Field Engineering
- E. Section 01 71 33 – Protection of Adjacent Construction
- F. Section 01 57 19 - Environmental Mitigation Measures
- G. Section 12 93 00 – Site Furnishings
- H. Section 31 40 00 – Shoring and Bracing
- I. Section 31 23 33 – Trenching and Backfilling
- J. Section 31 23 00 – Excavation and Fill
- K. Section 32 14 43 – Permeable Unit Pavers

- L. Section 32 91 19 – Planting Preparation

#### 1.4 QUALITY ASSURANCE

- A. Contractor shall utilize work persons skilled in the trades appropriate for each task.
- B. Contractor shall take precautions to guard against movement, settlement or collapse of any nearby structures not designated for demolition and be liable for the consequences of any such movement, settlement or collapse.
- C. Contractor shall prepare a fully coordinated plan for demolition, site shoring, and excavation work as indicated in the Contract Documents.
- D. The Contractor shall perform demolition work in accordance with the requirements of Sections 700 and 701 of the DPW Standard Specifications, except as indicated herein.

#### 1.5 SUBMITTALS

- A. Before commencing work the Contractor shall submit to the City the following information:
  - 1. Written protection plan for City's review describing protection for neighboring buildings, walkways, roads, utilities, components and finishes, site elements, surrounding materials, and existing trees to remain. Describe in detail the materials, methods, and equipment to be used for protection of elements and materials during demolition operations.
  - 2. Detailed schedule showing the commencement, order, sequence and completion dates for the various work activities.
  - 3. When working on existing utilities (electrical, sewer, storm drain, water, telecommunication, gas, fire lines, etc.) that will be temporarily disconnected or disrupted, submit a notification to the utility owner 72 hours in advance and obtain the City's approval in writing before proceeding with this phase of the work.
  - 4. Demolition of the ACM west wall Pump Station shall be conducted under supervision of an EPA accredited supervisor and trained workers with appropriate PPE. Submit current copies of at least 16 hours O&M Asbestos training for the supervisor and 4 hours awareness training for the trained workers. Submit PPE and medical clearance qualifications for each qualified personnel prior to commencement of the wall demolition.

#### 1.6 JOB CONDITIONS

- A. Transport salvaged items from site as they are demolished. Storage or sale of demolished items shall not be permitted on the project site.
- B. Explosive use or possession on-site is not permitted.
- C. Contractor is required to conduct demolition operations and debris removal to minimize interference with roads, streets, walks, and other adjacent facilities. The Contractor shall not close or obstruct streets, walks, or other occupied and used facilities without approval, and provide alternate routes around closed or obstructed traffic ways in accordance with applicable regulations.



- D. Do not allow equipment to pass over existing streets or other public and private property without ample protection. Protect and maintain existing driveway concrete paving. Any such property, which is damaged as the result of operations, shall be restored to original condition.
- E. Comply with the requirements of CCR Title 8, Construction Safety Orders, and California State Building Code. Protect adjacent structures, sidewalk, curbs and streets from settlement or other damage.
- F. Every precaution shall be taken to prevent spillage when hauling on or adjacent to any public street or highway. If spillage occurs, all such spillage shall be removed and the streets and highways shall be swept, washed or otherwise cleaned as required by the City.
- G. All precautions shall be taken by the Contractor to prevent dust nuisance to off-site facilities, and prevent erosion and transportation of soils to off-site properties. Any damage to facilities to remain caused by Contractor shall be repaired at the Contractor's expense.
- H. All portions of the Work shall be kept free of standing water at all times. Maintain uniform grades, construct ditches and provide and operate pumps as necessary to prevent erosion, softening of compacted surfaces and formation of mud in trenches and excavations. If ditches are required, they shall be constructed, tamped and maintained in a neat, uniform shape. Do not under any circumstances, conduct or pump water or allow water to be diverted or flow towards other areas of the site, which may, in the opinion of the City, be damaged thereby. Protect inlets from siltation as necessary.

#### 1.7 PROTECTION

- A. The Contractor shall provide, erect and maintain all catch platforms, lights, barriers, weather protection, warning signs, and all other items as required for the proper protection of workers engaged in demolition operations, visitors, public and adjacent construction.
- B. Contractor shall provide adequate fire protection in accordance with all governing agency requirements.
- C. Provide and maintain temporary protection of all existing elements designated to remain including but not limited to utility lines, streets, sidewalks, light standards, hydrants, street signs, trees, and fire alarm boxes. Make all repairs necessitated by operations under this Section to the complete satisfaction of the owner of the damaged property.
- D. Make all necessary explorations to determine required protective measures before proceeding with demolition and removal work. Contractor shall pay particular attention to shoring and bracing requirements to prevent damage to elements to remain and/or adjacent properties.

#### 1.8 ASBESTOS CONTAINING WALL DEMOLITION

- A. The City's environmental consultant surveyed the facility for the presence of various hazardous materials. The survey findings are documented in the following report: *Asbestos Survey Report, Reinforced Concrete Structure, Amador Pump House,*

*Envirosurvey Inc, July 15, 2016.* The Amador Pump Station West wall was determined to contain less than 1% asbestos.

- B. The Contractor shall contract and use trained and qualified contractors for the asbestos-containing wall demolition. Demolition of the portion of the west wall as ACCM shall be conducted under supervision of an EPA accredited supervisor, trained workers with appropriate PPE.
- B. Notifications to BAAQMD will not be required due to non friability of concrete.
- C. Wet methods or wetting agents, to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup is required.
- D. Conduct prompt clean-up and disposal of wastes and debris contaminated with asbestos. All concrete waste generated during the demolition must be stored inside a lined closed top dumpster. The waste maybe recycled and/or disposed of as regular construction debris.

#### 1.9 EXISTING UTILITIES

- A. Prior to starting any work related to existing utilities, notify utility owner 72 hours in advance and obtain utility owner's written approval before proceeding with this phase of the Work. Utilize the services of Underground Service Alert (U.S.A.) at 1-800-642-2444 for all notifications.
- B. The Contractor shall be responsible for protection of existing utility lines. If existing active utility lines are encountered, protect same from damage and notify the City. Do not interrupt service except as directed or accepted by the City and allow sufficient time to make arrangements for continuation of required services. Damage to said lines as a result of demolition operations shall be repaired or replaced as directed by the City.
- C. Protect existing active utilities as required to prevent unauthorized disruption of services. Prior to commencing any operations in the general location where utilities are indicated, determine exact alignment and depth of utilities.
- D. Abandon-in-Place existing utility piping, conduits, and other related items that are to be abandoned and plug open ends with concrete. Utility piping to be abandoned in place, cut, or capped shall be tagged with permanent markings identifying the type of service.
- E. Remove existing utilities shown to be removed, cap and backfill trenches.
- F. Provide chiseled mark at sidewalk indicating location and type of utilities capped.

#### 1.10 NOISE CONTROL

- A. All motorized equipment on the site, including hauling trucks, shall be equipped with sound control devices at all times. The sound level measured at a distance of 15 feet from any piece of equipment or communication device shall not exceed 60 decibels.

#### 1.11 DUST CONTROL

- A. Take necessary precautions to prevent dust and dirt from rising by wetting demolished asphalt concrete, concrete, plaster, and similar debris or by erecting temporary

enclosures, and other suitable methods to limit dust and dirt rising and scattering in air. Total dust when measured upwind or downwind from the construction site should not exceed the California State standard for PM10 over a 24-hour period of 0.56 micrograms/cubic meter. Visible dust shall be minimized. Contractor shall comply with air pollution control regulations of the Bay Area Air Quality Management District.

- B. Control the use of water so that it does not create hazardous or objectionable conditions such as flooding, or silt/debris runoff into sewer systems.
- C. Clean adjacent areas and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

## PART 2– PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

- A. The Contractor shall furnish all labor, materials, and equipment, as required for removing existing surface facilities as shown in the Drawings.

## PART 3 – EXECUTION

### 3.1 PREPARATION

- B. Verify conditions in the field prior to the start of work. If unanticipated utility elements conflict with the proper operation of systems that are to remain, investigate and measure both nature and extent of the conflict and notify City prior to proceeding with demolition work.
- C. Provide shoring, bracing, and other supports as required to comply with all laws and regulations. If the safety of adjacent structures and other elements appears to be endangered, cease operations, and notify City immediately. Take precautions to support endangered work until determination is made for continuing operations.
- D. Notifications
  - 1. Underground Service Alert
    - a. Before commencing any excavation, the Contractor shall obtain an Underground Service Alert (USA) inquiry identification number by calling (800) 642-2444.
    - b. The Contractor shall allow four (4) calendar days after the identification number is obtained and before excavation work is started so that utility owners can be notified by the Contractor.
    - c. Identification numbers will not be given more than ten (10) calendar days prior to starting excavation work.

### 3.2 PROTECTION

- A. The Contractor shall provide for temporary protection of street lighting and traffic signals required for construction operations.
- B. The Contractor shall take necessary precautions to preserve and protect private and public property within and adjacent to the site.

- C. The Contractor shall provide and maintain barricades, guard rails, plates and other safety devices as required, as Incidental Work. Refer to Section 01 50 00 – Temporary Facilities and Controls.

### 3.3 SURVEY REFERENCE POINTS

- A. The Contractor shall locate and preserve horizontal coordinates, and vertical elevations of San Francisco survey monument points during construction. The Contractor shall notify the County Surveyor at (415) 554-5833 to report any monuments in danger of disturbance, destruction, or removal. All City monuments are to be protected per State Land Surveyors Act and Section 01 71 33 – Protection of Adjacent Construction.
- B. The Contractor shall not disturb, destroy, or remove any survey monuments without approval from the County Surveyor. The Contractor shall salvage any monuments removed during construction and deliver these monuments to the Public Works Bureau of Street-Use and Mapping at 49 South Van Ness Avenue, Suite 300, 9th Floor, Subdivision and Mapping, San Francisco, CA 94103.

### 3.4 SITE DEMOLITION

- A. Remove all asphalt concrete, concrete, and other features noted in the Contract Documents.
- B. All abandoned utilities within the project area encountered shall be removed, unless otherwise indicated in the Contract Documents. Ends of abandoned utilities shall be capped or plugged as approved and tagged with permanent identification.
- C. Excavations resulting from the removal of such items shall be cleaned out to firm, undisturbed soil.
- D. At completion of demolition, remove all debris from the project and finish off grades and other work in a neat and uniform manner.
- E. All surfaces, paving, utilities, improvements, or other items of any kind or nature not indicated to be demolished, which are cut or otherwise disturbed shall be restored to their original condition, quality, finish, appearance, and wearing value with duplicating materials all to the acceptance of the City.
- F. Work under this Section shall include complete responsibility for damage by erosion, to areas both inside and outside the limits of Work, caused or contributed to by operations under this Section.
- G. If the Contractor is forced to suspend Work prior to completion because of inclement weather, it shall be responsible for leaving the project in a suitable condition with proper erosion control to drain properly until such time as work is again commenced.

### 3.5 SURFACE FACILITIES

- A. The Contractor shall remove as part of the surface facilities, all related subsurface foundations, footings and encasements of removed or salvaged facilities as indicated on the Drawings and as necessary to accommodate the Work, including new planters and permeable pavers.
- B. The Contractor shall remove existing paving, gutter and subsurface baserock and soils

per depths as indicated on the Drawings.

- C. The Contractor shall provide 48 hours notice prior to any delivery of salvaged items.
- D. Salvaged traffic signs will be delivered to the Municipal Transportation Agency (MTA) Sign Section at 1508 Bancroft Street, San Francisco. Telephone (415) 554-9785. Refer to Section 01 55 26 for Sign Inventory Form submittal requirements.
- E. Salvaged traffic signals, poles and other related equipment will be delivered to MTA's Traffic Signal Division Shop Yard at 2650 Bayshore Blvd, Daly City, CA 94104, Phone (415) 550-2736.
- F. Salvaged street lighting equipment specified or shown to be salvaged as City property will be delivered to the Bureau of Light, Heat and Power at 15th and Harrison Streets, San Francisco, Phone (415) 554-0730.
- G. Salvaged rims, gratings and covers of DPW catch basins, sewer water inlets and manholes will be delivered to the City Yard at 2323 Cesar Chavez Street, San Francisco.
- H. All facilities to be removed as the Contractor's property will be removed from the site and disposed of in a legal manner.
- I. The Contractor shall remove debris from the site daily, unless otherwise directed. Refer to Section 01 50 00 – Temporary Facilities and Controls, for maintenance of the site and dust control requirements.

### 3.6 SUBSURFACE FACILITIES

- A. If applicable, the Contractor shall remove as part of the surface facilities all related subsurface foundations, footings and encasements of removed or salvaged facilities as indicated on the Drawings and as necessary to accommodate the Work.
- B. Cobblestones
  - 1. In the event cobblestones are encountered in any street under construction, the Contractor shall remove them from the site as City property. All delivery must be initiated and authorized by City Representative. The cobblestones will be neatly and securely placed on pallets so they can be moved about safely after delivery. The cobblestones will be delivered, including off loading, to the lower lot of the City Yard at 2323 Cesar Chavez Street, San Francisco, or where directed by the City Representative within the City.
    - a. Contact Matthew Naclerio of the Bureau of Building and Street Repair at [Matthew.Naclerio@sfdpw.org](mailto:Matthew.Naclerio@sfdpw.org).
    - b. Provide a minimum of 48 hour notice for delivery / cancellation via written notification with the following information:
      - Project Name
      - Project Number
      - City Representative Name
      - Contractor Contact Number
      - Estimated Delivery Quantity
  - 2. The Contractor shall clean the cobblestones of dirt, debris, and other construction material and exercise care in transporting the cobblestones so as to minimize damage.

3. Salvage, hauling and delivery of existing cobblestones to the designated areas from the site will be done as Incidental Work.
  - a. Delivery is to be made between 8am to 3pm, Monday through Friday.
  - b. During delivery, driver is to check in with the Yard Master for designated deliver location.
  - c. Yard Master may reject mix and/or unclean load.
  - d. Additional charges will be incurred for:
    - 1) Cleaning and Sorting, if Yard must double-handle load to sort, clean and stack delivery
    - 2) Yard Opening and Operation during non-operation hours and unscheduled deliveries.

### 3.7 PAVEMENT CUTTING

- A. Pavement cutting will be performed in accordance with the requirements of Section 31 23 33 –Trenching and Backfilling.

### 3.8 DISPOSAL OF REMOVED AND DEMOLISHED MATERIALS

- A. General: On a daily basis, remove from site accumulated debris, rubbish, and other materials resulting from demolition operations.
- B. Burning of combustible materials from demolished structures will not be permitted.
- C. Removal: Transport from site and legally dispose of materials removed from demolished structures.
- D. The Contractor shall dispose of all removed and demolished materials, in a legal manner as the Contractor's property, except for items indicated to be salvaged and delivered to the City.
- E. Excavated materials to be disposed of by the Contractor in a legal manner as the Contractor's property, will include, but are not limited to the following: Asphalt concrete and concrete base roadway pavement, concrete pavement and parking strip, concrete gutter, concrete curb, concrete sidewalk, shrubbery, roots, garbage, extra soil material, and other debris.

### 3.9 STREET, CURB AND SIDEWALK REPAIR

- A. General: Contractor shall be responsible for repair of all curbs, gutters, street pavements and sidewalks surrounding the project area that are damaged by these operations.

### 3.10 CLEANING UP

- A. Upon completion of all work under this Section, remove all tools, materials, plants, apparatus, and rubbish of any sort. The premises shall be left clean.

END OF SECTION





## SECTION 02 81 05

## NATURALLY OCCURRING HAZARDOUS MATERIALS

## PART 1 - GENERAL

## 1.1 SUMMARY AND SCOPE OF WORK

- A. Serpentine containing Naturally Occurring Asbestos (NOA) shall be encountered on the project as known through USGS map, soil assessment, soil sampling or other information indicating that the project shall be disturbing NOA.
- B. The Contractor is alerted to the fact that the site soils and geology is predominantly made up of ultramafic rocks, including serpentinite (which contains natural occurring asbestos - NOA). Disturbance of ultramafic rocks, including serpentinite, trigger the requirements the California Air Resource Board (CARB) Asbestos Airborne Toxic Control Measure (ATCM) for Construction. There is no minimum threshold for ultramafic rocks. The ATCM is triggered even if no asbestos is detected
- C. Naturally Occurring Asbestos (NOA): NOA is typically associated with ultramafic rocks within the Franciscan mélange, including serpentinite, greenstone, and blueschist. There are six regulated naturally occurring asbestos minerals: chrysotile, crocidolite (asbestiform riebeckite), amosite, tremolite, actinolite, and anthrophyllite (CGS 2002). The six asbestos minerals are divided into two distinct mineral groups; serpentine minerals (chrysotile), and amphibole minerals, which include the remaining five above-mentioned minerals. These asbestos minerals are considered hazardous to humans, and are classified as known human cancer-causing substances by local, state, and federal health agencies (DTSC 2004).
- D. The Contractor shall comply with the California Code of Regulations, Title 17, Section 93105 - Asbestos Airborne Toxic Control Measure (ATCM) for Construction, Grading, Quarrying, and Surface Mining Operations [www.arb.ca.gov/toxics/atcm/asb2atcm.htm](http://www.arb.ca.gov/toxics/atcm/asb2atcm.htm).
- E. Cal/OSHA regulations are triggered when asbestos is present in any amount. The Contractor shall meet its obligations under CCR Title 8, Section 1529. The regulation requires monitoring to determine exposure levels, wet methods, respirators and protective clothing, controlled access to the work area, and similar precautions associated with asbestos work regardless of the origin of the asbestos. Use of a competent person to oversee the work may also be necessary. The Contractor shall utilize an experienced Certified Industrial Hygienist (CIH) and a Professional Geologist (PG) to assist it with this work.
- F. Environmental Training shall be required as per these contract specifications.
- G. Work in this Contract shall involve working environments that may be hazardous due to the demolition, disturbance, generation, excavation, handling, management, characterization, processing, loading, transportation, and disposal of geologic materials that contain naturally occurring asbestos (NOA) and/or naturally occurring metals, Particulates Not Otherwise Regulated (PNOR), and silica in geological and building materials. All these materials are referred to as "naturally occurring hazardous materials".
1. This specification includes the regulatory requirements for demolishing, disturbing, generating, excavating, handling, managing, characterizing,

- processing, loading, transporting and disposing naturally occurring hazardous materials that are not otherwise contaminated with other hazardous materials.
2. The Franciscan Formation, colluvium, alluvium, serpentinite, and fill materials are potentially NOA-containing materials, AND IS PRESENT ALONG THE ALIGNMENT.
- H. Control of naturally occurring hazardous materials, and conditions at the Project Site is the responsibility of the Contractor.
- I. The Contractor, not the City, is responsible for protection from exposure risks of its employees and subcontractors, as per federal, state and local statutes, laws and regulations.
- J. The Contractor at its cost, is obligated to conduct personnel air monitoring of its personal and subcontractors as required by Federal, State and local laws. The City will conduct ambient air monitoring as it deems so.
- K. The Contractor shall hire an experienced Certified Industrial Hygienist (CIH) and a Professional Geologist (PG) to assist it with:
1. Complying with both the Cal/OSHA, CARB and BAAQMD requirements and other Federal, State and local regulations for naturally occurring hazardous materials.
  2. Develop precautionary measures prior to disturbance of naturally occurring hazardous materials, other protection requirements for all other individuals concurrently performing other work adjacent to those performing earth disturbing activities, such as buffer zones, air monitoring, engineered control measures, etc.
  3. Determining the Cal/OSHA Work Activity Level for naturally occurring hazardous materials as per the Cal/OSHA Construction Asbestos Standard, 8 CCR all applicable Sections. The Contractor shall meet its obligations under this regulation and provide workers trained for the Cal/OSHA Work Activity Level as determined by its CIH and RG, and at no cost to the City.
  4. Determining the respiratory protection required.
  5. Determining the personal protective equipment (PPE) required,
  6. Guiding and monitoring of its worker's health and safety and any other project-specific requirements.
  7. Determining the level and type of training and certifications required of its workers.
  8. Guiding and monitoring of its workers for managing, excavating, disturbing, generating, handling, managing, characterizing, processing, loading, transporting and disposing of geologic materials and building materials that contain naturally occurring hazardous materials.
  9. Guiding and monitoring of its workers performing work in a confined space.
  10. Ensuring that other areas of the work are not contaminated by naturally occurring hazardous materials.

11. NOTE: Other than limited entry and egress, if excavation of naturally occurring hazardous materials is occurring inside the basement of a building, there is the potential for concentrations of asbestos to exceed the PEL.
- L. The Contractor shall take into account the productivity losses, if any, due to but not limited to, encountering naturally occurring hazardous materials, and complying with this Section.
- M. The City will not pay any additional compensation to the Contractor due to encountering naturally occurring hazardous materials, and complying with this Section.
- N. The Contractor is obligated to conduct any required personal air monitoring of its workers, at its own expense, in accordance with Section 01 35 45 Health and Safety Criteria, and the requirements of this Section.
- O. The Contractor shall also be responsible for providing all levels of personal protective equipment (PPE) and the use of decontamination and hygiene facilities to all project visitors and individuals assigned to the project, regardless of the employer, requiring PPE and decontamination.
- P. For the purposes of bidding, the Contractor shall assume that in addition to its workers, employees, subcontractors, visitors and vendors, additional PPE and decontamination and hygiene facility capacity shall be provided for 10 persons throughout the duration of construction for City workers, and its employees, subcontractors, visitors, vendors and representatives of regulatory agencies.
- Q. Landfills also may have individual packaging criteria for the receiving of material containing asbestos. It is the Contractors responsibility to determine what the landfills requirements are, including but not limited to percent solids and “burrito wrapping” of the material or trucks with 10 mil-HDPE plastic. Any costs associated will be borne by the Contractor and included in the unit bid price for Transportation.
- R. The Contractor shall make provisions to ensure that the environmental mitigation measures for construction dust control in Section 01 57 30 Environmental Mitigation Measures are consistently implemented for the project duration.
- S. The Contractor shall be responsible for all costs incurred or necessary to fulfill the requirements of this Section, and to ensure compliance of its operations and its performance of the Work with all applicable Codes and contract requirements.
- T. The City reserves the option and right, at any time, to require the Contractor to increase its administrative and engineering controls, and its environmental mitigation measures as necessary, if the City determines that lack of it would be a potential hazard to the occupants and general public.
- U. Nothing contained in this Contract shall relieve Contractor, or any Subcontractor or Supplier, from the obligations set forth above and obligations as required by applicable laws, rules, or regulations. If a provision of this Document conflicts with any applicable provision of this Contract or any federal, state, or local safety regulations, the more stringent requirements that maintain a greater level of safety shall apply.
- T. Related Documents and Sections:
1. Section 00 31 00 Available Project Information
  2. Section 01 10 62 Environmental Conditions

3. Section 01 35 45 Health and Safety Criteria
4. Section 01 41 00 Regulatory Requirements
5. Section 01 57 19 Environmental Mitigation Measures
6. Section 02 41 00 Demolition
7. Section 31 25 00 Temporary Erosion and Sediments Controls

U. **Reference Documents:** The Contractor shall fully familiarize itself with, and read in its entirety the following environmental reports:

1. Geotechnical Investigation, Amador Street Sanitary Pump Station Improvements, T&R/RVCG, July 2011
2. Geotechnical Investigation, Pier 94 Backlands Improvements, T&R/RVCG, July 2012
3. Asbestos Survey Report, Reinforced Concrete Structure, Amador Pump House, EnviroSurvey Inc., July 2016

## 1.2 SUBMITTALS

- A. The Contractor shall submit the following in accordance with this Section, and have the Plans approved by the City Representative at least 15 working days before any excavation or demolition activity:
1. Notify the City Representative before the initial planned excavation, so that the City may notify the BAAQMD that excavation will occur in an area of Naturally Occurring Asbestos (NOA). The City is obligated to file the ADMP Discovery Notification Form with the BAAQMD at least 15 days prior to excavation occurring in an NOA area.
  2. Submit the Designated Competent Person references and qualifications as per Part 1.06 of this Section.
  3. Submit An exposure control plan for Respirable Crystalline Silica found in the California Code of Regulations, [Title 8, section 1532.3](#), and OSHA Regulation 29 CFR 1926.1153
  4. Asbestos Dust Mitigation Control Plan (ADMP) to comply with the California Code of Regulations, Title 17, Section 93105 - Asbestos Airborne Toxic Control Measure (ATCM) for Construction, Grading, Quarrying, and Surface Mining Operations mitigation measures.

## 1.3 ABBREVIATIONS

- A. Air Pollution Control Officer (APCO)
- B. Asbestos Dust Mitigation Plan (ADMP)
- C. Asbestos Hazard Emergency Response Act (AHERA)

- D. Asbestos Toxic Control Measure (ATCM)
- E. Bay Area Air Quality Management District (BAAQMD)
- F. California Air Resources Board (CARB)
- G. California Code of Regulations (CCR)
- H. California Occupational Safety and Health Administration (Cal/OSHA)
- I. Certified Asbestos Consultant (CAC)
- J. Certified Industrial Hygienist (CIH)
- K. Competent Person(s) (CP)
- L. Health and Safety Plan (HASP)
- M. High Efficiency Particulate Air (HEPA)
- N. Injury and Illness and Prevention Plan (IIPP)
- O. National Industrial Occupational Safety and Health (NIOSH)
- P. National Emissions Standards for Hazardous Air Pollutants (NESHAP)
- Q. Naturally Occurring Asbestos (NOA)
- Q. Permissible Exposure Limit (PEL)
- R. Phase Contrast Microscopy (PCM)
- S. Particulate Matter of Size Less Than or Equal to 10 Micrometers (PM10)
- T. Personal Protective Equipment (PPE)
- U. Professional Geologist (PG)
- V. San Francisco Bay Regional Water Quality Control Board (RWQCB)
- W. Site Surveillance Technician (SST)

#### 1.4 DEFINITIONS

- A. Certified Asbestos Consultant (CAC) – Persons currently certified by the California Department of Safety and Health under Section 1529 (q) will be responsible for Asbestos Air Monitoring and will oversee SSTs.
- B. Certified Industrial Hygienist (CIH) – Industrial Hygienist currently certified in Comprehensive Practice by the American Board of Industrial Hygiene.
- C. Competent Person (CP) – Persons trained and otherwise qualified in accordance with 8 CCR 1529 as a CP for a specific job function. CPs for other job functions are trained and otherwise qualified to perform their specific job function. CPs who perform other air monitoring (such as for metals) shall be approved by a CIH. CPs who provide

naturally occurring asbestos services must be a CIH with experience in naturally occurring asbestos (NOA), or a CAC with experience with NOA.

- D. Excavated geologic material - Includes soil and rock excavated, handled, and managed in the course of the Work. Excavated geologic material does not include asphalt, concrete, aggregate base, vegetation, debris, wood, obstructions, and other deleterious matter.
- E. Excess excavated geologic materials - Excavated geologic material that does not meet the specified requirements for backfill or is in excess of that required for construction. Excess excavated geologic material shall be managed, transported, and disposed of in accordance with the Contract Documents.
- F. Naturally occurring hazardous materials - geologic and building materials that contain naturally occurring asbestos (NOA) and/or naturally occurring metals, Particulates Not Otherwise Regulated (PNOR), and silica.
- G. Personal Breathing Zone (PBZ) – Area of air monitoring used to represent the worker's breathing zone. A sampling device is attached to the worker and set close to the worker's breathing level.
- H. Professional Geologist (PG) (NOA Identification Professional) – Geologist currently licensed by the California Board of Engineers, Geologists and Geophysicists. The PG shall designate areas containing naturally occurring asbestos, and conduct all sampling and testing of rock and soil materials that may contain NOA.
- I. Site Surveillance Technician (SST) – Personnel who perform air monitoring during construction in accordance with the requirements of this Section and who are trained under the direct supervision of a CAC.

## 1.5 CODES AND REGULATIONS

- A. Comply with the requirements of the Contract Documents and with all applicable laws and regulations in effect at the time of the disturbance, management, transport or disposal of the potentially NOA-containing geologic materials. In the event of conflict, the more stringent requirement will apply. The regulations include but are not limited to the following items:
  - 1. Cal/OSHA Construction Asbestos Standard, 8 CCR all applicable Sections and Section 1529.
  - 2. BAAQMD Regulation 11, Rule 2 and Regulation 11, Rule 14.
  - 3. Environmental Protection Agency NESHAP and AHERA regulations (40 CFR Part 763, as applicable).
  - 4. Occupational Safety and Health Administration (inclusive of OSHA 29 CFR 1926.1101).
  - 5. California Environmental Protection Agency (Cal/EPA) Title 22.
  - 6. Other applicable federal, state, and local governmental regulations pertaining to work involving asbestos-containing materials (ACM), naturally-occurring asbestos, asbestos waste, and naturally occurring hazardous materials.

7. The Final Regulation Order of the California Code of Regulations (CCR) Title 17, Public Health, Section 93105, on Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations.
8. San Francisco Health Code, Article 21, addressing Hazardous Materials.
9. The San Francisco Health Code, Construction Dust Control Requirements – Article 22B.
10. The San Francisco Building Code Section 106.3.2.6 (Ordinance #176-08).
11. The DPW Dust Control Order 171,378, of the San Francisco Public Works Code.
12. Clean Construction Ordinance under the SF Administrative Code, Chapter 6, Section 6.25 and Section 6.67, SF Environment Code, Chapter 4: Section 426 Clean Construction Assistance and Reporting, City Ordinance # 70-07, and City Ordinance # 28-15.
13. The Contractor is solely responsible for identifying which regulations of the examples below that may also apply to disturbance, generation, excavation, handling, management, characterization, transportation, and disposal of potentially NOA-containing, as well as for non-NOA-containing geologic materials include, but are not limited to, the following items:
  - a. Resources Conservation and Recovery Act, 42 U.S.C. Section 6901 et seq. and regulations 40 CFR Part 260 et seq.
  - b. California Health and Safety Code, Division 20 and regulations, and 22 CCR Section 66000 et seq.
  - c. California Code of Regulations Title 14, Chapter 3.5, Standards for Handling and Disposal of Asbestos Containing Waste.
  - d. California Code of Regulations Title 8 Sections 5155, 5144 and 5194 and related requirements.
  - e. OSHA's regulations, policies and directives including but not limited to the following:
    - i. 29 CFR 1910, 1915, 1917, 1918, and 1926.
    - ii. Unified Agenda Proposed Rule 1218-AB70.
    - iii. OSHA's Safety and Health Program Management Guidelines (Federal Register 54:3904-3916, January 26, 1989).
    - iv. OSHA's National Emphasis Program (NEP) for Crystalline Silica and PNOR exposure to identify, reduce, and eliminate health hazards associated with occupational exposures.

## 1.6 REQUIREMENTS OF THE CONTRACTOR'S ASBESTOS COMPETENT PERSON

- A. The Contractor shall designate in writing a responsible Asbestos Competent Person (ACP) at the Site whose principal duties shall be overseeing asbestos soil disturbing activities, implementing engineering and administrative controls to prevent asbestos from becoming airborne, and general compliance with Cal/OSHA, CARB, and EPA regulations related to asbestos and naturally occurring asbestos (NOA). The asbestos CP is also a qualified person having the necessary training and experience to be knowledgeable in the identification, control, and management of asbestos and naturally occurring asbestos encountered onsite. The Project Safety Representative (PSR) and ACP may be the same person if all training and experience requirements for both positions are met.
- B. The Contractor's Asbestos Competent Person (ACP) shall:
1. Communicate all NOA-related issues to the PSR daily and as needed as required for the PSR to fully execute its duties.
  2. Have completed 40-hour Cal/OSHA-required Asbestos Contractor Supervisor training and must submit documentation of such training to the City Representative.
  3. Possess qualifications, which include a minimum of three (3) years recent experience as an ACP on construction projects similar to this Contract.
  4. Implement the elements of Cal/OSHA asbestos in construction standard 8 CCR §1529 and other applicable regulations and standards, including but not limited to:
    - a. Demarcate the Regulated Areas and control the points of ingress and egress,
    - b. Conduct asbestos worker training to all workers in Cal/OSHA Regulated Areas, and NOA awareness training to all workers and visitors who enter the site and are outside of the Regulated Areas,
    - c. Assure that wet methods and other engineering controls are implemented to minimize asbestos emissions,
    - d. Conduct the Initial Exposure Assessment and select respiratory protection accordingly,
    - e. Conduct daily personal monitoring and communicate exposure results to workers,
    - f. Based on monitoring results, continuously re-evaluate PPE requirements select the appropriate respiratory protection to prevent exposure above the PEL,
    - g. Assure that personal decontamination stations are adequate and located to allow workers to decon thoroughly prior to exiting the Regulated Areas. The decon stations shall include water and boot scrubs, HEPA-vacuums, cleaning wipes for respirators, and facilities to dispose of used Tyvek,
    - h. Provide boot-washing and cleaning stations at points of site egress for workers and visitors who may contact NOA (such as walking on NOA) outside of Regulated Areas.
  5. Implement the airborne serpentine and dust control requirements specified in the CARB ATCM for Construction and Grading and other applicable regulations and standards, including but not limited to:
    - a. Pre-wetting and concurrent wetting of disturbance areas to prevent emissions of NOA,
    - b. Stabilization or covering of staging areas, disturbed areas, and soil stockpiles to prevent NOA emissions by wind,
    - c. Enforce the 15 MPH vehicle speed limit,



- d. Enforce equipment and vehicle decontamination prior to exiting the site,
  - e. Mitigate soil track out on public roads at points of egress,
  - f. Capping haul roads and access roads with non-Restricted Material as specified in the CARB ATCM for Surfacing Applications.
6. Perform twice daily inspections of NOA field work area(s) for compliance with all asbestos and NOA regulations and standards. Any deficiencies and corrective actions shall be documented. The daily inspection reports shall be submitted by transmittal to the City Representative on a daily basis.
  7. Have "Stop Work Authority" – the ability to stop work without any adverse consequences when unsafe conditions are present.

## 1.7 RECORD KEEPING

- A. Maintain onsite records of the following items:
  1. Maintain onsite records of watering schedules, locations of potentially NOA-containing materials, daily logs of dust mitigation and air monitoring activities at the Site.
  2. Copies of all test results and locations of potentially NOA- containing materials shall be retained at the Site and upon request, be readily available to the City Representative.
  3. Maintain all records including, but not limited to, the results of personal monitoring and medical records per the requirement of Cal/OSHA.
- B. Provide all documentation to the City Representative upon closeout in organized, indexed binders.

## 1.8 SILICA

- A. REGULATIONS:
  1. Respirable Crystalline Silica OSHA Regulation 29 CFR 1926.1153
  2. Employer obligations under the current Respirable Crystalline Silica standard for construction, found in the California Code of Regulations, [Title 8, section 1532.3](#).
  3. Effective October 23, 2017, Cal/OSHA is fully enforcing all appropriate provisions of the Silica standard. This follows federal OSHA's approach regarding enforcement of their corresponding standard.

Note that:

- a. Cal/OSHA's new permissible exposure limit (PEL) for respirable crystalline silica of 0.05 milligrams per cubic meter (0.05 mg/M3), found in [Title 8 section 5155, Table AC-1](#), went into effect on October 17, 2016.
- b. In addition, the Contractor shall continue to meet the requirements of [Title 8 section 1530.1](#) to control employee exposures to dust created by operations conducted on concrete or masonry materials.

- B. As per this Section, Silica is included as a component of a “naturally occurring hazardous materials”.
- C. Sand is an integral component in concrete and masonry materials, and crystalline silica is also a confirmed component of sand. Various construction techniques, including saw cutting, drilling, jack hammering, etc., on concrete and masonry materials are expected to release respirable silica thus triggering the currently applicable Cal/OSHA respirable silica standard (8 CCR 1532.3).
- D. The standard requires the Contractor to limit its worker exposures to respirable crystalline silica and to take steps to protect its workers. At a minimum, all the Contractor’s workers covered by the standard are required to:
  - 1. Establish and implement a written exposure control plan that identifies tasks that involve.
  - 2. Identify exposure and methods used to protect workers, including procedures to restrict access to work
  - 3. Identify areas where high exposures may occur.
  - 4. Designate a competent person to implement the written exposure control plan.
  - 5. Restrict housekeeping practices that expose workers to silica feasible alternatives are available.
  - 6. Identify workers who are required by the standard to wear a respirator for 30 or more days per year.
  - 7. Train workers on work operations that result in silica exposures and ways to limit exposure.
  - 8. Keep records of workers’ silica exposure and medical exams.

#### 1.9 ASBESTOS AIRBORNE TOXIC CONTROL MEASURES FOR CONSTRUCTION

- A. Serpentine containing Naturally Occurring Asbestos (NOA) shall be encountered on the project as known through USGS map, soil assessment, soil sampling or other information indicating that the project shall be disturbing NOA. The Contractor shall comply with the California Code of Regulations, Title 17, Section 93105 - Asbestos Airborne Toxic Control Measure (ATCM) for Construction, Grading, Quarrying, and Surface Mining Operations [www.arb.ca.gov/toxics/atcm/asb2atcm.htm](http://www.arb.ca.gov/toxics/atcm/asb2atcm.htm) and the regulations of the Bay Area Quality Management District (BAAQMD).
- B. The following indicated control, administrative, reporting and submittal requirements shall apply to this project:
  - 1. The Contractor at its own cost shall furnish all labor, equipment, and means required to implement the Asbestos Dust Mitigation Plan (ADMP), throughout the construction or grading activity
  - 2. The Contractor shall incorporate in its schedule the time it will take to implement and adhere to the ADMP.

3. Prevent visible emissions from crossing the project boundaries regardless of the size of the disturbance.
4. Mandatory Mitigation Requirements while disturbing serpentine:

Regardless of the project size for construction and grading operations the following dust mitigation measures are mandatory for projects disturbing serpentine or ultramafic rock:

1. Construction vehicle speed at the work site must be limited to fifteen (15) miles per hour or less;
2. Prior to any ground disturbance, sufficient water must be applied to the area to be disturbed to prevent visible emissions from crossing the property line;
3. Areas to be graded or excavated must be kept adequately wetted to prevent visible emissions from crossing the property line;
4. Storage piles must be kept adequately wetted, treated with a chemical dust suppressant, or covered with tarp when material is not being added to or removed from the pile;
5. Equipment must be washed down before moving from the property onto a paved public road; and
6. Visible track-out on the paved public road must be cleaned using wet sweeping or a HEPA filter equipped vacuum device within twenty four (24) hours.
7. All Mitigation Requirements for Dust Control as specified under Construction Dust Control Requirements in Section 01 57 19– Environmental Mitigation Measures, shall apply.

D. Discovery of Naturally Occurring Asbestos (NOA):

1. The Contractor's is limited to disturbing, grading or excavating to less than one acre at any given time and/or shall be directed to stop work in the serpentine, serpentinite, ultramafic rock, or NOA areas by the City Representative.
2. The Contractor may continue work as long as the mandatory mitigation measures for projects disturbing serpentine, serpentinite, ultramafic rock, or NOA as stated above are implemented. These measures must be implemented within 24-hours of encountering serpentine

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



SECTION 02 81 10  
ENVIRONMENTAL MANAGEMENT OF EXCAVATED MATERIALS

## PART 1—GENERAL

## 1.1 DESCRIPTION

- A. The Contractor is alerted that up to 90% of the surplus soils to be excavated, transported and disposed may be classified as a hazardous waste and/or contaminated material. Work in this Contract will involve working environments that may be hazardous, contaminated, or non-hazardous to activities associated with the excavation, handling, transportation, and disposal of all excavated materials and other wastes in the project area with emphasis to hazardous and contaminated materials.
- B. Serpentine, serpentinite, or other ultramafic rocks and soils containing Naturally Occurring Asbestos (NOA) shall be encountered on this project. Refer to Section 02 81 05 Naturally Occurring Hazardous Materials for additional requirements
- C. Such hazardous, contaminated, and non-hazardous environments include, and are not limited to hazardous and non-hazardous materials, soils, groundwater, heavy metals, petroleum hydrocarbons, polynuclear aromatic hydrocarbons, organic compounds, serpentine rock and ultramafic material (which may contain natural occurring asbestos - NOA), lead-based paint materials, sewage, sludge, debris, grit, sewer gases, bacterial/biological contamination, rail road ties, oxygen deficiency, and confined spaces.
- D. In the event that hazardous and contaminated material is unexpectedly discovered, the Contractor shall immediately notify the City Representative both verbally and in writing. Upon receipt of such notification, the City, at its sole option, may either (a) perform the remediation work using its own forces or using an outside contractor specializing in remediation work or, (b) direct the Contractor to perform all or any part of the remediation and hazardous materials removal work.
- E. The Contractor shall be responsible for providing its employees with all levels of personal protective equipment (PPE). The Contractor shall be responsible, and the City will not pay any additional compensation to the Contractor for providing its employees with the all levels of training and personnel protective equipment (PPE), including personal air monitoring if required. This includes areas where hazardous and contaminated soils and waste is encountered. For work in this Contract, the Contractor shall have taken into account the productivity losses, if any, due to the use of respirators and personal protective equipment.
- F. The Contractor shall not use the Project site as a storage facility for work it doing at another site.
- G. Lead Hazards: All work that affects any level of lead will at a minimum be performed by the General Contractor or its subcontractors under the Cal/OSHA Lead in Construction Standard 8 CCR 1532.1 as well as all Federal, State, and Local regulations at no additional cost to the City.
- H. Hazardous and non-hazardous waste shall only be disposed at permitted California landfills (22 CCR 66262), equivalent out-of-state landfills (40 CFR 262), permitted recycling facilities, and at other projects as approved by the City.
- I. The Contractor is hereby notified that any screening or crushing operations of excavated materials cannot proceed without the appropriate BAAQMD and Cal-EPA/DTSC permits.
- J. All work in this Section (including but not limited to environmental training, excavation, handling, stockpiling, and re-use of excavated soils) shall be

incidental to mobilization (Bid Item 1 Mobilization and Demobilization) unless noted otherwise.

- K. Bid Item Nos. 4 through 7 are for the Transportation; and Disposal of Class I, II and III soils.
- L. Bid Item No.47, Allowance for Pre-Excavation Soil Profiling and Unforeseen Environmental Conditions: This allowance is for the work associated with the discovery unforeseen hazardous materials, additional environmental testing, transportation, and disposal and other unforeseen environmental work that is not covered by the Contract, and as determined by the City Representative only.
- M. **Reference Documents:** The Contractor shall fully familiarize itself with, and read in its entirety the following environmental & geotechnical reports:
  - 1. Geotechnical Investigation, Amador Street Sanitary Pump Station Improvements, T&R/R/RYCG, July 2011
  - 2. Geotechnical Investigation, Pier 94 Backlands Improvements, T&R/R/RYC, July 2012
  - 3. Asbestos Survey Report, Reinforced Concrete Structure, Amador Pump House, Envirosurvey Inc., July 2016

## 1.2 RELATED SECTIONS

- A. Section 00 31 00 Available Project Information
- B. Section 01 10 62 Environmental Conditions
- C. Section 01 35 45 Health and Safety Criteria
- D. Section 01 41 00 Regulatory Requirements
- E. Section 01 57 19 Environmental Mitigation Measures
- F. Section 31 25 00 Temporary Erosion and Sediments Controls

## 1.3 SUBMITTALS

- A. The Contractor shall submit the documents listed below, and have the Plans approved by the City Representative at least 20 working days before any soil disturbing activity, and no later than 30 calendar days after the Notice to Proceed.
- B. Pursuant to the provisions of the General Conditions and Section 01 33 00, Submittal Procedures, the Contractor shall submit the following as separate submittals:
  - 1. Names of environmental consultant and the accredited environmental laboratory, if used.
  - 2. Pre-Excavation Soil Profiling Sampling Plan draft and final version in accordance with Part 1.4 herein.
  - 3. An Environmental Site Assessment (Phase II) draft and final report in accordance with Part 1.4 herein.
  - 4. Waste Profile Application Package on each waste stream that the Contractor plans for disposing the excavated soil. The Contractor shall prepare and submit waste profile application to each proposed disposal facilities for acceptance. The formal waste profile application will also include, if any, additional information (such as slurry additive applied

by the construction contractor as part of the construction) will be included in the formal waste profile application. Only the Generator (City) will sign the profile application.

5. Waste Profile # (s) from the permitted landfills or the permitted disposal & recycling facilities that the Contractor will use.
6. Workers Mandatory Environmental Training Records in accordance with Part 1.7 herein, as requested by the City's Representative.
7. Transporter's current Class 1 Certificate of Compliance from the California Highway Patrol and Hazardous Substance Removal Certification in accordance with Part 1.9 herein, as warranted.
8. Copy of the Non-Hazardous Waste form for and subsequent copies attached to the monthly Soil Disposal Spreadsheet in accordance with Part 1.10 herein.
9. Hazardous Waste Manifest in accordance with Part 1.11 herein, as warranted.
10. The original source of where the import soils are coming from, the name of the laboratory used to analyze the soils, and the date of chemical analysis, and the analytical test results, and frequency of the analytical testing in accordance with Part 3.3 herein.
11. Monthly Import Fill Spreadsheet in accordance with Part 3.3 herein.
12. Cal/OSHA asbestos Competent Person training records as pertaining to requirements specified in the Cal/OSHA standard 8 CCR § 1529, and when Serpentine, serpentinite, or other ultramafic rocks containing Naturally Occurring Asbestos (NOA) is present.
13. Cal/OSHA asbestos worker training records as pertaining to requirements specified in the Cal/OSHA standard 8 CCR § 1529, and when Serpentine, serpentinite, or other ultramafic rocks containing Naturally Occurring Asbestos (NOA) is present.

1.4 PRE-EXCAVATION ENVIRONMENTAL SOIL PROFILING (PHASE II ENVIRONMENTAL SITE ASSESSMENT)

- A. The Contractor may choose an environmental consultant from current list of as needed environmental consultants with master agreements with San Francisco Public Works to perform the pre-excitation soil profiling (Subsurface Investigation Work Plan and Phase II Environmental Site Assessment).
- B. If the Contractor seeks an exemption from the list of environmental consultants listed below, then the Contractor shall submit the name and qualifications of an environmental consultant that has done work in compliance with Article 21 of the City's Health Code (Maher Ordinance) for the City Representative's approval.
- C. NOTE: Environmental Consultants that work on the planning, design phase, and construction of this project are not allowed to work under the Contractor to perform this pre-excitation profiling.

The current list of as needed environmental consultants with master agreements with San Francisco Public Works is alphabetically listed as follows.

1. AEW Engineering, Inc; telephone: (415) 495-8400
2. Baseline Environmental Consulting; telephone: (510) 420-8686

3. Fugro USA Land, Inc; telephone: (916) 773-2600, ext. 128
  4. Ninyo & Moore; telephone: (510) 343-3000, ext.15212
  5. SCA Environmental, Inc; telephone: (415) 867-9540
  6. TRC-Avila JV LLC; telephone: (925) 688-2479
  7. Ward & Associates; telephone: (415) 626-3030
- D. The pre-excavation profiling (Phase II Environmental Site Assessment) shall be done so as to classify the excavated soils for disposal to a permitted landfill or to a reuse facility. The Contractor is responsible for working with the landfill or to a reuse facility to correctly profile the soils to the depth of the excavation, for landfill acceptance, and to ensure a load and go off-hauling during construction, with no further environmental testing. The pre-excavation profiling shall be done at least 30 days prior to excavation work. It is therefore necessary for the Contractor to identify this work in its schedule.
- E. The Contractor shall submit a Pre-Excavation Soil Profiling Sampling Plan for review and approval by both the City's Representative and SF Dept. of Public Health prior to any drilling. The Pre-Excavation Soil Profiling Sampling Plan shall:
1. Be prepared, signed and stamped by a registered Professional Engineer or Geologist.
  2. Include excavation volumes in cubic yards.
  3. Include a diagram showing sampling locations and depths.
  4. Include sampling analytical tests and sampling methods.
  5. Include the collection and compositing strategy.
- E. After receipt of the above approval, the Contractor shall collect soil samples 200 feet along the project alignment to the required depths of the excavation. Collect a minimum of 2 vertical composite soil samples per hole. This sampling strategy is subject to change pending the review and approval of the San Francisco Department of Public Health (SFDPH). At a minimum, the Contractor shall analyze each sample for:
1. Total Petroleum Hydrocarbons-Gasoline/BTEX/MTBE (EPA Method 8015 mod/8021).
  2. TPH-Diesel/Motor Oil (EPA Method 8015 with silica gel cleanup).
  3. Volatile Organic Carbons VOCs (EPA Method 8260). NOTE: All RCRA regulated compounds, including MEK must be reported.
  4. Semi-Volatile Organic Carbons SVOCs (EPA Method 8270C Full Scan/entire suite) with organic cleanup to achieve the lowest extent possible detection limits below the current San Francisco Regional Water Quality Control's Residential Shallow Soil Exposure Environmental Screening Level (ESLs). ([http://www.waterboards.ca.gov/rwqcb2/water\\_issues/programs/esl.shtml](http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/esl.shtml)). NOTE: All RCRA regulated compounds must be reported including pyridine and cresols.
  5. Organochlorine Pesticides (EPA Method 8081) and Polychlorinated Biphenyls (PCB's) by EPA Method 8082 with organic cleanup to achieve the lowest extent possible detection limits below the current San Francisco Regional Water Quality Control's Residential Shallow Soil Exposure Environmental Screening Level (ESLs).



([http://www.waterboards.ca.gov/rwqcb2/water\\_issues/programs/esl.shtml](http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/esl.shtml)). NOTE: All RCRA regulated compounds must be reported.

6. Title 22 Metals (EPA Methods 6000/7000 Series) and soluble Total Concentration Leaching Potential (TCLP) and Soluble Threshold Limit Concentration (STLC) metals (as warranted – 10x STLC & 20x TCLP).
  7. pH and Corrosivity tests (RCI).
  8. Asbestos (CARB Method 435, 400-point count for 0.25% sensitivity).
  9. Chromium +6 (EPA Method 7199).
  10. Methane (using field instruments).
  11. NOTE: For the above analyses, the Laboratory Reporting Limit (RL) for all constituents must be reported below state or federal limits to determine waste disposal classification.
- F. The Contractor shall forward the samples to an accredited environmental laboratory. The furnishing of all labor, materials, and equipment for sample collection and delivery to the testing laboratory will not be separate measures for payment.
- G. The Contractor shall determine the exact location of the drill holes, with reference to utility plans and Underground Service Alert clearance. The Contractor shall be responsible for all permits, utility clearance and traffic routing during the pre-excavation environmental soil profiling and as per other Sections in this Contract.
- H. The Contractor shall coordinate with the City Representative prior to scheduling the sampling to allow the City Representative to witness the sampling.
- I. The pre-excavation environmental soil profiling (Phase II Environmental Site Assessment) required in this Article shall be conducted by a California licensed Professional Geologist or Professional Civil Engineer, and the driller shall possess a State of California C-57 (Well Drilling) license.
- J. The Contractor shall provide the City Representative with a schedule for drilling the bore holes, at least 72 hours in advance of drilling the first hole or change any thereof.
- K. The Contractor shall allow in its schedule of work the time required in obtaining environmental analytical results of the soil samples on a standard (normal) turnaround time. The standard turnaround time to obtain environmental analytical results varies between 5 to 20 working days.
- L. Analytical testing shall be done at a California State accredited laboratory (or an out-of-state accredited laboratory if appropriate). The selected laboratory shall guarantee a maximum of 10 days standard turnaround time at standard rates for results of analytical testing. All original copies of test results shall be forwarded to the City Representative. Emailed copies of results are acceptable as an interim step.
- M. For the Environmental Site Assessment (Phase II) Report, the Contractor shall:
1. Perform a statistical analysis of the results in accordance with USEPA: SW-846 (Manual of Test Methods for Evaluating Solid Waste). The Contractor shall work with the landfill and the City Representative to obtain pre-acceptance approval letters and complete the generator's waste profile sheet, so as to get the excavated soils accepted for disposal at a landfill prior to its excavation. This will ensure a "load & go" operation during construction.

2. The Contractor shall tabulate the results from the laboratory results and submit it to the City Representative. Tabulation of the results shall compare the results against ESLs for Direct Exposure Human Health Risk Levels - Residential Shallow Soil Exposure, and for Construction Worker, TTLC, STLC, 10x STLC, TCLP, 20x TCLP values.
  3. Discuss the results and its implications as it relates to:
    - a. Federal and State hazardous waste disposal criteria.
    - b. Acceptance at local landfill in accordance with the landfill's acceptance criteria.
    - c. The Federal Regional Screening Levels (RSLs).
    - d. The Regional Water Quality Control Board (RWQCB)'s Environmental Screening Levels (ESLs, Table A).
    - e. California Human Health Screening Levels (CHHSLs).
    - f. Soils re-use strategy.
    - g. Health Risk to the construction workers (ESLs, Table K).
  4. Prepare a draft and final report of this Environmental Site Assessment (Phase II) that is signed and stamped by both the principal and a registered Professional Engineer or Geologist.
  5. The Environmental report shall also contain:
    - a. A table showing analytical parameters, test methods, locations and sample depths.
    - b. Tables showing analytical results for soil and groundwater. Field screening instrumentation readings to be included in both the tables and boring logs.
    - c. All units to be stated in "mg/l", "ug/l", "mg/kg", "ug/ft<sup>2</sup>", etc. (i.e., do not use "ppm" or "ppb")
    - d. Figures, drawings, maps, and photographs.
    - e. A 3-dimensional drawing showing excavation depths and categories/blocks of soil waste classifications based on the analytical results.
    - f. Laboratory analytical results, QC/QC and chain-of-custody documentation.
    - g. Log of boring/pothole.
  - N. The Contractor shall initially forward a digital copy of the draft environmental report for the City's review. After which, the Contractor shall forward the final environmental report at least 5 days prior to excavation work. This report shall be prepared, stamped, and signed by a California licensed Professional Geologist or Professional Civil Engineer.
- 1.5 CLASSIFICATION AND MANAGEMENT OF EXCAVATED MATERIALS
- A. The pre-excavation profiling shall be done so as to classify the excavated soils for a "load and go" disposal to a permitted California landfill or equivalent out of State landfill for Class I, II & III disposal, or permitted disposal & recycling facilities.
  - B. An intermediate soil staging and loading facility is not provided as part of this Contract. The Contractor may use its own or a subcontracted intermediate soil staging and loading facility. Such a facility shall be permitted in accordance with federal, State, and local regulations and

- meet the definitions of the California Code of Regulations (CCR) Title 22, 66260.10 for "Individual generation site", "Onsite", "Onsite facility".
- C. Except as otherwise stated in the Contract Documents, the Contractor is responsible for the excavation, loading, handling, transportation, and disposal of all surplus waste excavated soils and sediments from dewatering activities, meeting requirements of a certified and permitted California landfill or an equivalent out-of-state landfill. All such disposal activities shall require the approval of the City Representative prior to actual loading and disposal.
  - D. Conditions for acceptance at various local landfills/waste disposal facilities include, filling out of a waste profile, that the surplus waste excavated soil hauled to the landfill will have greater than 50 percent solids, and cannot have any free liquids. It is the Contractor's responsibility to meet landfill requirements for disposal.
  - E. The Contractor shall maximize reuse of excavated soils. Excavated soils can be reused anywhere along the project alignment. If the soils from this area cannot be reused, such surplus waste excavated soils shall be disposed at a certified and permitted California landfill for Class I, or Class II, or Class III, disposal or an equivalent out-of-state landfill. Acceptable landfills/waste disposal facilities for California Class I, II and III wastes are:
    - a. Republic Services, <http://www.republicservices.com/Corporate/Business/WasteRecycling/Facilities/landfills.aspx>
    - b. Waste Management Inc, <https://www.wm.com/find-a-facility.jsp>
    - c. Clean Harbors Buttonwillow LLC, [www.cleanharbors.com](http://www.cleanharbors.com)
  - F. Except for Article 1.4 herein, the Contractor shall not conduct any environmental or hazardous materials sampling or analysis without prior permission from the City Representative. If approved, the environmental or hazardous materials sampling shall be done in the presence of the City Representative. This does not include the Contractor's obligation for any personnel air monitoring.
  - G. The Contractor shall inform the City Representative in writing and obtain City's approval prior to any sale, supply, or offer to sell excavated material. The Contractor shall similarly comply with Bay Area Air Quality Management District's (BAAQMD's) Regulation 11, Rule 14 for asbestos-containing serpentine. Additional information may be found at <http://www.baaqmd.gov/~media/dotgov/files/rules/reg-11-rule-14-asbestoscontaining-serpentine/documents/rq1114.pdf?la=en>, the California Air Resource Board Advisory #161 (<https://ww2.arb.ca.gov/enforcement-advisory-161-serpentine-rock>), and Title 17, Section 93106 of the California Code of Regulation (CCR). In such a case, the Contractor, at its own expense, shall perform all the engineering and chemical testing as required by the City and by federal, State, and local statutes, laws, regulations, and policies.
  - H. Cal/OSHA regulations are triggered when asbestos is present in any amount. The Contractor shall meet its obligations under CCR Title 8, Section 1529. The regulation requires monitoring to determine exposure levels, wet methods, respirators and protective clothing, controlled access to the work area, and similar precautions associated with asbestos work regardless of the origin of the asbestos. Use of a competent person to oversee the work may also be necessary. The Contractor shall utilize an experienced Certified Industrial Hygienist (CIH) and a Professional Geologist (PG) to assist it with this work.
  - I. Asphalt, concrete, aggregate base, vegetation, debris, wood, obstructions, and other organic, unsound or deleterious matter shall be excavated separately from the soil layer and shall not be reused as backfill. The removal, management, transportation, and disposal of asphalt, concrete, aggregate base, vegetation, debris, wood, obstructions, and other organic, unsound, or deleterious matter shall be incidental to its respective bid items.
  - J. Soils of different waste disposal classification shall be segregated when excavated, managed, transported, and disposed separately with no mixing of the different types of wastes.
  - K. For work in this Contract, the Contractor shall take into account the productivity losses, if any, due to but not limited to encountering and managing hazardous or non-hazardous materials, the use of respirators and personal protective equipment. The City will not pay additional

compensation to the Contractor due to encountering and managing hazardous or non-hazardous materials, use of respirators, and personal protective equipment.

- L. The City reserves the option and right, at any time, to use its own forces to excavate, remediate, bioremediate, haul, recycle, or dispose of both, hazardous and non-hazardous materials at its own facilities, California State approved facilities, contracted facilities or contracted out-of-state facilities.

## 1.6 DEFINITIONS

- A. Generator: The City is the "generator" as defined in Section 66260.10 of Article 2, Chapter 10, Division 4.5 of Title 22 of the California Code of Regulations (CCR) and in Title 40, Code of Federal Regulations (CFR) of any excavated pre-existing hazardous waste. The City will be responsible as the generator to the extent of the law.
- B. Waste: Discarded material of any form as defined by the Code of Federal Regulations 40 CFR 261.2 (<http://www.access.gpo.gov/nara/cfr>) and the California Code of Regulations 22 CCR 66261.2 (<http://ccr.oal.ca.gov>).
- C. Hazardous Waste: This may include excavated material, friable asbestos containing material (ACM) that is not naturally occurring in rock and soil, loose and peeling lead-based paints, and other material that is regulated by and requires management, handling, transport, treatment, storage, and disposal according to the requirements of the Federal Resource conservation Recovery Act (RCRA) and associated regulation 42 U.S.C. 6901 et seq. (<https://www.epa.gov/laws-regulations/summary-resource-conservation-and-recovery-act>) and 40 CFR Part 260 et seq., or the California Hazardous Waste Control Law (<https://www.epa.gov/rcra/resource-conservation-and-recovery-act-rcra-regulations>) and associated regulations (Health and Safety Code 25000 et seq. ([https://leginfo.legislature.ca.gov/faces/codes\\_displayexpandedbranch.xhtml?tocCode=HSC&division=20.&title=&part=&chapter=&article=](https://leginfo.legislature.ca.gov/faces/codes_displayexpandedbranch.xhtml?tocCode=HSC&division=20.&title=&part=&chapter=&article=) and 22 CCR 66260 et seq.).
- D. References to hazardous material or contaminated material incorporate definitions of hazardous pollutants, hazardous contaminants, hazardous material, hazardous substances, hazardous waste, toxic pollutants, and toxic substances applicable in accordance with federal, State, and local statutes, laws, and regulations.
- E. Management of excavated materials or "management" means transportation, transfer, recycling, recovery, disposal, handling, processing, storage, and treatment of excavated materials in accordance with federal, State, and local laws and regulations
- F. Soil: earth material composing the superficial geologic strata (material overlying bedrock), consisting of clay, silt, sand, or gravel size particles as classified by the U.S. Soil Conservation Service. Soil does not include asphalt, concrete, aggregate base, vegetation, debris, wood, obstructions, and other organic, unsound, or deleterious matter.
- G. Excavated material includes all soils (fill, alluvium, bedrock), and other materials generated in the course of the project work, which are to be excavated, handled, or disposed of as part of the Contract.
- H. Waste excavated soil is excavated soil that is a waste and cannot be reused within the project site in accordance with reuse criteria of this Section. It is surplus and shall be managed, transported, and disposed of as part of the Contract. Waste excavated soil does not include asphalt, concrete, vegetation, wood, debris, obstructions, and other organic, unsound, or deleterious matter.
- I. Naturally Occurring Asbestos (NOA): NOA in the City and County of San Francisco is typically associated with ultramafic, metamorphic or metamorphosed rocks within the Franciscan mélange, including serpentinite, greenstone, and blueschist. There are six regulated naturally occurring asbestos minerals: chrysotile, crocidolite (asbestiform riebeckite), amosite (grunerite-cummingtonite), tremolite, actinolite, and anthophyllite (CGS 2002). The six asbestos minerals are divided into two distinct mineral groups; serpentine minerals (chrysotile), and amphibole minerals, which include the remaining five above-mentioned minerals. These asbestos minerals are classified as known human cancer-causing substances by local, state, and federal health agencies (DTSC 2004), and regulated by name.

- J. The following soil classifications with corresponding requirements are established solely for the purpose of payment for the handling, transportation and disposal of the excavated materials determined to be a waste:
- a. California Class I (non-RCRA) hazardous waste: is waste excavated material that is classified as California (non-RCRA) hazardous waste, requires disposal at a California Class I disposal facility or a similarly permitted out-of-state facility and requires transport by a registered hazardous waste transporter.
  - b. California Class II and Class III designated waste (Class II and Class III): is non-hazardous waste and is not a California or Federal hazardous waste. It requires disposal at a California Class II or Class III disposal facility or at a similarly permitted out-of-state facility without the need of a registered hazardous waste transporter.
  - c. Asbestos containing rock and soil where the asbestos is naturally occurring and not associated with cross contamination by building materials may be classified as California Class II waste. The Contractor shall contact the landfill it identifies to receive waste to assure that asbestos containing naturally occurring materials meet the acceptance criteria of the California Class II landfill.

#### 1.7 WORKER'S MANDATORY ENVIRONMENTAL TRAINING

- A. At no cost to the City, the Contractor shall provide sufficient numbers of properly trained personnel (including its subcontractors) who may come in contact with, may be exposed to, disturb, operate equipment in, or otherwise excavate, handle, transport and dispose hazardous or contaminated excavated materials, asbestos, naturally occurring asbestos (NOA), and silica.
- B. At no cost to the City, the Contractor shall ensure that its workers and that of its subcontractors have the following appropriate environmental training. It is the Contractor's responsibility (and not that of the City) to ensure that its workers and its subcontractors have the necessary training certifications, and personal protective equipment (PPE) as required by federal, state and local laws and regulations. The Contractor shall submit certifications or proof of such training when requested by the City.
- C. At no cost to the City, the Contractor shall hire an experienced Certified Industrial Hygienist (CIH) and a Registered Geologist (RG) to assist it with the following:
1. HAZWOPER: This training is required of the Contractor's employees (including its subcontractors) who may come in contact with, may be exposed to, disturb, operate equipment in, or otherwise excavate, handle, transport and dispose hazardous or contaminated excavated materials, asbestos, naturally occurring asbestos (NOA), and silica. Employee(s) shall possess a current 40-hour Hazardous Waste Operation and Emergency Response ("HAZWOPER") training and certification and the associated 8-hour HAZWOPER refresher training (in accordance with Sections 5192 and 5144 of Title 8, CCR and Title 29 CFR, Sections 1910.120 and 1910.134), and shall be certified to wear appropriate personal protective equipment and respirators.
  2. Cal/OSHA Asbestos Class II asbestos operations and Asbestos Competent Person (ACP): The Contractor shall meet its obligations under CCR Title 8, Section 1529 when Serpentine, serpentinite, or other ultramafic rocks containing Naturally Occurring Asbestos (NOA) is present.
    - a. The Contractor and its subcontractors shall have its workers, trades people and Competent Person that will come in contact with serpentine, serpentinite, or other ultramafic rocks containing Naturally Occurring Asbestos (NOA) be trained for the Class II work activity level as per the Cal/OSHA standard 8 CCR § 1529.

- b. The Contractor shall have a Cal/OSHA asbestos Competent Person as it pertains to requirements specified in the Cal/OSHA standard 8 CCR § 1529, and when serpentine, serpentinite, or other ultramafic rocks containing Naturally Occurring Asbestos (NOA) is present.
  3. SILICA: The Contractor shall meet its obligations under the Respirable Crystalline Silica standard for construction, found in the California Code of Regulations, Title 8, Sections 1530.1, 1532.3, and 5155; and OSHA Regulation 29 CFR 1926.1153.
  4. Health and Safety training.
  5. Lead awareness training (for all trades who will come in contact and disturb lead containing paints as per Cal/OSHA 1532.1 Lead in Construction standard). If personal exposures to the workers exceed the 8-hr Permissible Exposure Level (PEL) of 50 micrograms/cubic meter, such worker(s) must have received training as a CDPH Certified Lead Worker (as per 17 CCR Division 1, Chapter 8).
  6. Dust Control and Mitigation awareness training to enable the Contractor's personnel to comply with Section 01 57 30, Environmental Mitigation Measures.
  7. Medical examination and blood tests (as warranted).
  8. Respiratory protection (including current respirator fit test records).
  9. Storm water pollution prevention awareness training to enable the Contractor's personnel to comply with Section 01 57 13.
  10. Other training as necessary and pertaining to the work being conducted.
- D. Only qualified persons shall engage in hazardous materials-related work. Contractor and Subcontractor personnel, who come in contact with, are exposed to, disturb, operate equipment in, or otherwise handle hazardous or contaminated materials, or demolition debris shall have appropriate hazards communication, environmental training and medical monitoring.
- E. The City will not grant extensions of time or increases in payment for costs associated with the Contractor's productivity losses, inability to provide properly trained personnel, costs of training Contractor's workers, or hiring of required personnel.
- F. It is the Contractor's responsibility and liability to ensure that its workers and that of its subcontractors have the proper training, personal protective equipment (PPE), and respiratory protection.
- G. The Contractor, not the City, is responsible for the health and safety, training, personal protective equipment (PPE), and monitoring and protection from exposure risks of its employees and subcontractors, as per federal, state and local statutes, laws and regulations.
- H. The Contractor is obligated to conduct any required personal air monitoring of its workers, at its own expense, in accordance with Section 01 35 45 Health and Safety Criteria.
- 1.8 REGULATORY INDEMNIFICATION
- A. The City will not indemnify against liability of the Contractor resulting from the activities or duties, which are the responsibility of the Contractor under the terms of this Contract. This includes, but is not limited to, liability arising from the arrangement of transportation of excavated material, whether on- or off-site. Therefore, the City will not assume any liability, present or future, incurred by the Contractor by reason of these activities.

- B. The Contractor is specifically alerted to, and shall familiarize itself and its Subcontractor(s) to, the liability statutes of:
1. The Comprehensive Environmental Responses, Compensation, and Liability Act (CERCLA) of 1980 found in 42 USC, Section 9601 et seq.
  2. The Superfund Amendments and Re-authorization Act (SARA) of 1986 found in 42 USC, Section 9601 et seq.
  3. The California Hazardous Substance Account Act (HSAA) of 1981 found in California Health and Safety Code, Section 25300 et seq.
  4. California Health and Safety Code, Division 20, Regulations and CCR 22 Section 6600 et. seq.
  5. Cal/OSHA Lead in Construction Standard, Title 8, CCR, Section 1532.1.
  6. BAAQMD Regulation 6 for Particulate Matter and Visible Emissions (<http://www.baaqmd.gov/~media/files/planning-and-research/rules-and-regs/workshops/2017/rg0601-pdf.pdf?la=en>) and Regulation 11 for Hazardous Pollutants (<http://www.baaqmd.gov/regs/rulereg.htm>).
  7. The Final Regulation Order of the California Code of Regulations (CCR) Title 17, Public Health, Section 93105, on Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations ([http://www.baaqmd.gov/~media/Files/Compliance%20and%20Enforcement/Asbestos/final\\_reg\\_order.ashx](http://www.baaqmd.gov/~media/Files/Compliance%20and%20Enforcement/Asbestos/final_reg_order.ashx)).
  8. The California Air Resources Board (CARB) Asbestos Airborne Toxic Control Measure for Surfacing Applications.
  9. The San Francisco Building Code Section 106.3.2.6
  10. San Francisco Health Code, Article 22B - Construction Dust Control Requirements.
  11. The DPW Dust Control Order 171,378.
- C. The Contractor shall be responsible for all liability and costs necessary to prevent its own or Subcontractors' operations from violating federal, State, or local statutes, laws, regulations, and policies.

#### 1.9 REQUIREMENTS FOR THE TRANSPORTER

- A. As warranted, the Contractor shall ensure that its drivers as well as the subcontractor drivers have in their possession, during the hauling of material and soil, all applicable California State and local vehicle insurance requirements, valid driver's license, and vehicle registration and licensing. A current Class 1 Certificate of Compliance from the California Highway Patrol shall be affixed to each vehicle.
- B. All hazardous materials/waste haulers shall possess a Hazardous Substance Removal Certification granted by the State of California, Contractors State License Board (1 800-321-2752 or <http://www.cslb.ca.gov>), and all other required certifications and insurance.
- C. Haul trucks carrying excavated material shall be loaded so that the material does not extend above the walls of the truck bed, and there is no leakage from any vehicle. All truckloads shall be covered.
- D. All truckloads containing Naturally Occurring Asbestos (NOA) and Serpentinite require both covering the load as well as lining the underneath of the truck bed ("burrito wrap") with 10mil HDPE. This is required regardless if the material is wet, hazardous, or non-hazardous.
- E. The Contractor shall be responsible for cleaning up excavated material spill, which occurs during loading, handling, and transportation.
- F. Preparation for shipment: Marking, labeling, placards, and packaging prior to transport shall be in accordance with all regulations and shall be the responsibility of the Contractor.

#### 1.10 USE OF NON-HAZARDOUS WASTE MANIFEST FOR CLASS II MATERIAL OR LESSER

- A. For transportation and disposal of the non-hazardous waste, the Contractor shall initiate and fill out a non-hazardous waste profile form with the Class II/III landfill of its choosing. Then, submit this waste profile form to the City Representative's for its approval & signature. Next the Contractor shall prepare a Non-Hazardous Waste Manifest form from the landfill. The Non-Hazardous Waste Manifest form shall be completed for each vehicle carrying excavated

material classified as California Class II and Class III designated waste, or of a lesser waste classification. The Contractor shall submit the Non-Hazardous Waste Manifest form to the City Representative for the Generator's signature at least 72 hours in advance of the day of the off-haul with an estimate of the number of loads scheduled for off-haul. The Non-Hazardous Waste Manifest form shall contain the following information before providing the final copy for the City Representative to sign:

1. Name, address and phone number of the Generator, Project name, and Specification Section number.
  2. The Contractor's billing information
  3. The soil profile approval number and description of the waste.
  4. Name, address and phone number of the transport company.
  5. The Name, address, and telephone number of the receiving facility i.e., disposal facility.
- B. The City will not be responsible for off haul delays if the Contractor does not notify the City Representative in a timely manner to sign the Non-Hazardous Waste Manifest forms.
- C. On a monthly basis, the Contractor shall provide the City Representative with a copy of each completed Non-Hazardous Waste Manifest Form (with the landfills signature) and its corresponding certified weight ticket.

#### 1.11 HAZARDOUS WASTE MANIFESTING PROCEDURES FOR CLASS I MATERIAL

- A. As warranted, the Contractor shall furnish all labor, materials, equipment, and incidentals required to transport those materials identified as hazardous waste for the purpose of disposal.
- B. The Contractor shall comply with all applicable regulatory requirements listed as well as other applicable federal, State, or local laws, codes, and ordinances, which govern or regulate transportation of wastes (including but not limited to DOT-HM 181 in accordance with 49 CFR 172).
- C. All material classified as hazardous waste (Federal Class1 RCRA and California Class1 non-RCRA wastes only) shall be hauled off using a licensed hazardous waste transporter and the uniform hazardous waste manifest form (DTSC Form 8022A and/or EPA Form 8700-22 a.k.a. the manifest).
- D. Preparation and handling of waste manifests:
1. For transportation and disposal of the hazardous waste, the Contractor shall initiate and fill out a hazardous waste profile form with the Class I landfill of its choosing. Then, submit this hazardous waste profile form to the City Representative's for its approval & signature. Next the Contractor shall provide and prepare the hazardous waste manifest for each shipment of hazardous wastes from the site. The Contractor is hereby notified that hazardous waste manifest, waste profiling, and landfill service agreements have to be prepared and have to be approved by the landfill in advance of the off haul. The Contractor shall consult with the City Representative for local requirements in filling out the forms
    - a. The manifest shall describe the contents of each truck carrying materials to the waste disposal site, including the weight of the waste materials. Weight, not volume, shall be used to measure waste quantities.
    - b. The City Representative will provide a hazardous waste generator identification number for use on the manifest. The Contractor shall provide the State Transporter identification number and telephone number.
    - c. The licensed transporter shall also sign and date the manifest indicating that it has accepted the load described in the manifest on that particular day.
    - d. Only a City employee (and not the Contractor) will sign the manifest for the "generator" of the waste.
- E. The Contractor shall notify the City Representative 72 hours prior to off-haul of all excavated material. If the manifest and other forms above are to be signed by the City Representative during periods other than the hours stipulated above, the Contractor shall give an additional 72-hour advance notice to the City Representative.



- F. The City Representative will sign and keep the Generator's copy and give the remaining copies to the licensed transporter.
- G. The licensed transporter shall carry the hazardous waste manifest with each truckload using the traffic control approved routes for off haul
- H. Within 2 days of its return, the Contractor shall provide the City Representative with the completed waste manifest. The completed waste manifest shall be certified by the receiver of the waste shipment, confirming that the shipment was received at the waste treatment or disposal facility designated in the Contractor's bid, and certifying the weight of the shipment.
- I. Should any waste manifest not be returned within 35 days of shipment, the Contractor shall initiate follow-up, shall document such follow-up effort in writing with an Exception Report in accordance with 40 CFR 262.42 and/or 22 CFR 66262.42, and shall provide a copy to the City Representative.
- J. Mandatory City Information for the Manifest
  - 1. Manifest Item 1: Generator's US EPA ID Number for Project. (Will be provided by the City Representative after NTP as deemed necessary)
  - 2. Manifest Item 3: Emergency response Phone: # 24 hours line to be provided by the Contractor
  - 3. Manifest Item 5:
    - a. Generator's Name and Mailing Address:  
City and County of San Francisco  
Port of San Francisco  
Pier 1, The Embarcadero  
San Francisco, CA. 941111  
PM: Ken Chiu (415) 274 0593
    - b. Generator's Site Address:  
City and County of San Francisco  
Port of San Francisco  
500 Amador Street, Pier 92  
San Francisco, CA 94124
  - 4. Manifest Item 14: The following information is mandatory:
    - a. Contract JO # 1821J Amador Street Sewer and Pavement Improvement
    - b. Profile # \_\_\_\_\_ (to be obtained by the Contractor)
  - 5. Include the following statement for soil disposal on line 14 of the manifest: The City & County of San Francisco applies for an exemption from the BOE Hazardous Waste Generator fees in accordance with H&SC 25174.7, 25174.1; 25205.5, and 25345. (1) Hazardous wastes which result when a government agency, or its contractor, removes or remedies a release of hazardous waste in the state caused by another person, and in an area from beneath a public street and originated from earthquake fill."

#### 1.12 UNDERGROUND TANK REMOVAL PROCEDURES

- A. The Contractor is alerted to the fact that underground structures and tanks may be encountered during excavation. In the event that an underground storage tank, pipes, and associated fixtures are encountered, the Contractor shall immediately suspend the work in the immediate area and notify the City Representative as well as the San Francisco Department of Public Health (415-252-3900).
- B. The City Representative reserves the right to use City forces or City Contractors to remove any underground storage tank that may be discovered as part of this Contract. The Contractor shall work cooperatively with any City Contractor or City force in an effort to expedite the removal of the underground tank.
- C. If directed by the City, the Contractor under differing site conditions, shall be responsible for removing and disposing the underground storage tank, pipes, and associated piping in the excavation area according to applicable laws and regulations including:

1. California Health and Safety Code (H&SC), Division 20, Chapter 6.9 (Section 25280 et.seq.)
  2. California Code of Regulations (CCR), Title 23, Division 3, Chapter 16 (Section 2610 et.seq.)
  3. California State Water Resources Control Board (SWRCB), Leaking Underground Fuel Tank (LUFT) Manual.
  4. City & County of San Francisco, Department of Public Health, Underground Storage Tank Removal Regulations. Information available at but not limited to <https://www.sfdph.org/dph/EH/HMUPA/UST.asp>
- D. The Contractor shall obtain all permits, excavate, sample, analyze and prepare all reports as required by the San Francisco Health Code.
- E. The Contractor shall prepare an Underground Storage Tank (UST) Closure Plan in compliance with Article 21 of the San Francisco Health Code, if UST's will be removed. The Contractor shall only remove the underground tanks, pipes, and related appurtenances only in the presence of an inspector from the City's Department of Public Health, the City's Fire Department, and the City's Representative.
- F. The Contractor shall furnish three (3) copies of the draft report for review, and five (5) copies of the final report documenting the removal of an underground tank.
- G. Such work will be considered as change order work.

#### 1.13 DISPOSAL OF RAILROAD TIES AND TREATED WOOD WASTE

- A. Railroad ties and wood treated with preservatives (e.g. utility poles, piers, pilings, posts, pressure treated lumber, etc), such as creosote, and/or pentachlorophenol, and/or Copper Napthenate, Zinc Napthenate, and/or Copper, Chromium, Arsenate (CCA), and/or Ammonical Chromium, Zinc, and Arsenate (ACZA) (that are not otherwise recycled by the Contractor) shall be transported and disposed of at a California Class 2 (non-hazardous) landfill.
- B. For wood treated with chemical preservatives such as Chromate Copper Arsenate (CCA) treated wood: The Contractor shall comply with the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) and by the California Department of Pesticide Regulation (DPR) and Department of Toxic Substances Controls (DTSC) Regulations or for the treated wood waste as per the Health and Safety Code (HSC) 25150.7 and 25150.
- C. The Contractor shall fill out a separate waste profile with the landfill for such materials.
- D. The transportation and disposal of the railroad ties and treated wood waste shall be paid as a change order.

#### 1.14 POLLUTION INSURANCE

- A. All Work that involves the management, handling, transportation, and disposal of hazardous and contaminated (non-hazardous) materials shall be performed either by the Contractor or a properly licensed subcontractor, who shall furnish evidence of Contractor's Environmental Pollution Liability Insurance as specified in Section 00 73 16 – Insurance Requirements.

### PART 2 – PRODUCTS NOT USED

### PART 3 — EXECUTION

#### 3.1. TEMPORARY STOCKPILING OF EXCAVATED MATERIAL AND IMPORT MATERIAL

- A. The Contractor shall comply with Article 2.4: Excavation in the Public-Right of-Way and specifically Article 2.4.53(c) Storage of Materials and Equipment.
- B. If feasible and in the event that the City Representative permits the Contractor to temporarily stockpile excavated and import material along the project alignment, the following conditions shall apply (including those in Section 01 57 30 Environmental Mitigation Measures):
1. Material shall be stockpiled at a location approved by the City Representative. The volume of the stockpile will be limited within the discretion of the City Representative.
  2. Stockpiled materials shall not be stored for more than 48 hours.

3. The City Representative retains the right to suspend the use of temporary stockpiling in the event of negative public perception, aesthetic concerns, and regulatory concerns. In such an event, the Contractor is directed to remove the stockpile within 24 hours.
  4. After a stockpile has been removed, the Contractor shall wet sweep and vacuum the area, street, and sidewalk to remove residual soil, restore the site to its original condition.
  5. Stockpiles of site backfill soils shall be tarped using a different colored tarp from that of import soils.
  6. Stockpiles must be kept adequately wetted, treated with a chemical dust suppressant, or covered when material is not being added to or removed from the pile, and securely tarped & braced (weighted or tied down).
  7. Stockpile Maintenance requirements in Section 01 35 49 Minimum Environmental Procedures and Section 01 35 50 Additional Environmental Procedures.
- C. All costs associated with the temporary stockpiling of soils shall be borne by the Contractor, unless necessitated by an event that is otherwise compensable under the terms of the Contract. Such related incidental costs include, but are not limited to dust control, vacuum and wet sweeping, covering of stockpiles, multiple handling and transportation, multiple staging, work re-sequencing or rescheduling, time loss and standby time due to the duration of storage, and complying with Federal, State, and local requirements.

### 3.2. REUSE OF EXCAVATED SOILS AS BACKFILL

- A. The Contractor shall maximize the reuse of soils from the excavation, unless directed otherwise by the City Representative. In such a case, the following conditions shall apply:
1. The reuse of soils as backfill material shall meet the requirements of Section 31 23 33, Excavation and other Sections of this specification, and Sections 707 and 709 of the Standard Specifications and Plans, Department of Public Works, City and County of San Francisco. The Standard Specifications and Standard Plans are accessible online at <http://www.sfpublicworks.org/services/standards-specifications-and-plans>
  2. With the City's approval, Class I soils may be reused within the "area of contamination" and within 150 linear feet from its origin, as long as it meets the engineering backfill and compaction requirements, is delineated with markers, documented, and meets the San Francisco Department of Public Health (SFDPH) requirements.
  3. Asphalt, concrete, aggregate base, bentonite, bay mud, clay, bricks, cobblestones, rocks, rubble, scrap metal, railroad tracks and ties, debris, imported contaminated soils, vegetation, wood, debris, obstructions, and other organic, unsound, or deleterious matter will not be accepted as backfill material. The Contractor shall remove such materials matter prior to the placement and reuse of fill.
  4. The Contractor shall notify the City Representative when and where the soils are used as backfill.

### 3.3. REUSE AND RECYCLING OF EXCAVATED SOILS AT OTHER FACILITIES

- A. If the Contractor seeks to reuse or recycle surplus excavated soils at other projects or recycling facilities rather than dispose of them at a permitted landfill, the contractor at its cost shall:
1. Demonstrate that with the existing environmental test results that the soils can be reused or recycled. The Contractor at its expense may be allowed to conduct additional testing, and characterization of the soils, only with the City's prior approval.
  2. Submit the acceptance criteria of the receiving facility or project.
  3. Submit a letter of acceptance from the receiving facility or project. The letter shall indicate the volumes of soils accepted. Submit a value engineering calculation demonstrating cost savings to the City. Savings should be a split 50/50.
- B. If the City accepts the above, the Contractor shall prior to reuse or recycling:
1. Incur on the risk of, and indemnify the City from any and all increased cost and future liability arising from the reclassification, recycling, or reuse of the surplus excavated soils if, upon reuse or recycling of such soils at any time thereafter, it is determined that the

- surplus excavated soils are in fact hazardous, and should not have been reused or recycled.
2. Submit a copy of the letter of acceptance and all records, including the financial statements for the value engineering saving prior to the approval of the reuse or recycling of these soils.
  3. Bear all costs for any additional testing, characterization and profiling of the soils, including the value engineering cost.
  4. Bear all costs for the transportation, and any other associated cost for moving these soils to another project or to a recycling facility.
  5. Revise and retain its Pollution Liability insurance to cover this work.
  6. Repay any cost that the City at its discretion will incur to conduct its own testing to confirm the Contractor's findings.
  7. Submit a monthly Reuse and Recycling spreadsheet of all reused and recycled materials generated from the project. The spreadsheet shall include information of the receiving facility or project, quantity transported (Cubic Yards), weight tags from the recycling facility.
  8. The City will issue a Change Order for this work to effectuate any saving that may accrue from this Section.
  9. Such work will only be done as a change order after the acceptance and approval of the City and after the change order is processed.

3.4. IMPORT SOIL (FILL)

- A. Import Soil (Fill) is soil or fill material received from sources outside of the project right-of-way. Import soil (fill) includes import bedding sand and import recycled backfill sand used in the base and subbase layers of a pavement or roadway or sporting field.
- B. Environmental/chemical testing is required for each source and of the same soil classification type (based on the unified soil classification system) of the import soil (fill).
- C. In advance of hauling in and use of import soil (fill) the Contractor for each source of import soil (fill), shall provide the City the original source of where the import soil (fill) is coming from, the name of the laboratory used to analyze the soils, and the date of chemical analysis. Laboratory results shall not be over 6 months old.
- D. The Contractor shall provide chemical analytical results for each source and of the same soil classification type (based on the unified soil classification system) of import soil (fill) in accordance with the Recommended Fill Material Sampling Schedule stated in the Department of Toxic Substances Control (DTSC) Advisory Note for Clean Imported Material (as shown below). If the Contractor brings import soils from different sources, then the "Sample per Volume" count re-starts for each of different source of import soil (fill) (as shown below).

Import Fill Volumes (for each source of import soil (fill) and of the same soil classification type)	Samples Per Volume for each source of import soil (fill) and of the same soil classification type
Up to 1,000 cubic yards	1 sample per 250 cubic yards
1,000 to 5,000 cubic yards	4 samples for the first 1,000 yards + 1 sample per each additional 500 cubic yards
Greater than 5,000 cubic yards	12 samples for the first 5,000 cubic yards + 1 sample per each additional 1,000 cubic yards

- E. Each source of import soil (fill), import bedding sand and import recycled backfill sand of the same type, shall be analyzed as a four-point composite. Each composite shall be analyzed for Total Petroleum Hydrocarbons-Gasoline/BTEX/MTBE (EPA Method 8015 mod/8021), TPH-Diesel/Motor Oil (EPA Method 8015 with silica gel cleanup), Volatile Organic Carbons VOC's (EPA Method 8260), Semi-Volatile Organic Carbons SVOC's (EPA Method 8270), Organochlorine Pesticides (EPA Method 8081), Polychlorinated Biphenyls (EPA Method 8082), Title 22 Metals (EPA Methods 6000/7000 Series), Asbestos (CARB Method 435), Chromium +6 (EPA Method 7199), and soluble Total Concentration Leaching Potential (TCLP) and Soluble Threshold Limit Concentration (STLC) metals (as warranted – 10x STLC & 20x TCLP).
- F. Import soils (fill) has to meet both the engineering backfill criteria and the chemical criteria of these contract specifications.
- G. Chemical Criteria: To be accepted, the chemical concentrations of the import soil (fill) has to be equal or less than the values set forth in the Regional Water Quality Control Board (RWQCB)'s Environmental Screening Levels (ESLs), Tier 1 levels. Soils (fill) with the following chemical levels shall not be accepted as import soils (fill).
1. Exceedance of the chemical values set forth in the Regional Water Quality Control Board (RWQCB)'s Environmental Screening Levels (ESLs), Tier 1 levels.
  2. Lead that exceeds 80 mg/kg.
  3. Serpentine (naturally occurring asbestos) and odorous soils
  4. Petroleum Hydrocarbons or Oil and Grease of any type that exceed 100 mg/kg.
  5. Asphalt, concrete, bentonite, bay mud, clay, bricks, cobblestones, rocks, rubble, scrap metal, railroad tracks and ties, debris, soils containing asbestos, imported contaminated soils, vegetation, wood, debris, slag, obstructions, and other organic, unsound, unsatisfactory, or deleterious matter.
- H. Environmental/chemical testing is not required of the base and subbase layers for the following materials that are used to build a pavement or roadway or sporting field: Base rock, Class II Aggregate Base (AB), Class II Recycled Base, Crushed Aggregate Base (CAB), Crushed Miscellaneous base (CMB), Processed Miscellaneous Base (PMB), Recycled Aggregate, Aggregate Subbase (ASB), reclaimed/recycled asphalt concrete (AC), and drain/crushed rock.
- I. Reclaimed/recycled asphalt concrete (AC) is acceptable for the base and subbase layers to build a pavement or roadway or sporting field.
- J. Crushed concrete is acceptable for the base and subbase layers to build a pavement or roadway or sporting field.
- K. Import material for backfill shall comply with the Section 714 Standard Specifications and Plans, Department of Public Works, City and County of San Francisco. The Standard Specifications and Standard Plans are accessible online at <http://www.sfpublicworks.org/services/standards-specifications-and-plans>; and the specifications of the Water Department for work under the jurisdiction of the SFPUC's Water Department.
- L. The City reserves the right to spot check and analyze the import soils (fill) as it deems necessary, including prior to it being brought on to the project site, even after the approval of the submittal of analytical results from the Contractor, as well as after it brought onsite.

- M. Should the analyses of the import soils (fill) test out to exceed the above criteria, then the Contractor shall be given a chance to re-sample and spilt the samples with the City, for re-analyses. Should the re-analyses import soils (fill) test out to exceed the above criteria, then the Contractor shall have to remove the import soils (fill) at its own expense and replace with clean import soil (fill). In such a case, the Contractor shall bear all the cost (including the City's cost) for re-analysis.
- N. For Recreation and Park projects, and Community/Urban Gardens, the Contractor shall install a visual barrier (such as a plastic orange snow fence) in all areas between the native fill, backfill from other areas of the site, and the import (soil) fill. The Contractor shall call the City Representative for an inspection of the visual barrier, and wait for the approval of it, prior to the Contractor filling soil over it.
- O. The Contractor shall call the City Representative for an inspection of the subbase placement, and wait for the approval of it, prior to the Contractor filling soil over it, so that the City Representative may check the proper grades and depths.
- P. Analytical costs for imported fill (soil) incurred by the Contractor shall be Incidental Work to Division 31 Earthwork, and Section 31 23 00 Excavation and Fill.
- Q. The Contractor shall furnish the above analytical results at least 10 working days prior to bringing in the import soil (fill). The acceptance of import soil (fill) will be made by the City Representative and will depend on the results of the analytical testing, backfill requirements in this Contract, regardless if it meets the testing requirements of Division 31 Earthwork and Section 31 23 00 Excavation and Fill
- R. Import soil (fill) shall not be brought on-site, prior to the City Representative's approval of the analytical results submittal. Analytical results submitted shall be referenced on the import fill spreadsheet submittal.
- S. Import soil (fill) shall be brought on-site at a rate where it is immediately used in the excavation. If the City Representative allows for import material to be stored overnight (only, and not longer) on site, then such import material shall be covered and placed at the Contractor's soils management yard, approved soil stockpile staging area or an area within the project alignment authorized by the City Representative. Stockpiles being stored overnight shall be completely covered with 10 mil HDPE plastic and braced (weighted or tied down) securely.
- T. Import Fill Spreadsheet: As warranted, the Contractor shall submit five hardcopies or a digital copy of a monthly spreadsheet of all imported fill deposited at the project site to the City Representative. The spreadsheet shall include information on the project name, contract No., origin of import (street address, city), location of deposit (street address and depth range), quantity (cubic yards), soil type based on the unified soil classification system, the corresponding chemical, correspondent environmental analytical results submitted, truckers and trucking firm(s) used and trucking logs and invoices.
- 3.5. SECURING AREAS WITH EXPOSED, EXISTING SOIL
- A. Wherever construction work exposes the existing soil or where existing soil is stockpiled, these areas shall be barricaded all around with continuous (no gaps greater than 4 inches) fencing (either metal wire or orange plastic), Triton barriers or other barricades at least 3 feet high. The Contractor shall ensure that barricades are installed taunt and secured against strong winds. Alternatively, the exposed, existing soil in excavation areas such as trenches, may be covered over with plates or other acceptable means. The intent is to secure the exposed, existing soil from public contact.

END OF SECTION

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## SECTION 03 10 00

## CONCRETE FORMING AND ACCESSORIES

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. This specification section governs the furnishing, installing and removing of formwork to confine and shape concrete, including shoring and form supports, and installation embedded items.

## 1.02 RELATED SECTIONS

- A. Section 03 20 00 – Concrete Reinforcing
- B. Section 03 30 00 – Cast-in-Place Concrete

## 1.03 REFERENCES

- A. San Francisco Building Code (SFBC) 2022
- B. American Concrete Institute (ACI) Standards
  - 1. 301-20 – Specifications for Structural Concrete
  - 2. 318-19 – Building Code Requirements for Structural Concrete
  - 3. 347R-4 – Guide to Formwork for Concrete
  - 4. SP-15 – Field Reference Manual: Specifications for Structural Concrete (ACI 301-20) with Selected ACI and ASTM References
- C. The Engineered Wood Association PS-1 – Construction and Industrial Plywood.

## 1.04 SUBMITTALS

- A. Form-Facing Materials: Submit data on form-facing materials proposed if different from that specified in Section 2.01 of this specification.
- B. Construction and Contraction Joints: Submit location and detail of construction and contraction joints if different from those indicated in Contract Drawings.
- C. Reshoring and Backshoring Procedure: Before using reshoring or backshoring that is required or permitted, submit procedure, including drawings signed and sealed by a professional civil or structural engineer experienced in design of this work and is licensed in the State of California. Include on shop drawings formwork removal procedure and magnitude of construction loads permitted during reshoring and backshoring.
- D. Submit manufacturer's data sheet on the following:
  - 1. Formwork release agent
  - 2. Form liner

3. Form ties
4. Expansion joint materials
5. Waterstop materials and splices

#### 1.05 QUALITY ASSURANCE

- A. Design formwork under direct supervision of a professional civil or structural engineer experienced in design of this work and is licensed in the state of California.
- B. Allowable tolerances shall be in accordance with the requirements of ACI 347 unless otherwise noted on Contract Drawings or specified.
- C. Maintain copies of all applicable Codes and Standards at the project side at all times.
- D. Conform to the requirements of the Division of Industrial Safety, State of California, and all other codes and regulations.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products in accordance with manufacturer's instruction.
- B. Store materials in a manner that will preclude any damage or deterioration and provide easy access for inspection and identification of each item.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Form-Facing Materials
  1. General: form face material in contact with concrete shall be lumber, plywood, tempered concrete-form-grade hardboard, metal plastic, or paper that creates specified appearance and texture of concrete surface.
  2. Exposed Surfaces:
    - a. APA grade-stamped "B-B Plyform, Class I, Exterior" Douglas fir plywood; minimum  $\frac{3}{4}$  inch thick; each piece grade marked; clean, smooth, uniform in size and free of raised grain, torn surfaces, worn edges, patches or other defects; no mill oiling permitted.
    - b. APA grade-stamped "MDO – Concrete Form – Plyform, Class I, Exterior" Douglass fir plywood; minimum  $\frac{3}{4}$  inch thick; each piece grade marked; clean, smooth, uniform size and free of raised grain, torn surfaces, worn edges, patches or other defects; no mill oiling permitted.
    - c. Douglas fir boards, structural grade, 10 inch width, unless otherwise noted. Use dressed side of lumber for surface in contact with the concrete.
    - d. Metal forms shall be of smooth metal plate free of surface irregularities, of an acceptable type for the class of work involved, and of the thickness and design required for rigid construction.

3. Unexposed Surfaces:
    - a. Wood forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots; plywood shall be sanded smooth and fitted with tight joints between panels.
    - b. Metal forms shall be of an acceptable type for the class of work involved and of the thickness and design required for rigid construction.
  4. Curved Surfaces: Form with metal, plywood, or adequately supported, surfaced and matched Douglas fir boards not more than 4-inches wide.
- B. Formwork Accessories
1. Form Ties: Metal, removable to a depth of at least 1½ inches below the surface of the concrete. Ties shall be of sufficient strength to prevent the spreading of the forms during concrete placement. The use of wireties will not be permitted.
  2. Form Release Agents: Use an approved non-staining coating which will permit the ready release of forms and which will not affect application of applied finishes. Form release agents containing mineral oils or petroleum solvents such as paraffin will not be permitted. Use specifically formulated coatings for metal forms to prevent rust stains on concrete.
  3. Chamfer Strips: Except as noted on Contact Drawings and at flush joints between concrete and other construction, provide ¾ inch regular triangular wood or plastic strips, place and secure in forms at external corners.
  4. Expansion and Isolation Joint Material: Preformed, ½ inch thick, conforming to ASTM D994.
  5. Water Stop Material: Waterstop-RX as manufactured by Cetco, a Mineral Technologies Company, or approved equal.
- C. All other materials, not specifically described, but required for proper completion of concrete formwork, shall be as selected by the Contractor and subject to the approval of the City Representative.

### PART 3 – EXECUTION

#### 3.01 PREPARATION

- A. Contractor shall conform to the recommendations in ACI Standards.
- B. Vertical and Horizontal Controls: Establish and maintain necessary benchmarks, lines, or controls throughout construction.
- C. Obtain necessary information and provide for openings, sleeves, chases, pipes, recesses, nailers, anchors, ties, inserts, and similar embedded items. Coordinate with concrete and other related work for requirements governing embedment and sleeving of pipes and conduit.
- D. Obtain written approval from the City Representative before framing openings not shown on Contract Drawings.

### 3.02 CONSTRUCTION OF FORMS

- A. General:
1. Construct formwork to produce concrete surfaces conforming to tolerances in ACI 301. Construct formwork to the exact shapes, lines and dimensions of concrete members, arranged to allow erection in proper sequence and to permit removal without damage to concrete finish.
  2. Unless otherwise indicated on Contract Drawings, construct formwork panels in sections as large as practicable. Construct forms of boards or plywood of same widths, shapes, and design for accurate location of form joints as indicated on the shop drawings. Fasten together with cleats; joists and studs may be used, at Contractor's option, in lieu of cleats if required for structural integrity of formwork. Verify clear space between forms to insure allowable coverage for reinforcing steel and allowable tolerances for construction.
- B. Framing and Bracing: Framing, bracing and supporting members shall be of ample size and strength to safely carry, without excessive deflection (exceeding allowable tolerances), all dead and live loads to which formwork may be subjected, and shall be placed sufficiently close to prevent any apparent bulging or sagging of forms.
- C. Exposed Concrete Surfaces:
1. Make plywood panel patterns regular and symmetrical, joints plumb and level, horizontal joints continuous. Control reuse of forms for exposed surfaces to provide surface of uniform color and texture without sharp demarcation between adjacent surfaces.
  2. Form ties for exposed concrete surfaces shall be arranged symmetrically and shall be aligned both vertically and horizontally (do not stagger).
  3. In general, provide  $\frac{3}{4}$ -inch chamfer at corners for exposed concrete unless otherwise noted. At chamfers, the concrete cover for reinforcement is critical and the minimum specified thickness shall strictly apply.
  4. Edges of all form panels in contact with concrete shall be flush within  $\frac{1}{32}$ -inch and form for plane surfaces shall be such that the concrete will be plane within  $\frac{1}{16}$ -inch in 4 ft. Form joints shall be tight to prevent the passage of mortar, water and grout.
- D. Embedded Items: Contractor shall secure all inserts, bolts, plates, and other embedded items. Use templates for equipment anchor bolts and other embedded items where final alignment is critical. Fill voids with readily removable material to prevent entry of concrete.
- E. Waterproofing Conditions: Concrete surfaces to receive waterproofing and damp-proofing materials shall be formed to provide a relatively smooth surface free of sharp corners, projections, and offsets at form joints. Form ties shall not penetrate or damage applied waterproofing and damp-proofing.
- F. Camber forms for slabs and beams as required for compensating deflection of form members. Positive means of adjustment (wedges or jacks) of shores and struts shall be provided to permit realignment or readjustment.

- G. Forms for walls of considerable height shall be arranged with tremies and hoppers for placing concrete in a manner that will prevent segregation and accumulation of hardened concrete on the forms or reinforcements above the fresh concrete.
- H. Provide temporary openings at bottom of forms where necessary to facilitate cleaning and inspection before concrete placement. Provide blockouts for mechanical and electrical work wherever necessary.
- I. Provide forms for footings wherever concrete cannot be placed against solid earth excavation.
- J. Construction joints and expansion joints shall be provided where indicated on the Contract Drawings. Otherwise, Contractor shall provide the layout for review and approval.

### 3.03 APPLICATION OF FORM COATINGS

- A. Thoroughly clean forms and coat with approved form-coating material prior to initial use and before each reuse. Excess form coating material shall not stand in puddles in the forms nor shall such coating come in contact with hardened concrete against which fresh concrete is to be placed.
- B. Apply form-coating material before reinforcing steel, anchoring devices and embedded items are placed and in strict accordance with manufacturer's directions.

### 3.04 FALSEWORK

- A. Contractor shall be fully responsible for the proper strength, safety of the falsework, supports and bearing surfaces which are used in connection with the work. Falsework shall be designed to support imposed loads without deformation, deflection or settlement.
- B. Wedges in pairs or jacks shall be used where required to maintain and/or adjust forms and formwork for beams, slabs and other parts of the structure at exact elevations. To ensure uniform bearing, single wedges are not permitted. Comply with requirements of ACI 347.
- C. Vertical and lateral loads shall be carried to ground by falsework framing, or by the completed structure after it has attained the requisite strength. Falsework supports, when placed on ground, shall be protected against undermining or settlement.

### 3.05 REMOVAL OF FORMS AND FALSEWORK

- A. Responsibility: The sole responsibility for removal of forms/falsework and for any resulting structural or finish damage rests with the Contractor. If forms are to remain, The Contractor shall adhere to all governing requirements and/or recommendations.
- B. The removal of forms and falsework shall be carried out in such manner as to ensure the complete safety of the structure. Supports shall not be removed until members have sufficient strength to safely support their own weight and all superimposed loadings with proper factor of safety.
- C. Unless otherwise specified in the Drawings, the minimum time for forms to remain in place shall be:
  - 1. Side forms for footings, foundations, slabs on grade, or other components that do not resist bending shall not be removed in less than 48 hours after concrete

placement. At times of low temperature or other adverse weather conditions, the Engineer may increase the required time to five days.

2. The falsework and forms supporting concrete girders, beams, joists, slabs, walls, or other members subject to bending stress, shall not be removed or released in less than 14 days after the concrete has been placed. In any case, the falsework and forms supporting the members shall not be removed until the concrete has attained a compressive strength of at least 80% of the design strength based on test results of field cured cylinders. Furthermore, such members shall not be loaded until the concrete has attained its 28-day compressive strength.
- D. All forms, supports, and falsework shall be arranged so that they may be readily removed without hammering or prying against the concrete.
  - E. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed, recesses left by the removal of form ties shall be filled, and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

### 3.06 REUSE OF FORMS

- A. Reuse of forms will be accepted, providing they are in good condition and have been cleaned, repaired, and resealed as required to achieve concrete of the specified quality and texture. Do not reuse form facing more than four times.

END OF SECTION

SECTION 03 20 00  
CONCRETE REINFORCING

## PART 1 - GENERAL

## 1.01 WORK INCLUDED

- A. This specification section governs materials, fabrication, placement, and inspection of steel reinforcement and reinforcement supports.

## 1.02 RELATED SECTIONS

- A. Section 03 10 00 – Concrete Forming and Accessories
- B. Section 03 30 00 – Cast-In-Place Concrete

## 1.03 REFERENCES

- A. San Francisco Building Code (SFBC) 2022
- B. American Concrete Institute (ACI) Standards
  - 1. 117-10 – Specifications for Tolerances for Concrete Construction and Materials
  - 2. 301-20 – Specifications for Structural Concrete
  - 3. 318-19 – Building Code Requirements for Structural Concrete
  - 4. SP-66(20) – ACI Detailing Manual-2020
- C. AWS - American Welding Society
  - 1. D1.4 – Structural Welding Code – Reinforcing Steel, Latest Edition
- D. American Society for Testing and Materials (ASTM) Standards
  - 1. A615/A615M-15b – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - 2. A706/A706M-14 – Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
  - 3. A1064/A1064M-15 – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- E. Concrete Reinforcing Steel Institute (CRSI)
  - 1. CRSI MSP – Manual of Standard Practice, 29<sup>th</sup> edition

## 1.04 SUBMITTALS

- A. Submittals shall be in accordance with Division 1.
- B. Shop Drawings:

1. Contractor shall submit the reinforcing steel shop drawings to City Representative for review and approval, prepared in accordance with ACI SP-66, showing list of materials, sizes, dimensions, cutting, bending, placement details, and splicing and lapping.
  2. Contractor shall coordinate with architectural, structural, mechanical, and electrical Contract Drawings for the location of anchors, bolts, inserts, conduits, sleeves, and any other embedded items, which are required to be cast in concrete. Contractor shall make all necessary provisions as required for the reinforcing steel that will not interfere with the placement of the embedded items.
  3. Reinforcing steel shall not be fabricated or placed before the shop drawings are reviewed and approved by the City Representative, and returned to the Contractor. Such review does not relieve the Contractor from the full responsibility for both the accuracy of the shop drawings, and the accurate and complete placing of the work.
  4. Shop drawings shall not be reproductions of the Contract Documents, nor shall they use or incorporate reproductions of parts of the Contract Documents.
- C. Mill Test Reports: Certified mill test reports (tensile and bending), for each heat or melt of steel, showing physical and chemical analyses, shall be submitted to the City Representative for review and approval before the material delivery to the job site. Where reinforcing is required to be welded, mill test reports shall verify the weldability of the steel or the use of weldable steel (ASTM A706).

#### 1.05 QUALITY ASSURANCE

- A. Concrete reinforcement work shall be in accordance with CRSI Manual of Standard Practice and conform to ACI SP-66. Also see paragraph 3.04 for reinforcing steel special inspection requirements.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Reinforcement shall be shipped and stored with reinforcement of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same designations as shown on the submitted placing drawings.
- B. Reinforcement shall be stored off the ground and be protected from moisture. Keep free from soil, oil, or other injurious contaminants. All steel, which cannot be properly identified, will be rejected, and shall be immediately removed from the job site.

### PART 2 - PRODUCTS

#### 2.01 MATERIAL

- A. Reinforcing bars: Reinforcing bars shall be deformed, except spirals, load-transfer dowels, and welded wire reinforcement, which may be plain.
1. Reinforcing bars shall conform to ASTM A615, Grade 60, unless otherwise indicated.



2. Reinforcing bars shall be ASTM A706, Grade 60 at concrete shear walls and concrete moment frames as noted on the Contract Drawings and where welding is required.
- B. Wire: Use plain or deformed wire as indicated in the Contract Drawings. Plain wire may be used for spirals.
1. Plain wire shall conform to ASTM A82.
  2. Deformed wire size D4 and larger shall conform to ASTM A496.
- C. Welded Wire Reinforcement: Use welded wire reinforcement as indicated in the Contract Drawings.
1. Plain welded wire reinforcement shall conform to ASTM A185, with welded intersections spaced no greater than 12 inches apart in direction of principal reinforcement.
  2. Deformed welded wire reinforcement shall conform to ASTM A497, with welded intersections spaced no greater than 16 inches apart in direction of principal reinforcement.
- D. Mechanical Couplers: Mechanical couplers shall be Type 2 and shall be capable of developing 125% of the specified yield strength and the ultimate tensile strength of the reinforcing bar.

## 2.02 ACCESSORIES

- A. Tie wire: Minimum 16 gage black annealed wire.
- B. Supports and Spacers: Provide spacers, chairs, bolsters, and other devices to support and secure the reinforcement in place. Use plastic tip chairs for exposed finished concrete surfaces. Supports for reinforcing bars on ground, aggregate base or sand over vapor barrier shall be precast concrete blocks of sufficient strength, size and spacing to support the bars in proper locations.

## 2.03 FABRICATION

- A. All reinforcing bars shall be shop fabricated to conform to the required shapes and dimensions, in accordance with CRSI standards.
- B. All reinforcement shall be bent cold.
- C. Reinforcement partially embedded in concrete shall not be field bent, except as shown on the Contract Drawings or permitted by the City Representative.
- D. Inside diameter of bend, other than for stirrups and ties in sizes No. 3 through No. 5, shall not be less than the following:

Bar Size	Minimum Diameter
No. 3 through No. 8	6 <i>bar diameter</i>
No. 9 , No. 10, and No. 11	8 <i>bar diameter</i>
No. 15 and No. 18	10 <i>bar diameter</i>

- E. Inside diameter of bend for stirrups and ties shall not be less than 4 *bar diameter* for No. 5 and smaller.
- F. Standard hooks shall mean one of the following:
  - 1. 180-degree bend plus 4 *bar diameter* extension, but not less than 2 ½ inches at free end of reinforcing bar.
  - 2. 90-degree bend plus 12 *bar diameter* extension at free end of reinforcing bar.
  - 3. Stirrups and Tie Hooks:
    - a. No. 5 bar and smaller, 90-degree bend plus 6 *bar diameter* extension at free end of reinforcing bar
    - b. No. 6, No. 7, and No. 8 bar, 90-degree bend plus 12 *bar diameter* extension at free end of reinforcing bar
    - c. No. 8 bar and smaller, 135-degree bend plus 6 *bar diameter* extension at free end of bar
- G. Reinforcing bars that are to be butt spliced, placed through limited diameter holes in metal or have a threaded end shall have the applicable end saw-cut.
- H. Reinforcing bars shall not be damaged in bending or straightening, and reinforcing bars with kinks or improper bends shall not be used on the job.
- I. Welding of reinforcing bars shall conform to AWS D1.4. Type and location of welded splices and other required welding of reinforcing bars shall be indicated on the Contract Drawings.

## PART 3 - EXECUTION

### 3.01 PLACEMENT

- A. Before placing concrete, reinforcement shall be cleaned of oil, grease, soil, loose mill scale, loose rust, and any other coating of a character that would destroy or reduce the bond.
- B. Reinforcing bars shall be secured firmly in position. Use No. 16-gauge black annealed wire at each steel intersection. Use precast mortar blocks, metal chairs, spacers, metal hangers, supporting wires, and other approved devices to set steel in position with sufficient strength to resist crushing under full load and to prevent displacement during concrete placing operations.
- C. Precast Concrete Blocks: Precast concrete blocks shall not be less than 3 inches square with embedded wires and shall have at least the same 28-day compressive strength as the surrounding concrete. Space concrete blocks no less than 1'-6" and no more than 3 feet apart.
- D. Minimum concrete cover for reinforcement and minimum clear bar spacing shall be as specified on Contract Drawings, but in no case shall be less than values specified in ACI 318.

- E. Placing bars on layers of fresh concrete as the work progresses, or adjusting bars during the concrete placement, will not be permitted.

### 3.02 SPLICING

#### A. Lap Splices:

1. Reinforcing bars shall be lap spliced as indicated on the Contract Drawings. Splices at locations other than those indicated are subject to the approval of the City Representative and, if permitted, shall conform to the lap lengths specified in the Drawings, but not less than 40 bar diameters.
2. Locate splices not indicated on the Contract Drawings at points of minimum stress. Indicate splice locations on shop drawings. Splice locations shall be well staggered with no more than 50% of the bars spliced at any section, subject to review by the City Representative. Welded splices or mechanical couplers may be substituted for contact lap splices at the discretion of the Contractor, subject to approval by the City Representative.

#### B. Welded Splices:

1. No reinforcing bars shall be welded either during fabrication or placement unless specifically shown on the Contract Drawings, specified herein, or with prior written consent of the City Representative. All reinforcing bars that have been welded without such approval shall be rejected and immediately removed from the work site. When welding of reinforcement is approved or shown, it shall conform to AWS D1.4. All welded splices shall be subjected to Special Inspection performed by a certified Special Inspection and Testing Agency.

### 3.03 REINFORCEMENT AROUND OPENING

- A. Whenever conduit, piping, sleeves, bolts, hangers, boxes or other embedded items interfere with the proper placement of reinforcing steel as detailed, the Contractor shall submit to the City Representative the proposed reinforcement adjustment for review. Reinforcing bars shall not be bent around openings or sleeves, except with the City Representative's prior approval.

### 3.04 INSPECTION

- A. Before concrete is placed, reinforcement placement shall be inspected by a certified Special Inspection Agency. Any errors or discrepancies shall be corrected before placing concrete. Re-inspection shall be paid for by the Contractor. The Special Inspection Agency shall be notified for reinforcing steel special inspection not less than 48 hours prior to concrete placement.

END OF SECTION



## SECTION 03 26 00

## DRILLED DOWELS

**PART 1- GENERAL**

## 1.01 WORK INCLUDES

- A. This Section includes dowels installed in existing concrete work by drilling and epoxy grouting.

## 1.02 RELATED SECTIONS

- A. Section 03 20 00 – Concrete Reinforcement
- B. Section 03 30 00 – Cast-in-Place Concrete

## 1.03 SUBMITTALS

- A. Product data and manufacturer's recommended application procedures for epoxy grout.

## 1.04 QUALITY CONTROL

- A. Grouter's Qualifications for Epoxy Grouting
  - 1. Experience in epoxy work, particularly in grouting dowels into concrete.
  - 2. Employ field personnel with minimum one-year experience in epoxy grouting construction.
- B. See paragraph 3.05 of this Section for testing and inspection.

## 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Ensure storage facilities are weather-tight and dry.
- B. Do not use remnant portions for epoxy solids exposed to air or mixed beyond pot life.

**PART 2 - PRODUCTS**

## 2.01 MATERIAL

- A. Epoxy Grout
  - 1. High-strength, creep-resistant, two-component epoxy resin.
  - 2. Minimum heat deflection to temperature of 140 degrees F, ASTM D648.
  - 3. Bonds to damp surfaces.
  - 4. Non-sag gel for overhead and horizontal applications.

5. Use Adhesive Engineering Products manufactured by Sika or equal, unless otherwise noted on drawings.
- B. Other Polymer Adhesives:
1. Other grout materials may be used for specific application subject to City Representative's approval. No polyester-based resin shall be used.

### **PART 3 - EXECUTION**

#### 3.01 EXAMINATION

- A. Examine areas to be drilled and verify access conditions, existing materials, and interferences.

#### 3.02 PREPARATION

- A. Protect existing exposed surfaces from grouting operations.
- B. Clean dowels free of grease, paint and mill scale by wire brushing or washing with petroleum solvents as required. If solvents are used, surfaces shall be completely dry prior to installation.

#### 3.03 INSTALLATION

A. Drilling

1. Drill holes using rotary drill to a diameter  $\frac{1}{4}$  inch larger than the nominal diameter of the dowel and to a depth of 10 dowel diameters, unless otherwise noted on Drawings. No coring with water shall be allowed.
2. Do not cut reinforcing steel. Avoid drilling into existing reinforcement as much as possible by using a nondestructive magnetic device (Pachometer) to establish location of existing reinforcing steel. Notify City Representative when existing reinforcement is cut for instructions before proceeding further.
3. Where drilling causes existing concrete to spall, patch as directed by City Representative at no additional cost to the City.

- B. Clean holes by brushing with a nylon brush or stiff bristle brush and blowing out with oil-free high-pressure air jet.

- C. Per manufacturer's instructions place a measured amount of epoxy into caulk gun equipped with an extension tube matching the depth of hole. Place tube at bottom of hole and slowly withdraw as epoxy is evenly injected.

- D. Insert dowel slowly to bottom of hole, rotating it to remove trapped air.

- E. Clean excess epoxy from around hole before it hardens.

#### 3.04 PROTECTION

- A. Protect grouted dowels from accidental disturbance during curing time as specified by manufacturer or for 12 hours minimum, whichever is greater.

- B. Do not place pull-out or shear loads on dowels for minimum of three days after grouting.

### 3.05 FIELD QUALITY CONTROL

- A. Inspection and testing will be performed under provisions of Division 1 and in accordance with Section 1701 of the San Francisco Building Code. Contractor shall be responsible for coordinating inspections, construction, and installation.

- B. Testing and Inspection Agency shall:

1. Review manufacturer's recommended application procedures.
2. Periodically inspect installation for conformance with Contract Documents and manufacturer's recommendations.

- C. An independent testing agency will proof test dowels in tension after curing. This independent testing agency will be hired by and paid by the City for doing the testing work.

1. Test locations and frequency will be at Agency's discretion, unless otherwise directed by City Representative.
  - a. Test a minimum of 20% of each size dowel.
  - b. Test a minimum of 3 each size dowel.
  - c. Perform tests at different locations and conditions to obtain a representative sample.
2. Test load as indicated in table below. Maintain load for a minimum of 5 minutes. There shall be no loosening or movement of dowel out of hole and no cracking or spalling of concrete which dowel, or bolt is set.

<u>Reinforcement</u>	<u>Min. Embedment</u>	<u>Field Test Load</u>
#3	3 3/8"	2000 lbs
#4	4 1/2"	4000 lbs
#5	5 5/8"	6000 lbs
#6	6 1/4"	9000 lbs
#7	7 7/8"	12,000 lbs
#8		

3. Should any dowel or bolt fail to meet these criteria. The level of testing of similar dowels or bolts shall be increased to 100%. If other failures occur during additional testing, test all similar dowels or bolts.

- D. Contractor shall pay for increased testing caused by dowel or bolt failures.

END OF SECTION





## SECTION 03 30 00

## CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

## 1.01 WORK INCLUDED

- A. This specification section governs the construction of cast-in-place concrete including the following:
  - 1. Requirements for materials, proportioning, production, and delivery of concrete
  - 2. Production of cast-in-place structural concrete including methods and procedures for obtaining quality concrete through proper handling, placing, finishing, curing, and repair of surface defects.

## 1.02 RELATED SECTIONS

- A. Section 03 10 00 – Concrete Forming and Accessories
- B. Section 03 20 00 – Concrete Reinforcement

## 1.03 REFERENCED CODES AND STANDARDS

- A. San Francisco Building Code (SFBC) 2022
- B. American Concrete Institute (ACI) Standards
  - 1. 117-20 – Specifications for Tolerances for Concrete Construction and Materials
  - 2. 301-20 – Specifications for Structural Concrete
  - 3. 304R-(20) – Guide for Measuring, Mixing, Transporting, and Placing Concrete
  - 4. 305R-20 – Guide to Hot Weather Concreting
  - 5. 306R-16 – Guide to Cold Weather Concreting
  - 6. 308R-(16) – Guide to Concrete Curing
  - 7. 309R-05 – Guideline for Consolidation of Concrete
  - 8. 318-19 – Building Code Requirements for Structural Concrete
  - 9. 347R-14 – Guide to Formwork for Concrete
  - 10. SP-15 – Field Reference Manual: Specifications for Structural Concrete (ACI 301-10) with Selected ACI and ASTM References
- C. American Society for Testing and Materials (ASTM) Standards
  - 1. C31/C31M-06 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

2. C33-03 – Standard Specification for Concrete Aggregates
  3. C39/C39M-05 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
  4. C42/C42M-04 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
  5. C94/C94M-06 – Standard Specification for Ready-Mixed Concrete
  6. C150-05 – Standard Specification for Portland Cement
  7. C171-07 – Standard Specification for Sheet Materials for Curing Concrete
  8. C227 – Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
  9. C260/C260M-10a – Standard Specification for Air-Entraining Admixture for Concrete
  10. C309-07 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
  11. C494/C494M-05a – Standard Specification for Chemical Admixtures for Concrete
  12. C618-05 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
  13. C881/C881M-02 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
  14. C1017/C1017M-16 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
  15. C1077-16 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
  16. C1602/C1602M-06 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
  17. D1751-04 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
  18. E329-14a – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special inspection
- D. Concrete Reinforcing Steel Institute (CRSI)
1. CRSI MSP– Manual of Standard Practice, 29<sup>th</sup> edition

#### 1.04 SUBMITTALS

- A. The Contractor shall submit the following to the City Representative for review prior to concrete placement in accordance with Division 1:

1. Mixture Proportions: Submit concrete mixture proportions and characteristics including water-cementitious material (w/cm) ratio, weights, slump and compressive strength at 28 days.
2. Mixture Proportion Data: Submit field test records and/or trial mixture records used to establish the required average strength for the concrete mixture to be used.
3. Concrete Materials:
  - a. Cementitious materials: Information showing type, manufacturing locations, shipping locations, manufacturer's quality control reports, and certificates showing compliance with ASTM C150, ASTM C595, ASTM C618, ASTM C845, ASTM C989, ASTM C1157, or ASTM C1240.
  - b. Aggregates: Information showing types, pit or quarry locations, producers' names, gradings, specific gravities, and evidence not more than 90 days old demonstrating compliance with requirements herein.
  - c. Admixtures: Information showing types, brand names, producers' names, manufacturers' technical data sheets, and certificates showing compliance with ASTM C494/C494M, or ASTM C1017/C1017M.
4. Curing Materials: Submit manufacturer's product information including storage, handling, and application procedures.
5. Sealing Compounds: Submit manufacturer's product information including storage, handling, and application procedures.
6. Epoxy Bonding Adhesives: Submit manufacturer's product information including storage, handling, and application procedures.
7. Contraction or Expansion Joints: Submit manufacturer's product information including storage, handling, and application procedures. When contraction or expansion joints other than those indicated in the Drawings are proposed, submit locations for acceptance.
8. Construction Joints: Submit information for acceptance of proposed location and treatment of construction joints not indicated in the Drawings.
9. Manufacturer's specifications with application and installation instructions for all proprietary materials and item including admixtures, bonding agents, joint systems, and curing compounds.

#### 1.05 QUALITY ASSURANCE

- A. Specifications herein set minimum results required. The Contractor is responsible for the quality of concrete cast-in-place and bears the burden of proof that all concrete as cast meets minimum requirements.
- B. Codes and Standards: Maintain copies of all applicable Codes and Standards at the project site at all times. Comply with provisions specified in latest editions of all applicable standards of "ACI Manual of Concrete Practice", including but not limited to the following:
  1. ACI 301 – Specifications for Structural Concrete

2. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete
  3. ACI 305R – Guide to Hot Weather Concreting
  4. ACI 306R – Guide to Cold Weather Concreting
  5. ACI 308 – Guide to Concrete Curing
  6. ACI 309 – Guideline for Consolidation of Concrete
  7. ACI 318 – Building Code Requirements for Structural Concrete
- C. Acceptance tests for materials and concrete mixture designs:
1. Concrete mixture designs, including material certificates, shall be furnished by the Contractor and reviewed by the City Representative and the Special Inspection and Testing Agency. No concrete shall be used in the work until the materials and mixture designs have been accepted by the City Representative.
  2. Concrete manufactured and intended for placement in the work shall be tested and certified by a Special Inspection and Testing Agency. The Special Inspection and Testing Agency shall comply with ASTM C1077 and E329
  3. The Special Inspection and Testing Agency shall sample, cast and test fresh concrete with standard concrete test cylinders.
  4. The Special Inspection and Testing Agency shall provide special inspection of the concrete placement. The responsibility for furnishing and placing concrete conforming to the requirements of the Drawings and/or Specifications rests solely with the Contractor.
- D. Tolerances:
- 1 Formed surfaces: Tolerances on formed surfaces shall be as specified in ACI 347, except where other tolerances are indicated.
  - 2 Unformed surfaces: Tolerances on unformed surfaces shall be as specified in ACI 301 for the applicable surface finish, except where other tolerances are indicated.
- E. Mock-up Panel: Cast concrete wall panels to demonstrate typical joints, surface finish, texture, tolerance, and standard of workmanship.
1. Build wall panel approximately 6 feet tall by 12 feet long.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Cementitious Materials: Cementitious materials shall be of the same brand and type and from the same manufacturing plant as the cementitious materials used in the concrete represented by the submitted field test records or used in the trial mixtures. Cementitious materials shall conform to the following:

1. Portland Cement: ASTM C150, Type II
  2. Fly Ash: ASTM C618, Class F. When fly ash is used, the minimum amount shall be 15% by weight of the total cementitious materials, unless otherwise noted.
  3. Blast-Furnace Slag: ASTM C989, finely ground granulated
  4. Silica Fume: ASTM C1240
- B. Aggregates: Both fine and coarse aggregates shall conform to the requirements of ASTM C33 and shall be from sources with a proven history of successful use. Aggregates used in concrete shall be obtained from the same sources and have the same size range as aggregates used in the concrete represented by the submitted field test records or used in the trial mixtures. The maximum size of aggregates shall be 1 inch for normal weight aggregate.
1. Coarse: Cleanliness value shall not be less than 75 when tested in accordance with California Test Method No. 227.
  2. Fine: Sand equivalent shall not be less than 75 when tested in accordance with California Test Method No. 217.
  3. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
  4. Sample of coarse and fine aggregates shall be tested for alkali reactivity in accordance with ASTM C227. Submit certification of materials for review with the concrete mix design submittal.
- C. Lightweight Aggregates: Both fine and coarse aggregates shall conform to the requirements of ASTM C330 and shall be from sources with a proven history of successful use. Aggregates shall be vacuum saturated. Maximum dry weight shall be 115 pcf. The maximum size of aggregates shall be  $\frac{3}{4}$ -inch for lightweight concrete.
- D. Water: Water shall be clean and potable, free from impurities detrimental to concrete.
- E. Admixtures:
1. Admixtures shall be compatible and contain no chlorides, sulfides or nitrides.
  2. Admixtures for water reduction and setting time modification shall conform to ASTM C494
  3. Admixtures for use in producing flowing concrete shall conform to ASTM C1017
  4. Air entraining admixture shall conform to ASTM C260
- F. Curing Materials:
1. Liquid Membrane-Forming Curing Compounds: ASTM C309, Type 1, approved clear resin type, free of oil, wax, grease, or other substance which might discolor concrete or prove deleterious to or adversely affect the bonding of any material applied to the concrete.
  2. Curing paper: ASTM C171, non-staining waterproof paper, regular type.

- G. Sealing Compounds: ASTM C1315
- H. Epoxy Bonding Adhesives: ASTM C881
- I. Expansion Joint Materials: Premolded, ½ inch thick unless otherwise noted, composed of asphalt impregnated vegetable fiber, and mineral filler conforming to the requirements of ASTM D1751; size for installation 1/4-inch below concrete surface.
- J. Polymer Grit Additive: Additive shall be compatible with sealer and applied per manufacturer's instruction.

2.02 CONCRETE MIXTURE DESIGNS

- A. Concrete mixture designs for concrete shall be at the Contractor's expense. The designs shall be tested by a qualified Testing Agency, approved by the City. Concrete mixture designs, including quantities of admixture, shall be submitted for review and approval at least 30 days prior to placing any concrete. Refer to SUBMITTALS and QUALITY ASSURANCE Articles in this Specification Section.
- B. Concrete mixture designs shall be proportioned in accordance with ACI 318 Section 5.3, "Proportioning on the Basis of Field Experience or Trial Mixtures or Both" with a maximum w/cm ratio of 0.45. The w/cm ratio shall be based on total cementitious material, including Supplementary Cementitious Material (SCM). SCM, as a percentage of total weight of cementitious material shall be a minimum of 25 percent and a maximum of 50 percent. Fly ash shall be a maximum of 20 percent. Submit mix designs for each class of concrete for review.
- C. Concrete mixture proportions shall be such as to produce a dense, workable mix that can be placed without segregation or excess free surface water. Superplasticizers may be used to improve workability in thin or congested sections.
- D. If the concrete is to be placed by pumping, recommendations of ACI 304.3R shall be followed.
- E. All concrete used in horizontal surfaces exposed to the weather shall contain an acceptable admixture to produce air-entrained concrete with total air content of 4.5% ± 1%. Air content shall be measured at the discharge of the truck. If concrete is pumped, air content shall be measure at the discharge of the pump line. Tests for air content will shall meet ASTM C172 requirements.

2.03 SCHEDULE OF CONCRETE CLASSES

- A. General: The concrete class and slump for the various types of construction shall be as designated in the following table:

Location	Strength [psi]	Test Age [days]	Maximum Aggregate Size [inches]	Maximum Water/Cement Ratio
Footings	5,000	28	1½	0.450
Walls	5,000	28	1	0.45
Slabs-On-Grade	4,000	28	¾	0.45

- B. Strength: Concrete shall develop compressive strengths as noted above and on Drawings. The tests shall be performed on concrete cylinders in accordance with ASTM

C39. The averages of all sets of three consecutive strength tests shall be equal to or greater than the specified strength and no individual strength test result shall fall below the specified strength by more than 500 psi.

- C. Slump: Concrete shall be of such consistency and mix composition that it can be readily worked into the corners and angles of the forms and around the reinforcement, inserts, and wall castings without permitting materials to segregate or free water to collect on the surface.

### PART 3– EXECUTION

#### 3.01 PRODUCTION OF CONCRETE

- A. Concrete shall be ready-mixed concrete in conformance with ASTM C94. Measure, batch, and mix concrete materials and concrete in conformance with ASTM C94. Equipment shall be adequate for the purpose and kept in good mechanical condition at all times. No hand-mixing will be permitted.
- B. Ready-mixed concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of rated capacities for the respective conditions as stated on the name plate. Discharge at the site shall be completed within 1-1/2 hours, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of water to the mix. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85°F or above, discharge of concrete shall be completed within 1 hour. Central mixed concrete shall be plant-mixed a minimum of 1-1/2 minutes per batch and then shall be truck-mixed or agitated a minimum of 8 minutes. Agitation shall begin immediately after charging the truck, followed by agitation without interruption until discharged.
- C. Mixers shall be equipped with an automatic device for recording number of revolutions of drum or blades prior to completion of mixing operation. Revolution counters shall be set at "0" and shall commence to operate when drum revolution begins after introduction of ingredients into the mixer. Delivery tickets shall show departure time from plants.
- D. Retempering of concrete, that is, remixing with or without additional cement, aggregates, water, or admixtures, will not be permitted.
- E. No water shall be added to the mix after the initial introduction of mixing water for the batch except when, on arrival at the job site, the slump of the concrete is less than that specified. In this case, additional water may be added only if neither maximum permissible w/cm ratio nor maximum slump is exceeded and if the addition of water is approved by the City Representative. The drum or blades shall then be turned an additional 30 revolutions or more until the mix is uniform.
- F. All concrete used in suspended slabs and slabs-on-grade shall be designed with a shrinkage limitation of 0.04% after 28 days of drying.

#### 3.02 PLACEMENT OF CONCRETE

- A. General:
1. Maintain continuous and accurate log of placing of concrete in structure. Record date, location, quantity, air temperature, test samples taken. A copy of the log shall be given to the City Representative.

2. Notify City Representative a minimum of 72 hours prior to placing of any concrete.
3. Do not place concrete until data on materials and mixture proportions are accepted by the City Representative.

B. Preparation

1. Forms shall be constructed to sizes, shapes, lines, and dimensions as required to obtain accurate alignment, location, grades, level, and plumb work in the finished structure. Refer to Specification Section 03 10 00.
2. Remove debris, mud, water, and all foreign materials from places to receive concrete. All surfaces of forms and embedded materials shall be cleaned of all mortar or grout before the surrounding or adjacent concrete is placed.
3. Absorbent forms shall be thoroughly wetted before concrete is placed. Aggregate base/sand beds for slabs on grade shall be moist but not saturated when concrete is placed.
4. No concrete shall be placed until reinforcing is fastened in place and inspected nor until forms are complete. No concrete shall be placed before work that is to be embedded has been set. Reinforcement or other materials that have been set in place shall not be disturbed.
5. Before placing concrete, embedded pipes and conduits shall be sleeved providing  $\frac{1}{4}$ " minimum clearance all around. Sleeves shall be positioned so as not to impair the strength of surrounding elements. All items to be embedded in the concrete shall be free from oil, or foreign matter, that would impede the bond of the concrete to these items.
6. Where new concrete is to be cast against existing concrete, the existing concrete surface shall be roughened to a minimum of  $\frac{1}{4}$ " amplitude by sandblasting or bush hammering. The existing surface shall be cleaned and laitance removed. Apply bonding adhesive to existing concrete surface prior to placement of new concrete in accordance with manufacturer's recommendations.

C. Weather Considerations:

1. Hot Weather: Comply with the recommended practices of ACI 305R and the requirements specified herein. Procedures for hot weather concreting will be subject to the approval of the City Representative.
2. Cold Weather: Comply with the recommended practices of ACI 306R and the requirements specified herein. Procedures for cold weather concreting will be subject to the approval of the City Representative.

D. Conveying:

1. Transport concrete from mixer to place of final deposit as rapidly and directly as practicable and by methods which prevent segregation or loss of ingredients and displacement of reinforcement, and which avoid rehandling. Do not deposit partially hardened concrete.



2. Conveying equipment shall be acceptable to the City Representative and shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Equipment having components made of aluminum or magnesium alloys, which would have contact with plastic concrete during pumping, chuting or tremie operations, shall not be used.

E. Depositing:

1. Place no concrete when sun, wind, heat or other limitation of facilities will prevent proper finishing and curing procedures. Depositing under water will not be permitted.
2. Within the planned placement, deposit concrete continuously and as near as practicable to the final position.
3. Concrete shall not be dropped through the reinforcing steel in such a manner as to cause segregation of the aggregates. In no case, within the formwork or otherwise, shall concrete be permitted to fall from a height greater than 4 feet except through elephant trunks or other approved devices.
4. Deposit concrete in layers not exceeding 18 inches in thickness, force concrete around and under reinforcing and embedded items without displacing them. Integrate fresh concrete with that already placed; no retempering of concrete already placed will be allowed. After concrete has taken an initial set, protect forms from jarring and do not place any strain on ends of projecting reinforcement.
5. Splash or accumulation of hardened or partially hardened concrete shall be removed. Contact faces of forms for exposed concrete shall be protected from splash during placing of adjacent concrete.
6. Do not deposit fresh concrete on concrete that has hardened sufficiently to cause formation of cold joints, unless construction joint requirements are met.
7. Do not place concrete over columns or walls until concrete in columns and walls has reached final set.
8. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as the concrete for adjacent slabs.
9. Interruption in depositing longer than 45 minutes shall be cause for discontinuing casting of the section of work. In this event, cut back concrete and provide construction joints as the City Representative directs; clean forms and reinforcing as necessary to receive concrete at later time.

F. Consolidating

1. Concrete shall be thoroughly consolidated by placing the mechanical vibrator directly in concrete at 18" to 30" intervals for a period of approximately 5 to 15 seconds and withdrawing slowly or as directed. Thoroughly work concrete around reinforcing and embedded items and into corners and shapes of formwork. One vibrator will be required for each location where simultaneous concrete placing takes place, to ensure thorough vibrating of all sections. Provide sufficient spare vibrators on the job so as to have them readily available in case any vibrator in use should suddenly cease to function properly.

2. Mechanical vibrator shall be of the flexible immersion type having a frequency of not less than 8,000 rpm. Use and type of vibrator shall conform to ACI 309.
  - a. Penetrate placed layer and at least 6 inches into preceding layer. Do not consolidate placed concrete by mechanical vibrating supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
  - b. Do not use vibrators to transport concrete inside forms. Move the vibrators vertically at uniform spaced locations with no effectiveness of the machine function. Place vibrators into the lower layers of concrete that have begun to set.
  - c. Contractor shall have a minimum of one spare vibrator on site during concrete placement operations to be used as needed.
3. Consolidate slabs six inches and less in thickness by means of vibrating screeds or, for small areas such as curbs, wood tampers.
4. Completely eliminate honeycombing or planes of weakness due to air voids and stone pockets.

G. Construction Joints

1. All pours shall be terminated at construction joints.
2. Placement of construction joints and the manner in which they are provided for shall be approved by the City Representative or as shown on the Drawings. Construction joints shall be as few as possible and will not be permitted simply to save forms.
3. Construction joints including keys shall be cleaned and roughened in an acceptable manner that exposes aggregate uniformly and does not leave laitance, loosened aggregate particles, or damaged concrete at the surface. Forms and reinforcing shall be cleaned of drippings, debris, etc. Apply bonding adhesive to hardened concrete surface prior to placement of fresh concrete in accordance with manufacturer's recommendations.

3.03 CONCRETE FINISH

- A. Exposed Surfaces: At all exposed surfaces of the structure, produce smooth form finish in accordance with ACI 301, unless otherwise noted.

3.04 SAWED JOINTS

- A. Where saw-cut joints are required or permitted, start cutting as soon as concrete has gained sufficient strength to prevent raveling, or the dislodgment of coarse aggregate particles.
- B. Saw a continuous slot to a depth one-fourth the thickness of the slab but not less than 1 inch.
- C. Complete sawing within 12 hours after placement.

3.05 CURING AND PROTECTION

- A. Curing: All newly placed concrete shall be cured by one or more of the following methods:
1. Water Method. The concrete shall be kept continuously wet by the application of water for a minimum of 7 days after the concrete has been placed. Cotton-mats, rugs, carpets, or earth or sand blankets may be used as a curing medium to retain the moisture during the curing period.
  2. Waterproof Membrane Method for Slabs. All slabs shall be saturated such that free moisture occurs over the entire area. After dampening, slabs shall be immediately covered with curing paper lapped 4 inches at all joints and sealed with adhesive tape or waterproof glue. Curing paper shall remain in place for not less than 10 calendar days. Curing floor slab with chemical hardener/sealer may be used. Application shall be promptly in accordance with the manufacturer's instructions. Impervious sheeting is then applied over the slabs with sealed laps, and planks are laid over the slab to prevent injury from traffic.
  3. Use an approved Liquid Membrane-Forming Curing Compound. Application shall commence immediately following completion of specified finishing. When applying compound, the surfaces shall be damp but shall be free from standing water. Using pressurized spray equipment, apply as recommended by Manufacturer. Curing compounds shall not be used on surfaces when their use may be detrimental to bonding of concrete, caulking and sealants or the specified surface hardener.
  4. Forms-in-Place Method: Keep formed concrete surfaces continuously wet both in forms and after removal of forms for at least seven (7) days after placing. Wood forms and any metal forms exposed to the sun shall be kept wet. If forms are removed prior to expiration of curing period, exposed concrete surfaces shall be kept continuously wet by means of fog sprays or non-staining cotton or burlap mats kept moist or by approved curing compound.
  5. Difficult Access: For formed concrete surfaces that have access difficulties, Contractor shall provide a method for concrete curing to City Representative for review and approval.
- B. Protection:
1. All concrete placed in forms shall have a temperature of between 50°F and 70°F and adequate means shall be provided for maintaining this temperature for as much time as is necessary to ensure proper curing of the concrete. The housing, covering or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heating is discontinued.
  2. Wherever practicable, finished surface and slabs shall be protected from the direct rays of the sun to prevent checking and crazing. During hot weather, as defined in ACI 305R, the Contractor shall implement the requirements of ACI 305R.

### 3.06 REPAIR OF SURFACE DEFECTS

- A. Immediately after removing forms, all concrete surfaces shall be inspected and any pour joints, voids, rock pockets, tie holes, etc., shall be patched within 48 hours after removal of forms, but not until surfaces have first been examined by the City Representative.

- B. If rock pockets, in the opinion of the City Representative, are of such an extent or character as to affect the strength of the structure materially or does not provide adequate protection of steel reinforcement, the City Representative may declare the concrete defective and require the removal and replacement of the portions of the structure affected at the Contractor's expense.
- C. Sacking: Tie holes, superficial air voids and irregularities shall be filled solid with a cement mortar grout with all excess grout "sacked" off without the use of water. The following formula (by volume) for cement grout shall be used for this purpose:

5 ½ parts sand  
2 ½ parts Portland Cement  
1 ½ parts lime hydrate

Care shall be taken in the application of the grout and in sacking the excess grout from the surface in order that all voids are filled without grout built up on the smooth surface.

- D. Patching: Honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of not less than 1 inch. The edges of the cut shall be perpendicular to the surface of the concrete. After cleaning the exposed concrete by air-blasting, saturate the area to be patched and at least 6 inches adjacent thereto with water before placing the mortar. Mix the mortar approximately one hour before placing and remix occasionally during this period with a trowel without the addition of water. A grout of cement and water mixed to the consistency of paint shall then be brushed on to the surfaces to which the mortar is to be bonded. The mortar shall be compacted into place and screeded slightly higher than the surrounding surface. Finish patches on exposed surfaces to match the adjoining surfaces, after they have set for an hour or more. Cure patches as specified for the concrete. Application of patch mortar shall be in accordance with ACI 301. Patchwork mixture shall match adjacent surfaces in color and texture. Determine exact mix by trial mixtures before patching, and obtain approval of mix proposed prior to application.
- E. Site-Mixed Portland Cement Repair Mortar: Mix repair mortar using the same materials as concrete to be patched, with no coarse aggregate. For repairs in exposed concrete, make a trial batch and check color compatibility of repair material with surrounding concrete. Use a repair mortar at a stiff consistency with no more mixing water than necessary for handling and placing.

### 3.07 FIELD QUALITY CONTROL

- A. Certification: In addition to the information specified in ASTM C94 to be provided on the delivery ticket with each batch of concrete, provide the following information on the same ticket:
1. Reading of the revolution counter at the first addition of aggregates to the mixer.
  2. Times of day at which cement and aggregates are first intermingled, and at which water and cement are first intermingled.
  3. Mix identification.
  4. Weight of cement, aggregate, water and admixtures, and aggregate size.
  5. Indicate that all ingredients are as previously approved for use.
- B. Testing:

1. Compression Tests: Work related to compression tests shall be performed by the City Testing and Inspection Agency. During progress of work, 4 compression test cylinders shall be taken for each placement of 150 cubic yards or 5,000 square feet of surface area for slabs or walls, or fraction thereof of each class of concrete placed each day. Make, cure and store test cylinders as per ASTM C31. One cylinder shall be tested at 7 days for information; two at 28 days for acceptance; and the fourth held in reserve. Cylinders will be numbered in sets (1A, 1B, 1C, 1D) and a record kept on extent of pour represented by each set and type of concrete tested. Cylinders will be tested in accordance with ASTM C39. If any test report indicates 28-day specimen below required strength level (within standard of acceptability established by ACI 318), and if required by City Representative, the Testing Agency will take test cores of hardened concrete in accordance with ASTM C42. Such concrete shown to be defective shall be removed and replaced. Cost of core tests, repairs and removal and replacement of defective concrete shall be paid by the Contractor.
  2. Slump Test: Slump tests will be performed as per ASTM C143 at time of taking test cylinders.
- C. Inspection:
1. The Contractor shall advise the City Representative of his readiness to proceed at least 72 hours prior to each concrete placement. No placement shall be made without the inspection and acceptance of the Engineer.
  2. When forms are removed, voids, stone pockets and other defects shall not be remedied until the City Representative has inspected them and given directions.
  3. Continuous special inspection by a Special Inspection and Testing Agency is required during concrete placement. As a minimum, two special inspectors are required – one at the concrete truck/pump and one at the point of concrete placement

### 3.08 DEFECTIVE CONCRETE PATCHING AND REPAIRS

- A. Concrete shall be considered defective for the following reasons:
1. Failure of finished concrete profiles, and dimensional tolerances, to conform to the requirements specified in the Formwork section of this specification or the requirements specified in ACI 117, whichever is more critical for the surface or profile being considered.
  2. Failure to meet the specified cylinder strength requirements set forth in paragraph 16.5.1 of ASTM C94.
  3. Concrete showing cracks, rock pockets, voids, spalls or other defects that adversely affect the structural adequacy of the concrete.
- B. All defective concrete shall be subject to removal and replacement by the Contractor, at his expense, unless it is determined by the City Representative that it can be patched as specified below or that the location of this defective concrete is not detrimental to the function and the appearance of the structure.

- C. As directed by the City Representative, the Contractor shall take cores, as needed, from any questionable area in the concrete work, for determination of concrete quality. The Contractor shall repair all core holes as required. Core specimens shall be drilled and tested in accordance with the requirements of ASTM C42. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.

### 3.09 DAMAGED WORK

- A. Before final acceptance of the work, damaged surfaces, corners of concrete, and concrete finish, whether such damage shall have resulted from the action of the elements or from any cause whatsoever, shall be neatly repaired. Any damaged places where surface repairs are permitted shall be brought to a smooth, dense, watertight condition to the satisfaction of the City Representative.

### 3.10 CLEAN-UP

- A. Remove from site all debris resulting from the work of this section.
- B. Ensure removal of bituminous materials, form release agents, bond breakers, curing compounds or other materials employed in work of concreting which would otherwise prevent proper application of sealants, liquid waterproofing, or other delayed finishes or treatments.
- C. Where cleaning is required, take care not to damage surrounding surfaces or leave residue from cleaning agents.

END OF SECTION

SECTION 05 12 00  
STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. This specification section governs the furnishing, materials, storage and handling, and erection of structural steel and miscellaneous metal, including, but not limited to, columns, beams, plates, and anchor bolts.

1.2 RELATED SECTIONS

- A. Section 05 53 00 – Metal Gratings

1.3 REFERENCED CODES AND STANDARDS

- A. San Francisco Building Code (SFBC) 2022
- B. American Institute of Steel Construction (AISC)
1. Steel Construction Manual, 16<sup>th</sup> Edition
  2. 303-16 – Code of Standard Practice for Structural Steel Buildings and Bridges
- C. American Society for Testing and Materials (ASTM) Standards
1. A36/A36M-08 – Standard Specification for Carbon Structural Steel
  2. A53/A53M-10 – Standard Specification for Pipe, Steel Black and Hot-Dipped, Zinc Coated, Welded and Seamless
  3. A123/A123M-09 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  4. A307-21 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
  5. ASTM F3125/F3125M-21 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  6. A449-10 – Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
  7. A490-12 – Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
  8. A500/A500M-17a – Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
  9. A563-21a – Standard Specification for Carbon and Alloy Steel Nuts
  10. A572/a572M-21 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

11. A780/A780M-20 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
  12. A992/A992M-20 – Standard Specification for Structural Steel Shapes
  13. F436-19 – Standard Specification for Hardened Steel Washers
  14. F1554-20 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- D. American Welding Society (AWS)
1. AWS D1.1 – Structural Welding Code – Steel, latest edition.
  2. AWS D1.8 – Structural Welding Code – Seismic Supplement, latest edition.
- E. National Association of Architectural Metal Manufacturers (NAAMM)
1. Pipe Railing Systems Manual, latest edition
- F. Occupational Safety & Health Administration (OSHA)
1. Regulations (Standards – 29 CFR) Part 1926 – Safety and Health Regulations for Construction
- G. Society for Protective Coatings (SSPC)
1. SP 2 – Hand Tool Cleaning
  2. SP 3 – Power Tool Cleaning
  3. SP 6 – Commercial Blast Cleaning
- 1.4 SUBMITTAL
- A. Submittals shall be in accordance with Division 1.
- B. Shop Drawings:
1. Contractor shall submit the structural steel shop drawings to City Representative for review and approval, showing list of materials, sizes, and dimensions.
  2. Contractor shall coordinate with architectural, structural, mechanical, and electrical Contract Drawings for the location of penetrations.
  3. Structural steel shall not be fabricated or erected before the shop drawings are reviewed and approved by the City Representative, and returned to the Contractor. Such review does not relieve the Contractor from the full responsibility for both the accuracy of these shop drawings, and the accurate and complete erection of the work.
  4. Shop drawings shall not be reproductions of the Contract Documents, nor shall they use or incorporate reproductions of parts of the Contract Documents.



- C. Mill Test Reports: Certified mill test reports (tensile and bending), for each heat or melt of steel, showing physical and chemical analyses, shall be submitted to the City Representative for review and approval before the material delivery to the job site.
- D. Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1 for each welded joint, including the following:
  - 1. Power source (constant current or constant voltage).
  - 2. Electrode manufacturer and trade name, for demand critical welds.

## 1.5 QUALITY ASSURANCE

- A. Welding:
  - 1. Performed by certified welders in compliance with AWS D1.1.
  - 2. Welders shall be duly qualified (test passed in the preceding 12 months) in the position in which they are to weld and the qualifications and specifications for workmanship shall comply with the AWS D1.1.
- B. Certifications:
  - 1. Prior to fabrication or shipment of materials to the job site, furnish certification of the manufacturer of the structural steel that materials furnished meets or exceeds requirements of ASTM standards specified or noted on drawings for each type of materials
  - 2. Prior to site welding operation, submit welders' written certification and qualification.
- C. Tolerances: All steel exposed to view shall be architectural steel, and tolerances as minimum shall comply with section 10 of AISC Code of Standard Practice.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Exercise care during unloading, storage and erection to avoid damage. Dumping on the ground is not permitted.
- B. Support material stored at the site completely free to the ground, and cover to avoid damage from the elements.

## PART 2 – PRODUCTS

### 2.1 GENERAL

- A. To ensure proper fitting of the work, field-verify critical dimensions at the jobsite prior to preparing of Shop Drawings and before product fabrication begins. Field fabrication will not be permitted.

### 2.2 MATERIALS

- A. Standard Structural Wide Flange Beams and Columns: ASTM A992,  $F_y = 50$  ksi
- B. Other Hot-Rolled Structural Steel Shapes: ASTM A36

- C. Steel Bars and Plates: ASTM A36 or ASTM A572
- D. Steel Pipe: ASTM A53, Grade B
- E. Hollow Steel Sections (HSS): ASTM A500, Grade B
- F. Shear Stud Connectors: ASTM A108
- G. Machine Bolts: ASTM A307, Grade A
- H. Anchor Rods and Threaded Rods: ASTM A36 or ASTM F1554
- I. High Strength Bolts: ASTM F3125 or ASTM A490.
- J. Nuts: ASTM A563
- K. Washers: ASTM F436
- L. Welding Electrodes: As permitted by AWS D 1.1. Where exposed and unpainted, select filler metal to match base metal.
- M. Paint (Primer): Fast-dry, lead- and chromate-free, rust-inhibitive shop primer; gray color.
- N. Tubular Railing: Conform to requirements of NAAMM Pipe Railing Systems Manual where same covers points not otherwise detailed or specified. Size as noted on the Contract Drawings.

## PART 3 – EXECUTION

### 3.1 PREPARATION

- A. Verification of Conditions:
  - 1. Verify anchor bolt locations, grouting and elevation of base and setting plates, and other material set by other Trades before commencing work.
  - 2. Notify City Representative of Work set by others which does not comply with specified tolerances. Do not erect materials upon such work until it has been satisfactorily corrected.

### 3.2 ERECTION

- A. Erect Work to the proper lines and levels, plumb and true, and in correct relation to other Work. Maintain this condition to completion.
- B. Connections:
  - 3. Machine Bolting:
    - a. Fair-up holes with pins to align holes before bolting.
    - b. Ream unfair holes to obtain
    - c. Enlargement of holes with drift pins or burning of new holes is not permitted.
    - d. Draw bolts up tight after member are aligned and leveled, and set or deform threads to prevent loosening.

4. Welding:
    - a. Weld by shielding arc method per AWS standard code for arc and gas welding in building construction.
    - b. Submit certification that welders have passed AWS code qualification tests.
    - c. Certification must be dated no earlier than 3 months prior to beginning of project.
    - d. Refer to Shop Drawings for weld size and dimensions.
    - e. Close joints exposed to weathering with continuous 1/8 inch weather welds.
    - f. Grind smooth exposed welds, but grinding shall not reduce weld strength or required cross section.
    - g. Protect finish material from damage due to welding.
    - h. Remove unsatisfactory welds by chipping or arc air method.
  5. Connect members temporarily and align completely before making permanent connections.
    - a. Temporary conditions shall consist of bolts in not less than 1/3 of the holes and in no case less than 3 bolts in any single connection.
    - b. Surfaces in contact shall be thoroughly clean when assembled.
    - c. Provide necessary temporary bracing and guying to align the structure properly for permanent connection and safely resist erection dead load and wind stress.
    - d. Take particular care to have the work plumb and level (maximum tolerance 1 to 500 for interior member, 0 to 1000 for exterior members) before making permanent connection.
    - e. Remove bracing and guys only after permanent alignment and assembly and structure is capable of completely sustaining design and temporary construction loads.
- C. Exposed Steel:
1. Verify the condition of exposed steel after erection.
  2. Exert particular care to provide a neat, accurate installation with members straight and true, corners and edge square, sharp and free from burrs and irregularities, adjacent members perfectly matched and no bolts or rivets exposed.
  3. Removed erection bolts and seats and plug weld and grind holes smooth.
  4. All exposed steel shall be hot-dipped galvanized.
- D. Field Painting.
1. Spot paint abrasions, field bolts and field welds with same paint used for shop coat.

### 3.3 CLEANING

- A. During the course of work and on completion of the work, remove excess materials, equipment and debris and dispose of away from premises.

- B. Leave work ready to receive fireproofing when applicable.

END OF SECTION

## SECTION 05 53 00

## METAL GRATING

## PART 1 – GENERAL

## 1.1 SECTION INCLUDES

- A. This specification section governs the furnishing, materials, storage and handling, and installation of metal grating.

## 1.2 RELATED SECTIONS

- A. Section 05 12 00 – Structural Steel Framing

## 1.3 REFERENCE STANDARDS

- A. San Francisco Building Code (SFBC) 2022
- B. American Institute of Steel Construction (AISC)
  - 1. Steel Construction Manual, 16<sup>th</sup> Edition
- C. AWS - American Welding Society
  - 1. D1.1 – Structural Welding Code – Structural Steel, latest edition.
- D. American Society for Testing and Materials (ASTM) Standards
- E. California Department of Industrial Relations (CAL/OSHA)

## 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Grating shall withstand the effects of gravity loads and the following loads and stresses within limits and under condition indicated:
  - 1. Walkways and elevated platforms: Uniform live load of 100 psf.
  - 2. Limit live load deflection to L/240 or ¼ inch, whichever is less.

## 1.5 SUBMITTALS

- A. Submittals shall be in accordance with Division 1.
- B. Shop Drawings:
  - 1. Contractor shall submit the structural steel shop drawings to City Representative for review and approval, showing list of materials, sizes, and dimensions.
  - 2. Contractor shall coordinate with architectural, structural, mechanical, and electrical Contract Drawings for the location of penetrations.
  - 3. Structural steel shall not be fabricated or erected before the shop drawings are reviewed and approved by the City Representative, and returned to the Contractor. Such review does not relieve the Contractor from the full

responsibility for both the accuracy of these shop drawings, and the accurate and complete erection of the work.

4. Shop drawings shall not be reproductions of the Contract Documents, nor shall they use or incorporate reproductions of parts of the Contract Documents.

- C. Mill Test Reports: Certified mill test reports (tensile and bending), for each heat or melt of steel, showing physical and chemical analyses, shall be submitted to the City Representative for review and approval before the material delivery to the job site.

## 1.6 QUALITY ASSURANCE

### A. Welding:

1. Performed by certified welders in compliance with AWS D1.1.
2. Welders shall be duly qualified (test passed in the preceding 12 months) in the position in which they are to weld and the qualifications and specifications for workmanship shall comply with the AWS D1.1.

### B. Certifications:

1. Prior to fabrication or shipment of materials to the job site, furnish certification of the manufacturer of the structural steel that materials furnished meets or exceeds requirements of ASTM standards specified or noted on drawings for each type of materials
2. Prior to site welding operation, submit welders' written certification and qualification.

- C. Tolerances: All steel exposed to view shall be architectural steel, and tolerances as minimum shall comply with section 10 of AISC Code of Standard Practice.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Exercise care during unloading, storage and erection to avoid damage. Dumping on the ground is not permitted.
- B. Support material stored at the site completely free to the ground, and cover to avoid damage from the elements.

## PART 2 – PRODUCTS

### 2.1 GENERAL

- A. To ensure proper fitting of the work, field-verify critical dimensions at the jobsite prior to preparing of Shop Drawings and before product fabrication begins. Field fabrication will not be permitted.

### 2.2 MATERIALS

- A. Steel Grating: Type 19-W-4 with bearing bar, galvanized. Leading edge shall be 1-1/4" x 1/8" checker plate. Paint leading edge strip yellow.

- B. Steel Grating Treads: Type 19-W-4 with bearing bar, galvanized. Nosing shall be 1-1/4" x 1/8" checker plate. Paint nosing strip yellow.
- C. Machine Bolts: ASTM A307, Grade A
- D. High Strength Bolts: ASTM A325 or ASTM A490
- E. Nuts: ASTM A563
- F. Washers: ASTM F436
- G. Welding Electrodes: As permitted by AWS D 1.1. Where exposed and unpainted, select filler metal to match base metal.
- H. Paint (Primer): Fast-dry, lead- and chromate-free, rust-inhibitive shop primer; gray color.

### 2.3 FASTENERS

- A. General: Unless otherwise noted, provide Type 316 stainless-steel fastener for exterior use and zinc-plated fastener with coating complying with ASTM B 633, Class Fe/Zn 5. Select fastener for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening stainless steel.

### 2.4 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and 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.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

## 2.5 GRATING FRAMES AND SUPPORTS

- A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
  - 1. Unless otherwise noted, fabricate from same basic metal as gratings.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- E. Fit exposed connections accurately together to form hairline joints.
  - 1. 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 the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. 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.
- G. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- H. Attach non-removable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.



**3.2 CLEANING**

- A. During the course of work and upon completion of the work, remove excess materials, equipment and debris and dispose of away from premises.
- B. Leave work ready to receive fireproofing when applicable.

END OF SECTION



## SECTION 09 90 00 – PAINTING &amp; COATING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES BUT IS NOT LIMITED TO:

- A. This specification covers preparation of surfaces and completion of coating of all sewage piping, and painting of pipe hangers.
- B. All materials delivered to the jobsite/painting shop shall be in the original sealed and labeled container of the coating manufacturer.

## 1.2 SCOPE

- A. Structural items to be painted include, but are not limited to, the following:
  - 1. Galvanized Surfaces where components are covered under Divisions : Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- B. Mechanical items to be painted include, but are not limited to, the following:
  - 1. Painting includes field-painting exposed bare and covered pipes (including color coding), hangers, supports, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
  - 2. Supports.
  - 3. Accessory items.
  - 4. Operating parts not to be painted include moving parts of operating equipment, such as the following:
    - a. Hardware such as nut, washers and bolts.

## 1.3 RELATED SECTIONS

- A. All Division 22 Specification Sections
- B. All Division 33 Specification Sections

## 1.4 SUBMITTALS

- A. Submit complete product data and four (4) samples, 8 inches by 10 inches, of each color for painting and finishing sufficiently in advance so that no delay shall occur in the work. The submittals shall include, but not limiting to, the following:
  - 1. Product Data:  
Submit manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
  - 2. Material List:

Provide an inclusive list of required coating materials. Indicate each material with specific coating, finish system, color designation, sheen, and application methods. Identify each material by the manufacturer's catalog number and general classification.

3. VOC Compliance:  
Provide manufacturer's certified documentation that products supplied comply with local regulations controlling use of volatile organic compounds.
4. Samples for Initial Color Selection:  
Submit samples in the form of manufacturer's color.
5. Applicator qualification:  
Submit the year of experience which is similar to this project. Similar projects in the past 5 years with reference's contact phone number.

## 1.5 REFERENCE STANDARDS

- A. Perform surface preparation in strict accordance with the methods currently published by the Steel Structures Painting Council (SSPC) as listed in this Section.
- B. Comply with the safety coating colors specified in the Occupational Safety and Health Standards, Section 1910.44, "Safety Color Code For Marking Physical Hazards". Parts of mechanical equipment to be painted with these colors are identified in these OSHA Standards. Such equipment includes but is not limited to: belt guards; emergency stop buttons for machinery; dangerous parts of machines which may cut crush, shock or otherwise injure operating personnel. The Contractor shall identify such requirements and provide safety color coatings accordingly.
- C. Standard coating terms defined in ASTM D16 (latest version) apply to this section.

## 1.6 QUALITY ASSURANCE

- A. Applicator Qualification  
A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Single Source Responsibility  
Provide primers and intermediate coats for each coating system from the same manufacturer as the finish coats.
- C. Material Compatibility  
Provide primers and intermediate coats for each coating system from the same manufacturer as the finish coats.
- D. Material Quality  
Provide the manufacturer's best quality paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification is not acceptable.
- E. Project Conditions  
Apply paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45°F and 95°F (7°C and 35°C). Do not paint in snow, rain,

fog or mist, when the relative humidity exceeds 85 percent, at temperature less than 5°F (3°C) above dew point, or to damp or wet surfaces.

1.7 WARRANTY

- A. Furnish a two (2) year Warranty for work covered by this section per the requirements of Section 01 78 36, "Warranties."

PART 2 PRODUCTS

2.1 UNDER-PIER CAST IRON SEWAGE PIPE MARINE COATING

- A. Manufacturers:
  - 1. PPG – Protective & Marine Coating

COATING SYSTEM No.	SUBSTRATE	SURFACE PREP.	PRIMER	DFT MILS	FINISH	DFT MILS
1	Cast Iron Pipe	SP.1 & SP.6 commercial blast cleaning	-	10-12	PPG Amercoat 240	12
2	Galvanized Steel, Submerged Sewage	-	-	10-12	PPG Amercoat 240	12

2.2 STRUCTURAL, MECHANICAL AND ELECTRICAL PAINTING SYSTEMS

- A. Manufacturers:
  - 1. International - Heavy Duty Group
  - 2. Ameron
  - 3. Sinclair
  - 4. Or equal.
- B. Coating Systems: Indicated in the table below, primer and finish numbers shown are based on International as the manufacturer.

(DFT = Dry Film Thickness)

COATING SYSTEM No.	SUBSTRATE	SURFACE PREP.	PRIMER	DFT MILS	FINISH	DFT MILS
1	Steel, Submerged Sewage	SP.1 & SP.10	Intertuf 708	8	Intertuf 708	8
2	Galvanized Steel, Submerged Sewage	SP.1 & SP.7	Interline 982	2	Intertuf 708	16
3	Structural Steel, Zinc Coated	SP.1 & SP.2,		0	Interseal 385	6-8

COATING SYSTEM No.	SUBSTRATE	SURFACE PREP.	PRIMER	DFT MILS	FINISH	DFT MILS
4	Galvanized Steel, Non-Submerged	SP.1 & SP.2		0	Interseal 385	6-8
5	Steel, Submerged Potable Water	SP.1 & SP.10	Interline 925	5	Interline 925	5
6	Steel Submerged, Treated Sewage	SP.1 & SP.10	Interline 925	5	Interline 925	5
7	Black Iron Piping	SP.1 & SP.6		0	Interseal 385	6-8
8	Insulated Piping	Clean & Dry	Intercryl 530	2	Intercryl 530	2
9	Steel Stacks, Breeching, Manifolds, etc. (to 800 deg. F)	SP.1 & SP.10	Interterm 875	1	Interterm 875	1
10	Steel Buried In Concrete	SP.1 & SP.2		4	7100	12
11	Asphalt Coated Pipes	Clean and Dry	Intercryl 530	2	Intercryl 530	2
12	Motors, Pumps, Compressor (Factory Primed)	SP.1	Interseal 670HS		Interthane 990HS	2
13	Copper Piping	clean/ dry			Interthane 990HS	2
14	Cast Iron/ Ductile Iron				Interthane 990HS	2
15	(Outdoor Exposed) PVC Pipe	Solvent Wipe	Interseal 670HS	2	Interthane 990HS	2
16	Stainless Steel (304, 316)	SP.1 & SP.2			Interthane 990HS	2
17	FRP Duct and Equipment	Solvent Wipe	Interseal 670HS	2	Interthane 990HS	2

## 2.2. SAFETY COATINGS:

- A. American Standard OSHA colors; OSHA orange, yellow, red, blue, green, white, black.
- B. Use colors specified to comply with the Occupational Safety and Health Standards, Section 1910.44, "Safety Color Code for Marking Physical Hazard." Parts of mechanical equipment to be painted with these colors are specified in this particular section of the OSHA standards.

## PART 3 EXECUTION

### 3.0 DELIVERY, STORAGE AND HANDLING

- A. Delivery materials to the job site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, product description, date of manufacture, color name, and manufacturer's thinning and application instructions.
- B. Store materials not in use in tightly covered containers in a well ventilated area at minimum ambient temperature of 45°F (7°C). Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

### 3.1 PREPARATION

- A. Under-pier Sewage Cast Iron Pipe: Prepare all under-pier cast iron sewage pipe surfaces in accordance with the procedures in SSPC-SP1 followed by SSPC-SP6 Commercial Blast Cleaning. Ensure all protective coating applied to the pipe during fabrication is removed prior to blasting. Prepared surface shall be a 2-3 mil angular blast profile.
- B. For other surfaces other than under-pier sewage pipe sewage, prepare surfaces as indicated in the tables above.
- C. Galvanized Metal: Prepare surface with procedure SP.1 followed by SP.7 or Galvaprep.

### 3.2 APPLICATION

- A. Apply coating systems in strict accordance with the manufacturer's written instructions and recommendations.
- B. Air and surface temperatures shall be applied within limits set forth by the manufacturer for the coatings being applied and work area shall be reasonably free of air-born dust at the time of application and while coating is drying.
- C. If a substrate requires a primer and several finish coats, apply painting in one prime coat and two finish coats, each of which shall be a different shade or hue so that a visual inspection can be made to verify the number of coats applied.
- D. In the event that the requirements of this Section conflict with any manufacturer's specific coating or painting requirements for the service intended by the Contract Documents, the more stringent requirement or standard shall govern.

- E. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

### 3.3 ACCEPTANCE OF WORK

- A. All surface preparation and repairs shall be approved by the Engineer or Inspector before primer is applied. Request acceptance of each coat by engineer or inspector before applying in next coat. Correct work that is not acceptable and request re-inspection by engineer/inspector.

END OF SECTION



## SECTION 09 97 23

## EPOXY COATING SYSTEM FOR SUMP AND VALVE BOX

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. This Section includes applying a 100% solid epoxy coating system, including surface preparation and prime coats to:
  - 1. Coat interior surface of valve boxes and wet well.

## 1.2 RELATED SECTIONS

- A. Section 01 33 00 - Submittal Procedures
- B. Section 01 77 00 - Closeout Procedures
- C. Section 33 45 10 – Main Submersible Pump
- D. Section 33 45 20 – Dewatering Pump

## 1.3 REFERENCES

- A. ASTM - American Society for Testing and Materials Standards
- B. NACE - National Association of Corrosion Engineers
- C. SSPC - Steel Structural Painting Council; Vol. 1, Good Painting Practice, Vol. 2, Systems and Specifications

## 1.4 SUBMITTALS

- A. General: Submit the following according to Section 01 33 00.
- B. Product data for each coating system specified, including top coats and primers.
  - 1. Provide the manufacturer's technical information, including instructions for handling, storing, clean up of material.
  - 2. List each material and cross-reference for specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification. Include thinner or solvent (for cleaning only) and abrasive grit material.
  - 3. Certification by the manufacturer that products supplied comply with all regulations controlling use of volatile organic compounds (VOCs).
- C. Submit Manufacturer's MSDS (Material Safety Data Sheet).
- D. Submit certification from manufacturer that coating system material provided conform to current specification or technical information submitted.
- E. Submit manufacturers batch numbers and dates of manufacture for coating system material to be provided under this contract.

- F. Samples for Verification Purposes: Provide samples of each material to be applied with texture to simulate actual conditions for each application.
1. Provide stepped samples, defining each separate coat, including top coats and primers. Use representative colors when preparing samples for review. Resubmit until the samples are acceptable to the Engineer.
  2. Submit samples on the following substrates for the Engineer's review of texture only.
    - a. Metal: Provide two 4-inch-square samples of flat metal for each finish.
- G. Submit coating inspection procedure (Refer to Article 3.4).
- H. Submit manufacturer's documented results for the following data for coating system materials to be provided under this contract determined in accordance with the listed ASTM standard.
- |                                 |   |            |
|---------------------------------|---|------------|
| 1. Weight in pound/gallon       |   | ASTM D2196 |
| 2. Specific gravity             |   | ASTM D1475 |
| 3. Percent solids by volume     | - |            |
| 4. Percent solids by weight     | - |            |
| 5. Air cure dry to re-coat time |   | ASTM D1640 |
| 6. Adhesion to steel substrate  |   | ASTM D4541 |
| 7. Adhesion between coats       |   | ASTM D4541 |
- I. Manufacturer's Instructions
1. Submit coating manufacturer's latest written instructions and recommendations for coating system materials storage, surface preparation, coating repair, application equipment, mixing and application of coating system, ventilation, and curing of coating system. Include maximum and minimum storage temperatures, maximum surface temperature, maximum time to re-coat without special preparation of paint surface, special preparation of paint surface when maximum re-coat time has been exceeded, and curing required prior to holiday detector test.
- J. Submit details of vacuum system for removing dust and abrasive from abrasive blast cleaned surfaces.
- K. Submit air compressor manufacturer's latest written instructions and recommendations for air compressor air filters and air filter change intervals.
- L. Provide manufacturer representative's certification for the installation.
- M. Submit warranties as specified in Article 1.8.

## 1.5 QUALIFICATIONS

- A. **Manufacturer Qualifications:** The manufacturer of the specified products shall have a minimum of 5 years experience in manufacturing 100% solids epoxy coating systems specifically for municipal waste water environments.
- B. **Contractor Qualifications:** Contractor shall have at least 5 years of experience in applying solvent free epoxy system. The Contractor shall provide 5 verifiable reference projects in coating steel in municipal waste water environments, in the last 5 years. References shall be notarized and submitted with the bid documents.
- C. **Applicator Qualifications:** Engage an applicator who has successfully completed a minimum of verifiable 3 years in applying solvent-free epoxy coating systems.
- D. **Single-Source Responsibility:** Provide primers and undercoat material produced by the same manufacturer as the finish coats for each type of coating.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label, and the following information:
  - 1. Name or title of material.
  - 2. Product description (generic classification or binder type).
  - 3. Manufacturer's name, stock number and date of manufacture.
  - 4. Contents by volume, for major pigment and vehicle constituents.
  - 5. Application instructions.
  - 6. Color and number.
  - 7. Handling instructions and precautions.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 70-80 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
  - 1. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to insure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying the coatings.

#### 1.7 ENVIRONMENTAL CONDITIONS

- A. Apply coatings only when the temperature of surfaces to be coated and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).
- B. Do not sand blast or apply coatings in rain, fog, or mist; when the relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
  - 1. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing the coating operation.

2. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and the temperature and relative humidity within the area can be maintained within limits specified by the manufacturer during application and drying periods.

## 1.8 WARRANTIES

- A. Special project warranty submit two copies of standard Coating Warranty, covering work of this Section including preparation, priming and finish coat, signed and countersigned by the Installer and the Contractor, for the following period of time:
  1. 2 years after date of Substantial Completion.
- B. Manufacturer's Warranty: Submit executed copy of coating manufacturer's Standard Warranty Agreement, covering primers and finish coating epoxy material, signed by an authorized representative of the Epoxy Coating System manufacturer, or form that was published with product literature as of date of Contract Documents for the following period of time:
  1. 2 years after date of Substantial Completion.

## 1.9 SAFETY

- A. Coating shall be performed in strict accordance with the safety recommendations of the coating manufacture; with the safety recommendations of the National Association of Corrosion Engineers, contained in the publication of painter safety; and FED, OSHA, CAL-OSHA and Bureau of Water Pollution Control.

## 1.10 MANUFACTURER SERVICES

- A. The coating manufacturer technical representative shall be available for on - site service.

## PART 2 PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Material Compatibility: Provide, finish coat, and related materials that are compatible with one another and the substrates indicated under conditions of service and application as demonstrated by the manufacturer based on testing and field experience.
- B. Material Quality: Provide the highest grade of the various coatings as regularly manufactured by acceptable coating manufacturers. Materials not displaying manufacturer's identification as a best-grade product will not be acceptable.
  1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials are not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish the manufacturer's material data and certificates of performance for proposed substitutions.

### 2.2 COATING REQUIREMENTS

- A. Apply the coating to the steel surfaces as follows:

1. Surface – Sandblasting in accordance with the requirements of SSPC-SP-10
2. Priming and Sealing – Apply one coat for a total MDFT (minimum dry film thickness) of 3 Mils by airless spary pump
3. Grouting/Lining – Apply two coats for a total of 150 Mils (75 Mils for each coating) by parastatic pump

B. Full cure must be obtained for the completed system. The Contractor shall follow the coating manufacturer's written instructions for these requirements.

### 2.3 ACCEPTABLE PRODUCTS

A. Provide 100% solid; solvent, sand and silica free 2-component epoxy system as follows:

1. Primer/sealer: Hydro-Prime 251 as manufactured by Con Tech of California (209) 941-8324
2. Grouting/Lining: Hydro-Pox 212 GL as manufactured by Con-Tech of California (209) 941-8324

### 2.4 MATERIAL PROPERTIES

A. Properties of Primer/Sealer

1. Vol, Solids: 100%
2. Vol.: 0 g/l
3. Flash Point: 213° F
4. Solids by WT: 100%

B. Properties of Grouting/Lining

1. Vol. Solids: 100%
2. Vol.: 0g/l
3. Flash Point: 213° F
4. Solid by WT: 100%

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Examine substrates and conditions under which coatings will be applied for compliance with requirements on applying coatings. Surfaces to receive coatings must be thoroughly dry before coatings are applied.

1. Do not proceed with coating application until unsatisfactory conditions have been corrected.
2. Start of application will be construed as the Applicator's acceptance of surfaces within that particular area.

### 3.2 PREPARATION

- A. All surfaces to be coated with HYDRO-POX 212 GI must be clean, sound, dry and have an "open" capillary system to ensure mechanical bond (surface adhesion). Remove all dirt, dust, cement laltance, efflorescence, form release agents, curing compounds, grease oils, growths, etc. by mechanical means, such as abrasive air blasting or jet water blasting at a minimum of 5000 psi., to achieve an anchor pattern similar to course sandpaper. For concrete, reference applicable standards ASTM D-4259 or NACE RPO892-92. For new concrete sandblast to open bug holes. All steel surfaces contained within structure to be lined shall be sandblasted to SSPC SP-10 minimum.

### 3.3 APPLICATION

- A. For optimum application properties pre-condition material to 70° – 80° prior to moding and application. Mix entire contents of A and B with a power mixer for a minimum of 3 minutes until a smooth homoganous consistency is obtained. Use a Jiffy Mixer or approved equal. Material is supplied as a unit. Always mix a complete unit. Do not apply material at temperatures below 40° F.
- B. The coating shall be applied in a single coat multiple pass application to achieve 80 mil minimum thickness for proper protection of waste water substrates. Successive coats must be applied within the recoat time period for proper bonding. For successive coats applied after the recoat interval has been exceeded, a sweep blast will be necessary to remove any gloss to achieve a 2-4 mil anchor pattern to achieve proper bonding.
- C. Eliminate pinholing and shadowing of the applied HYDRO-POX Grouting lining system by pre-conditioning material to 70 – 80 F, and by using cross spray methods when applying. Always use a multiple pass spray method when applying.
- D. Complete cure of HYDRO-POX will take 7 days. Down time is avoided by allowing a sturcture to be immersed following a thin film set. In the case of high velocity water running through the structure a 24 hr. cure time is required.

### 3.4 QUALITY ASSURANCE

- A. Refer to Drawings for locations of Epoxy Coating System described in this Section.
- B. Manufacturer's written instructions for applying each type of paint or protective coating shall be submitted to the Engineer prior to application. Cleaned surfaces and all coats shall be inspected prior to the succeeding coat. Schedule such inspections accordance with the Certified Inspector and Engineer one (1) day in advance. Stripe brush coating of the welded joints shall be done before any coating of the pipe. Apply all coatings in strict reviewed and approved by the Engineer.
- C. Film Thickness
  - 1. Coverage is listed as the total minimum dry film thickness (MDFT) in mils. The number of coats is the minimum required regardless of the minimum required paint thickness and depends on the application method, differences in manufacturer's products and atmospheric conditions. Maximum film build per coat shall not exceed the coating manufacturer's recommendations.
  - 2. Film thickness measurements and electrical inspection of the coated surfaces shall be performed by the Certified Inspector. Re-coat and repair as necessary

for compliance with the manufacturer's standard requirements. All coats will be subject to inspection by the Certified Inspector.

3. Particular attention shall be given to edges, angles, flanges, etc. Where insufficient film thickness are likely to be present, ensure proper millage in these areas.
  4. After repaired and re-coated areas have dried sufficiently, final tests will be conducted by the certified inspector per Article 3.5.
- D. The Contractor shall allow a complete curing period of 7 days.

### 3.5 INSPECTION

- A. The entire procedure of the three facets, surface preparation, application of the coating and the coating material itself, making up the total coating system, must be rigidly inspected. Such inspection shall not relieve the Contractor of its responsibility to furnish material and perform work in accordance with this installation application data.
- B. When an Inspector is furnished by the owner, all coating work shall be done in the presence of the inspector. Any coating work done in the absence of the inspection is subject to rejection unless specifically allowed by the Inspector.
- C. The coating shall not have cracks, voids, mechanical damage, holidays, pinholes, or discontinuities. The use of high voltage spark testers is an acceptable means of holiday or pinhole detection. Use Tinker Razor APW or approved equal.
- D. At the inspectors' discretion random samples may be taken to assure adhesion and specified film thickness. Use Elcometer model 106 or approved equal.
- E. For areas with low coating thickness, see section 4.2. For pinholes use a conical shaped die grinder bit, open void completely, blow down with clean dry air. Fill voids displacing air with HYDRO-POX. Repeat spark testing.

### 3.6 CLEANING

- A. Cleanup: At the end of each work day, remove rubbish, empty cans, rags and other discarded materials from the site.
  1. After completing work, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

### 3.7 PROTECTION

- A. Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as acceptable to the Engineer. Leave in an undamaged condition.
  1. Upon completion of other trades' construction activities, touch up and restore damaged or defaced coated surfaces.

END OF SECTION



## SECTION 12 93 00

## SITE FURNISHINGS

## PART 1 - GENERAL

## 1.01 SCOPE

- A. Provide all material, labor, and equipment for complete fabrication, and services necessary for the furnishing and installation of all site furniture items, as shown on the Drawings and as specified herein. The work of this Section includes but is not limited to:
1. Recycled Granite Curbs
  2. Mortared Cobble at Stormwater Planters

## 1.02 RELATED SECTIONS

- A. Section 02 41 00 – Demolition  
B. Section 02 13 13 - Concrete

## 1.03 SUBMITTALS

- A. General: Submittals to be in accordance with Section 01 33 00 Submittal Procedures.

## B. MOCK UP

## Recycled Granite Curbs:

1. Contractor to provide 2 (two) full size mock-ups on site, one of shorter planter length at 8' and one of longer length at 16' as indicated on the drawings.
2. Contractor to construct recycled granite curbs from salvaged granite curbs from City of San Francisco Treasure Island facility. For complete installation in accordance with drawings and as specified, refer for Landscape drawings and Specifications. See Section 02 41 00 – Demolition.
3. Power Wash: All granite curb segments of mock-up to receive heavy-duty power wash at all outside facing concrete surfaces. City Representative to approve quality of power wash. Approved Mock-up shall be used to establish the standard against which the completed work shall be judged.
4. Approved quality and workmanship of Mock-up shall be used to establish the standard against which the completed work shall be judged. Saw-cut edges of granite shall be smooth and clean cuts, free of sharp edges. Edges are to be eased. Mock-up will be approved based on conformance to drawings.
5. The mock up shall demonstrate quality of cut granite, and adherence to all other performance standards detailed in this section.
6. Contractor shall alter, revise, or reconstruct mock-up up to (3) times as directed to obtain approval of City Representative.
7. If the contractor chooses, a full scale recycled granite curb edging may be submitted as the mock-up, and then, if approved, incorporated into the completed work, if in the same condition as new at time of final acceptance.
8. Contractor shall be responsible for all storage and transportation of recycled granite curb segments within project area.

## Mortared Cobble:

1. Contractor to provide 1 (one) full size mock-up on site.
2. Approved quality and workmanship of mock-up shall be used to establish the standard against which the completed work shall be judged. Mock up will be approved based on conformance to drawings.

3. The mock up shall demonstrate quality of workmanship of mortared cobbles in reinforced mortar bed with burial of cobbles and size of joints conforming to the Drawings.
4. Workmanship of cobbles in mortar bed to be clean, and set cobbles are to be free of messy mortar residues.

#### 1.04 QUALITY ASSURANCE

- A. Workmanship and materials: All workmanship and materials within this section shall conform to these specifications for installation.
- B. The Contractor agrees to hire qualified subcontractors and workers with demonstrable experience in fabrication, handling, protection, and installation of granite curbs or masonry.
- C. Qualifications:
  1. At least 5 years' demonstrable experience in masonry, stonework, or installation of granite curbs.

#### 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Granite curbs shall be picked up at City of San Francisco salvage yard located on Treasure Island. Ask City Representative for address and contact information.
- B. Granite curbs shall be delivered and unloaded at job site in such a manner that no damage occurs to the product during hauling, handling, or unloading at the job site.
- C. Cobbles shall be delivered and unloaded at job site in such a manner that no damage occurs to the product during hauling, handling, or unloading at the job site.

#### 1.06 SUBSTITUTIONS, ADDITIONS, AND DELETIONS

- A. No substitutions, additions and deletions exist for recycled granite curb. Installation is to conform to these specifications and drawings.
- B. In the event that specified dry creek cobbles are not available, a substitution may be considered if size, shape and color are similar to specified herein and approval from City Representative must be obtained.

#### 1.07 WARRANTY

- A. The Contractor shall furnish a two (2) year Warranty for installation by this Section per the requirements of Section 01740.

#### 1.08 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  1. ASTM C97 - Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
  2. ASTM C99 - Test Method for Modulus of Rupture of Dimension Stone.
  3. ASTM C170 - Test Method for Compression Strength of Dimension.
  4. ASTM C241 - Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic.
  5. ASTM C270 - Mortar for Unit Masonry.
  6. ASTM C880 - Flexural Strength of Dimensional Stone.

## PART 2 - PRODUCTS

### 2.01 SITE FURNISHINGS

- A. General: All site furnishing shall be as noted and/or Drawings and herein:
- B. Recycled Granite Curbs:
  - a. See drawings for locations, sizes and quantity. Final locations to be determined in the field by City Representative.
  - b. Sawcutting/Stone cutting: No rough or sharp edges will be allowed at saw cut edges. Grind smooth sharp exposed edges.  
Footing: All recycled granite segments to be mounted in concrete footing with mortar setting bed, see drawings.  
Powerwash: All recycled granite segments to receive heavy-duty power wash at all outside facing concrete surfaces of planters. City Representative to approve quality of heavy-duty power wash. If necessary, two rounds of heavy-duty power wash may be requested at no extra expense to the City.  
Note: See required Mock-ups. See: Section 02 41 00 – Demolition. Contractor to properly replace any segments which sustain significant damage to the satisfaction of the City Representative.
  - c. Joints: Mortar color to match color of granite curbs. Mortar product shall be:
- C. Mortared Cobbles
  - a. See drawings for locations, sizes and quantities. Final locations to be approved in the field by City Representative.
  - b. Cobbles to be 4"-6" size Dry Creek Cobbles from Lyngso or approved equal.
  - c. Reinforced Mortar Bed
    - i. Mortar color to match color of cobbles.
    - ii. 4.0/4.0 Welded Wire Mesh

## PART 3 - EXECUTION

### 3.01 LAYOUT OF RECYCLED GRANITE CURBS

- A. Layout: Layout granite curbs according to the locations and dimensions shown on the Drawings.
- B. Install all curbs level, plumb and per Drawings.
- C. Adjustments: The City Representative reserves the right to make adjustments as needed without additional cost to the City.

### 3.02 PROTECTION

- A. Protect installed granite curbs, if required, during the construction period to prevent damage, and wear.

### 3.03 EXAMINATION

- A. Examine areas to receive granite curbs.
- B. Notify City Representative of conditions that would adversely affect installation or subsequent use.
- C. Do not begin installation until unacceptable conditions are corrected.

## 3.04 INSTALLATION

- A. Install granite curbs in accordance with these specifications at locations indicated on the Drawings.
- B. Install curbs level and plumb.
- C. Set granite curbs securely in concrete footings per drawings.
- D. Install mortar joints in between granite curb segments per drawings.

## 3.05 ADJUSTING

- A. Finish Damage: Repair minor damages to finish in accordance with specifications and drawings and as approved by City Representative.
- B. Component Damage: Remove and replace damaged components that cannot be successfully repaired as determined by City Representative.

## 3.06 PROTECTION

- A. Protect installed benches to ensure that, except for normal weathering, benches will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

## SECTION 22 04 00

## GENERAL REQUIREMENTS FOR PLUMBING

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. Specifications and Drawings
- B. Description of Work
- C. Protection of Equipment
- D. Quality Assurance
- E. Substantial Completion
- F. Title 24 Compliance
- G. Review of Construction Work
- H. Manufacturer's Instructions
- I. Substitutions
- J. Submittals
- K. Operating and Maintenance Manuals
- L. Product Delivery, Storage, And Handling
- M. Contract Drawings And Coordination With Other Work
- N. Project Record Drawings
- O. Damage Responsibility
- P. System Acceptance
- Q. Preliminary Operation
- R. Equipment Identification
- S. Miscellaneous Requirements

## 1.02 SCOPE OF SECTION

- A. The requirements of this Section shall apply to all work of Divisions 22 and 33.

- B. Provide all labor, materials, supervision and incidentals and perform all operations necessary for the installation of complete and operable mechanical systems as specified herein, including those which are shown on the Drawings and those which can be reasonably inferred.

### 1.03 SPECIFICATIONS AND DRAWINGS

- A. When equipment is specified by manufacturer's name and catalog designations, published data in effect on the date of Bid Opening is to be considered a part of this Specification.

### 1.04 DESCRIPTION OF WORK

- A. Provide all plumbing, piping, heating, ventilating, filtration, painting and other related mechanical work as indicated on the Drawings and in Specification Divisions 22 and 33.
- B. Determine all items and quantities required. Provide complete, automatic, continuous, operational and functioning systems, fully coordinated with the work of other sections.
- C. Repair all damage done to premises and remove all debris left by those engaged in this installation.
- D. Provide trenching, excavation and backfilling for the work of Division 22.
- E. Provide all rigging transportation and hoisting necessary for the placement of all mechanical equipment in the final locations shown.
- F. Provide any necessary disassembly and re-assembly of any equipment furnished under Division 22 should this be required in order to move equipment into final locations shown on the Drawings.
- G. Provide all labor, material, tools, appliances and equipment required to furnish and install the complete installation for Division 22 including that which is reasonably inferred.
- H. Cooperate with other crafts in putting all mechanical installations in place.
- I. Provide temporary scaffolding necessary for performance of the work in Division 22.
- J. Provide all cutting and patching for the work of Division 22 including pipe sleeves for all holes in walls, roofs, floors and ceilings.
- K. Provide waterproofing as necessary for the installation work of Division 22.
- L. Provide painting and coating systems for all equipment furnished under Division 22.
- M. Provide and install curbs and pads at locations shown on the Drawings.

### 1.05 PROTECTION OF EQUIPMENT

- A. The Contractor shall be responsible for damage to any of the work or premises prior to acceptance by the City. Should any new or existing equipment become damaged, the Contractor shall restore it to its original condition and finish before final acceptance. Damage to City property or to the work of other Divisions, caused by the work of this Division shall be replaced or repaired by, and at the expense of, the Contractor to the satisfaction of the Engineer. All exposed materials shall be clean at the time of acceptance of the installation for Substantial Completion.

## 1.06 QUALITY ASSURANCE

### A. Requirements Of Regulatory Agencies

Provide work in accordance with applicable Standards, codes and recommendations including, but not limited to the following partial list of agencies:

1. American Society Of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
2. Air Movement And Control Association (AMCA)
3. Air Conditioning and Refrigeration Institute (ARI)
4. American Gas Association (AGA)
5. American Society Of Mechanical Engineers (ASME)
6. Occupational Safety And Health Administration (OSHA)
7. California Mechanical Code (CMC)
8. California Plumbing Code (CPC)
9. National Fire Protection Association (NFPA)
10. Underwriter's Laboratories (UL)
11. Factory Mutual (FM)
12. California Electric Code (CEC)
13. National Electric Manufacturer's Association (NEMA)
14. City and County of San Francisco Plumbing Code
15. City and County of San Francisco Building Code
16. City and County of San Francisco Electrical Code
17. Office Of The California State Fire Marshall
18. American National Standards Institute (ANSI)
19. American Water Works Association of Plumbing Officials (AWWA)

20. American Air Balance Council (AABC)
  21. California Administrative Code (CAC)
  22. Cast Iron Soil Pipe Institute (CISPI)
  23. Commercial Standards (CS)
  24. International Association of Plumbing Officials (IAPMO)
  25. National Bureau of Standards (NBS)
  26. National Certified Pipe Welding Bureau (NCPWB)
  27. National Environmental Balancing Bureau (NEBB)
  28. Sheet Metal & Air Conditioning Contractor's Association (SMACNA)
- B. Nothing in the Contract Documents shall be construed to permit work not conforming to the applicable laws, ordinances, rules and regulations.
- C. When requirements of the Contract Documents exceed requirements of applicable laws, ordinances, rules, or regulations, the requirements of the Contract Documents shall take precedence.
- D. It is not the intent of the Contract Documents to repeat requirements of codes except where necessary for completeness or clarity.
- E. Provide without extra charge, any additional material and labor when and where required to comply with the Regulations and Standards, through the work be not mentioned in these specifications or shown on the drawings. When these specifications or drawings call for or describe materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of these specifications and accompanying drawings shall take precedence.

#### 1.07 SUBSTANTIAL COMPLETION

- A. Refer to Section 01 77 00 – Closeout Procedures: Article 1.3 of these Specifications for conditions required to achieve Substantial Completion.
- B. Substantial Completion for items of Mechanical equipment covered under Division 22, shall require satisfactory operation for a period of one (1) week following all testing, startup and commissioning requirements.
- C. The Contractor shall provide the manufacturer's recommended maintenance to equipment, controls, associated components and materials furnished under this Contract immediately after the system is placed in productive use until approval of the Contractor's application for final payment has been approved.

#### 1.08 TITLE 24 COMPLIANCE

- A. The entire mechanical installation shall comply with all requirements of Title 24 of the California Administrative Code.



### 1.09 REVIEW OF CONSTRUCTION WORK

- A. Work may be reviewed at any time by the Engineer.
- B. Advise the Engineer that the work is ready for review at the following times:
  - 1. Change of Contract Work, including but not limited to equipment and piping runs, orientations and detailed installations other than that previously approved by the Engineer.
  - 2. Work not shown in the Contract Drawings or submittals but are required for the completion of the Contract.
  - 3. When requirements of the Contract call for review by the Engineer.
  - 4. Equipment testing and start-up.
  - 5. Prior to concealment of work in walls, roofs and above ceilings.

### 1.10 MANUFACTURER'S INSTRUCTIONS

- A. The Contractor shall obtain and pay strict attention to equipment manufacturer's instructions in all cases. Where such instructions are in conflict with the Drawings and Specifications, the Engineer shall be consulted before installing the work.

### 1.11 SUBSTITUTIONS

- A. Refer to Section 01 25 13 of these Special Provisions.
- B. Do not offer substitutions unless a thorough check of the field condition is made. In the event that a substitution is permitted, the Contractor shall furnish Drawings of revised arrangements caused by Substitutions.
- C. If the approved substitution affects system design or the required size or capacity of other equipment, piping, electrical work, etc., the Contractor shall make necessary changes as directed by the Engineer. All engineering and materials costs attributed to the approved substitution shall be borne by the Contractor without additional cost to the City.

### 1.12 SUBMITTALS

- A. Submit all materials and equipment provided in accordance with Section 01 33 00 and/or 01 77 00.
- B. Quality of Materials: Significance of Names: Equipment and materials used on this job shall be new and of the best quality. Any material on the site which cannot be identified by manufacturer's mark shall be removed from the site at the Construction Manager's request. When specific trade names are used in connection with materials they are mentioned as standards, but implies no right on the part of the contractor to substitute other materials or methods without permission of the Architect.
- C. Materials Lists:

1. A list of items as listed on the schedule and specified hereinafter, or the material and equipment which the Contractor proposes to use shall be submitted to the construction Manager.
  2. The proposal of any item as a substitute shall be accompanied by drawings, catalog materials, other data giving sizes, capacities, and other necessary information.
  3. Shop drawings submitted to show installation in greater detail shall not excuse the Contractor from the requirements of the contract drawings and specifications. Subsequent requests for changes and substitutions shall conform to other related provisions herein. Authorization to make such changes or substitutions will only be by written permission of the Architect.
  4. Shop drawings shall be furnished, where specified, noted on the drawings, or at the discretion of the Architect, for any items proposed to be substituted for those specified.
- D. Test of Equality: Burden of Proof: The decision of the Architect shall govern as to what material is equivalent to that name, but the burden of proof as to the quality of any proposed materials shall be upon the Contractor. If any tests are necessary to determine the quality of the proposed material, such tests shall be made at the expense of the Contract by an unbiased laboratory.
- E. Uniformity: For purposes of uniformity, only make and/or brand of materials will be accepted for each type of material used. Materials where applicable shall be listed by Underwriters' Laboratories, Inc., and shall meet their requirements and bear their label.
- F. Equipment specified by manufacturer's number shall include accessories and controls listed in the catalog as standard with the equipment. Optional or additional accessories shall be furnished as specified.
- G. Equipment and materials damaged during transportation, installation and operation shall be considered as "totally damaged" and shall be replaced with new. Any variance from this clause shall be made only with written approval of the Engineer.
- H. Prepare shop drawing submittals for items of equipment and material specified and indicated on the Drawings. Note that Seismic Restraint system shop drawings are also required.

#### 1.13 LUBRICATION OF MECHANICAL EQUIPMENT

- A. Prior to system testing and acceptance by the City, all mechanical equipment and equipment components requiring lubrication, greasing or periodic oil change, shall be given complete final lube and oil change. The type of lubricant shall be in strict conformance with the manufacturer's instructions.
- B. The Contractor shall be responsible to ensure that the above has been accomplished and he/she shall not permit any rotating or other mechanical equipment to be started until the Engineer has verified that the work described in Paragraph "A" above has been accomplished."
- C. The Contractor shall furnish complete data regarding lubricants, grease and lube oils required as a part of mechanical equipment Submittals, as follows:
  1. For Liquid Lubricants, specify:

- a. Viscosity grade in ISO units.
  - b. Viscosity in SUS units at 100 degrees F and/or 210 degrees F.
  - c. AGMA classification for gear oils.
  - d. SAE classification where applicable.
2. For Grease Lubricants, specify:
- a. NGLI number.
  - b. Thickener type and percent.
  - c. Dropping point.
  - d. Base oil viscosity range, in SUS units at 100 degrees F.

#### 1.14 FIELD MEASUREMENTS

- A. For purposes of clarity and legibility, Contract Drawings may be essentially diagrammatic to the extent that the exact location of equipment, piping, ductwork, fittings and miscellaneous devices need not be shown. Specific dimensions shall be governed by structural conditions and equipment already in place.
- B. The Engineer reserves the right, at no increase in Contract cost to make any reasonable change in the location of exposed mechanical items, to group them in orderly relationships and/or increase their utility. The Contractor shall verify the Engineer's requirements in this regard prior to roughing in.
- C. Mounting heights of brackets, outlets and similar items shall be as required shown on the Drawings.
- D. Verify in the field for exact location of outlets to center with architectural features, panels and similar items at the approximate locations shown on Mechanical Drawings.

#### 1.15 OPERATING AND MAINTENANCE MANUALS

- A. Provide operation and maintenance manuals covering mechanical systems and equipment in accordance with Section 01 78 23.
- B. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in. The manual shall be complete in all respects for equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:
  1. Wiring and control diagrams with data to explain detailed operation and control of each component. A control sequence describing start-up, operation and shutdown.
  2. Adjustments, maintenance and overhaul instructions.

3. Lubrication schedule including type, grade, temperature range and frequency.
4. Performance data.
5. Parts lists, with manufacturer's name and catalog numbers.
6. Service organization with name, address and telephone numbers.

#### 1.16 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 01 60 00 for Product Requirements for material and equipment.
- B. Protection: Use means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of other trades.
- C. Replacements: In the event of damage, immediately make repairs and replacements necessary for the approval of the Engineer and at no additional cost to the County.
- D. Identify materials and equipment delivered to site to permit check against Submittals list and shop drawings.
- E. Protect products and materials from loss or damage. Replace lost or damaged materials and equipment with new materials at no cost to the City.
- F. Following approval of the project submittals specified, undamaged products shall be delivered to the project site in manufacturer's sealed containers or wrappings with legends and labels intact.

#### 1.17 CONTRACT DRAWINGS AND COORDINATION WITH OTHER WORK

- A. Contractor's Shop Drawings
  1. For purposes of clarity and legibility, Contract Drawings may be essentially diagrammatic to the extent that the exact location of equipment, piping, ductwork, fittings and miscellaneous devices need not be shown. Specific dimensions may be governed by structural conditions and equipment already in place.
  2. The Engineer reserves the right, at no increase in Contract Price to make any reasonable change in the location of exposed mechanical items, to group them in orderly relationships and/or increase their utility. The Contractor shall verify the Engineer's requirements in this regard prior to roughing in.
  3. Mounting heights of brackets, outlets and similar items shall be as required.
  4. Verify in the field for exact location of outlets to center with architectural features, panels and similar items at the approximate locations shown on Mechanical Drawings.
- B. Contractor To Coordinate Work:
  1. Work out all "tight" conditions involving work of this Division and work of other Divisions in advance of installation. If necessary, and before work proceeds in

these areas, prepare supplementary Drawings and additional work necessary to overcome these "tight" conditions at no increase in Contract price.

2. Coordinate electrical interlocks of mechanical equipment with the work of Division 26 - Electrical.
3. Provide templates, information, and instructions for the work of other Divisions to properly locate holes and openings to be cut out or provided for mechanical work.

C. Large Scale Layout Drawings By Contractor:

Prepare large scale detailed layout Drawings showing locations of equipment, piping, control panels and all other elements of mechanical systems required to be provided as part of the work of this Division. Include sections of all congested areas to shown relative positions and spacing of affected elements. Symbols and designations used on record Drawings shall match those used in Contract Documents.

1.18 PROJECT RECORD DRAWINGS

- A. Provide and keep up to date a complete set of prints which shall be corrected regularly and shall show every change from the original contract drawings, including change orders and similar type work. This set of drawings shall be delivered to the Architect at the end of the job.
- B. Invert elevations of end points of sewers and depths and dimensions and locations of piping outside the building, including sewers and water lines and capped services for future extensions, shall be shown.

1.19 DAMAGE RESPONSIBILITY

- A. The Contractor shall be responsible for damage to the City's property including the grounds, buildings, ductwork, and services and the loss of refrigerants fuels or gases caused by leaks or breaks in pipes or equipment furnished or installed by this work.

1.20 SYSTEM ACCEPTANCE

- A. Final Review: The Contractor shall request a final review prior to the system acceptance after:
  1. Completion of the installation of all systems required under the Contract Documents.
  2. Submission and acceptance of all operating and maintenance manuals.
  3. Completion of the ductwork cleaning process.
  4. Satisfactory operation of all systems for a period of at least one week.
- B. Acceptance shall be contingent upon:
  1. Completion of final review and correction of all deficiencies.

2. Satisfactory completion of the acceptance tests which shall demonstrate compliance with all performance and technical requirements of the Contract Documents.
3. Satisfactory completion of the O&M training program and submission of all O&M manuals and Drawings required by the Contract Documents.
4. Providing the maintenance tools and spare parts required by the Contract Documents.

#### 1.21 PRELIMINARY OPERATION

- A. The City reserves the right to operate portions of the mechanical system on a preliminary basis without voiding the Warranty or relieving the Contractor of his responsibilities.

#### 1.22 EQUIPMENT IDENTIFICATION

- A. Items of mechanical equipment such as control panels, air conditioning and fan units, shall be identified by approved nameplates. Nameplates shall bear notations corresponding to the same notations corresponding to the same notations on the Drawings.
- B. Nameplates shall be Aluminum, 2-1/2 inch x 3/4 inch with a black enamel background with etched or engraved natural aluminum lettering.
- C. Provide nameplates at each thermostat indicating which AC unit is being controlled. Nameplates shall be aluminum 1-1/2 inch x 1/2 inch (approximate) with black enamel background with etched or engraved natural aluminum lettering.

#### 1.23 MISCELLANEOUS REQUIREMENTS

- A. Adequate clearance for maintenance and repair access to all mechanical equipment shall be maintained. Manufacturer's clearance requirements shall be used as minimum guidelines.
- B. Gauges, thermometers and other indicating devices shall be installed so that they may be easily read from the floor level.
- C. Finish work shall present a neat and workmanlike appearance.
- D. Warning signs shall be placed on all machines driven by electric motors which are controlled by fully automatic starters. The Contractor shall refer to Section 3320, Article 7, Subchapter 7, General Industry Safety Orders, Title 8, California Administrative Code.
- E. All lubrication points shall be accessible. Where this is impossible, provision shall be made for lubrication at an accessible location. Where oil is used as a lubricant, an oil level indicator with capped and vented filling connection shall be provided in an accessible location. All equipment, including automatic dampers and control linkages shall be thoroughly lubricated before the equipment is operated and before acceptance by the City.

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PART 2 PRODUCTS

2.01 MATERIALS

- A. Identify materials and equipment by manufacturer's name and nameplate data. Remove unidentified materials and equipment from site.
- B. Equipment specified by manufacturer's number shall include all accessories, controls, and other components listed in catalog as standard with equipment. Furnish optional or additional accessories as required.
- C. Where no specified make of material or equipment is mentioned, request the name and type of a recommended product from the system or equipment manufacturer.
- D. Equipment and material damaged during transportation, installation, or operation shall be considered as totally damaged. Replace with new equipment of material. Variance from this will be permitted only with written approval by the City.

PART 3 EXECUTION

3.01 PRE-CONSTRUCTION CONFERENCE

- A. Immediately upon award of the Contract and before any Work is started, the City will arrange a meeting to be attended by the Contractor and the City's representative. The meeting will cover the details of contract work construction procedures, payment, and other Contract requirements.

3.02 INSTALLATION

- A. Manufacturer's Directions shall be strictly followed.
- B. Equipment: Accurately set and level with supports neatly placed and properly anchored. Seismic bracing and anchorages shall be provided per Secti of these Special Provisions. No allowance will be made for failure to foresee means of placing or installing equipment into position.
- C. Seismic restraints of mechanical systems shall be the Standards approved by the Office of the State Architect-Structural Safety Section, publications R0001 and R0010.
- D. Existing equipment and materials not identified for reuse: All materials and equipment in place but not shown or specified to be reused or which will not be essential to functioning of various systems when Work is complete, shall be removed. No existing material or equipment shall be reinstalled or reused unless shown or specified. Concealed material which is not shown or specified to be reused and becomes exposed due to construction changes shall be removed to nearest available accessible reused outlet.
- E. Protection: Protect the work of other Sections as well as the Work of this Section.

3.03 TESTING AND ADJUSTING

- A. Furnish all labor, equipment, materials, supervision and incidentals required for the work.
- B. Test mechanical systems in sections as Work progresses. Systems or sections previously tested shall become parts of any repeated test when it becomes part of distribution or collection system.
- C. Repair leaks by remaking with approved new material. Makeshift leak stopping will not be accepted.
- D. Should any equipment or material fail during testing, immediately remove and replace the defective material or equipment with new; retest system.
- E. Perform all tests in accordance with requirements of authorities having jurisdiction.
- F. After completion of testing and adjustment, operate systems and equipment under normal working conditions for five (5) days and show specified performance. If, in the opinion of the Engineer, performance of equipment or systems is not in accordance with specifications, equipment shall be adjusted or replaced at the Contractor's expense.
- G. Upon completion of Work, provide written certification that all systems have been installed according to Contract requirements and are functioning satisfactorily and without defects. Testing and Certification shall include the requirements where specified in other sections of this Division.
- H. Before the City assumes the full operation of the work, replace all air filters.
- I. Lubricate each item of equipment, including motors, if required, before operation.

### 3.04 OPERATION AND MAINTENANCE MANUAL

- A. Six (6) Operation and Maintenance manuals, covering mechanical systems and equipment, shall be provided by the Contractor. These manuals shall be well-written, step-by-step operating and maintenance procedures specific for the site's equipment, written in a simple and straightforward manner, that is easy for the City's operating and maintenance engineers to understand, or even memorize. In addition, large sheets of drawings should be folded in. Manuals shall be complete in all respects for equipment, controls, accessories, appurtenances stipulated. These manuals shall include but not be limited to:
  - 1. START UP AND SHUT DOWN instructions and control sequence for the specific system, equipment or components installed. Wiring and control diagrams with data to explain detailed operation and control of each component using standard legends and symbols approved by Regulatory Committees.
  - 2. A collection of manufacturer's description and maintenance bulletins pertinent ONLY to the procedures being discussed shall be added at the back of the manuals as references.
  - 3. Adjustments, maintenance and overhaul instructions.
  - 4. Lubrication schedule including type, grade, temperature range and frequency.



5. Performance data.
  6. Parts lists, with manufacturer's name and catalog numbers.
  7. Service organization with name, address and telephone numbers.
- B. A draft copy of the manual shall be submitted to the Engineer allowing sufficient time for review, so that the final approved copy shall be received at least seven (7) days before the scheduled O&M training. The manual shall be prepared and typed in acceptable format on 8-1/2 x 11-inch sheets, properly labeled and referenced for the specific school, and shall be submitted in a 3-ring binder.
- C. In addition to the O&M manual, the Contractor shall also submit, and affix at the back of the manual, a complete set of the manufacturer's INSTRUCTIONS AND MANUALS.

### 3.05 OPERATION AND MAINTENANCE TRAINING

- A. Refer to individual Specification Sections.

At the conclusion of the contract and before final payment is made, the Contractor shall arrange training for City personnel.

The training shall be provided by the equipment manufacturer's engineer, and shall cover a thorough discussion of the O&M manual which includes but is not limited to, operation and maintenance of the specific equipment and systems installed, telltale signs of equipment malfunctioning and their solutions, other pertinent topics that relate to optimum system operation and energy conservation.

### 3.06 SPECIAL EXTENDED WARRANTY

- A. Refer to Section 01 78 36 of these Special Provisions.
- B. The Contractor warrants that all work performed under this contract conforms to the contract requirements and is free of any defect of equipment, materials or design furnished, or workmanship performed by the Contractor or any of his subcontractors or suppliers at any time.
- C. Such warranty shall continue for a period of two (2) years from the date of final acceptance of the work by the City. If any of the work is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of a written notice from the Engineer to do so.
- D. If the Contractor does not proceed with the correction of such defective or non-conforming work within a reasonable time fixed by written notice from the Engineer, the City may proceed with the correction at the expense of the Contractor. In addition, the Contractor shall bear the cost of repairing all work of the City or separate Contractors destroyed or damaged by such correction or removal.
- E. This Special Extended Warranty shall also cover all labor, materials, equipment, supervision and incidentals to provide regular service maintenance, as recommended by the manufacturer, to all equipment installed in this contract for a period of three (3) years starting from the City's approval of the Contractor's Application For Final Payment.

- F. To ensure that City can keep accurate records of the service maintenance to be performed for all equipment installed in this contract during the warranty period, the Contractor shall:
  - 1. Log all service maintenance and repair performed. Updated copy of the log book shall be returned to Building and Grounds (B&G) for safekeeping.
  - 2. Notify the City of the scheduled service or repair work. Actual work may be verified from time to time.
- G. Service maintenance procedures, frequency of service for each equipment or items, format of the service maintenance log book shall be submitted to the City for approval within 15 calendar days of the Notice to Proceed. A copy of the log book shall be maintained by the Engineer.
- H. The Performance Bond which covers this Special Extended Warranty shall have this requirement with words similar to the attached form, Performance Bond.

### 3.07 EQUIPMENT ANCHORING DEVICES

- A. All anchoring devices covered under Division 22 which are designed to be embedded in concrete shall be cast-in-place at the time such concrete is poured.
- B. The Contractor shall note that cast in place anchoring devices and expansion anchors are not interchangeable. Approval by the Engineer shall be required when the use of expansion anchors is proposed by the Contractor.
- C. Testing of Expansion Anchors: Anchors drilled into concrete and which are to be loaded in tension shall be proof-tested to two times the maximum allowable load. Fifty (50%) percent of all the number of anchors shall be proof tested. In the event of a single failure, testing of all remaining anchors shall be performed as directed by the Engineer. Additional testing required because of a test failure shall be paid for by the Contractor.
- D. With respect to all items of equipment requiring anchor mounting bolts to be cast into concrete, and which are furnished under Division 22, the Contractor shall furnish equipment mounting templates suitable for accurate placement of the cast-in-place anchor bolts. Templates shall be furnished in a timely manner so as not to delay the pouring and placing of concrete.

### 3.08 SALVAGED EQUIPMENT

- A. The Contractor shall remove and deliver to the City's warehouse all identified equipment and controls to be salvaged.

### 3.09 RESTORATION AND FINAL CLEANING OF WORK AREAS

- A. Walls, floors and ceiling of the existing facility that are damaged during the course of construction shall be repaired, patched, grouted or restored accordingly to match surrounding finishes.
- B. Debris accumulated by the Contractor during construction, and unused materials and equipment not meant to be salvaged shall be removed from the work area as

Contractor's property and, at the conclusion of the project but prior to start-up, the areas shall be adequately cleaned and, if required, hosed down with domestic water.

### 3.10 PAYMENTS FOR MATERIALS AND EQUIPMENT BROUGHT ON SITE

- A. The City will only pay for materials and equipment installed in place. The actual amount will be determined by the Engineer, based on the percentage of work completed.

### 3.11 ACCESS TO WORK AREAS

- A. One set of keys and a number of temporary pass cards will be issued by the City, to the Contractor to the Contractor for access to the work area.

The Contractor shall require all his/her construction personnel to wear a temporary pass card while on site.

The Contractor shall make security calls to the City's Security Monitor prior to entering and leaving the site. The telephone number and additional instructions will be provided when the keys are issued.

### 3.12 PRE-CONSTRUCTION SURVEY

- A. Immediately following the Notice To Proceed, the Contractor shall undertake, with the City's joint participation, a thorough pre-construction survey of all existing site improvements, interior and exterior, which will remain in place. The purpose of this joint survey is to document the condition of the site before work commences, in order to determine responsibility for damages and defects that may arise during construction. The Contractor is advised to thoroughly document all defects, since any defect found at the end of construction, and not documented in the pre-construction survey will be assumed, within reason, to have been caused by the Contractor's Operations and be the responsibility of the Contractor to correct. Such defects could include damages to architectural finishes and inoperable electrical and mechanical equipment, but would not include defects not evident at the start of construction. The Contractor shall inspect and check all mechanical and electrical equipment, and note any defects in the survey.
- B. The Contractor shall provide all equipment needed to conduct the survey, including videos, cameras and notes. One full copy of the results of the survey will be reviewed and approved by both the Contractor's and City's representatives within 10 days of the Notice to Proceed. Upon approval, two full copies of the approved survey will be submitted to the City.

END OF SECTION



## SECTION 22 05 00

## COMMON WORK RESULTS FOR PLUMBING

## PART 1 GENERAL

## 1.01 RELATED DOCUMENTS

- A. The requirements of this SECTION apply to all Work of DIVISIONS 22 and 33 where applicable. The materials, equipment and methods herein are generally common to the various SECTIONS of this DIVISION of the Specification. Materials that apply to only one SECTION are generally included in that SECTION.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions, and Division I Specification Sections apply to this section.

## 1.02 WORK INCLUDED

- A. The work includes, but is not necessarily limited to the furnishing and installation of all work as shown and noted on the Drawings and specified herein. This section describes the General Requirements for materials, equipment and installation applicable to all Sections of the work under this Division. The following summary is included to indicate some items common to the work. It is not necessarily all inclusive.
  - 1. Labor, material, equipment, tools, rigging, hoisting, temporary scaffolding, transportation, supervision, inspections, services, insurance, fees and taxes.
  - 2. Repair of damage done to premises or other property as a result of the work and removal of debris left by those engaged in the work.
  - 3. Preparation of submittals, Shop Drawings, Project Record Drawings, Operating and Maintenance Manuals, Operating Instructions and training of City Personnel for each system.
  - 4. Prime coat painting as specified including piping, equipment and related items.
  - 5. Access doors and panels required for the work.
  - 6. Identification of piping and equipment.
  - 7. Service connections to items installed by other Contractors and Trades.
  - 8. Disassembly and reassembly of any equipment furnished should this be required in order to move equipment into locations indicated.
  - 9. Prior to commencing the work, carefully inspect installed work of other Contractors and Trades and verify that such work is complete to the point where this installation may properly commence.
  - 10. Verify that piping and equipment may be installed in accordance with applicable codes and regulations, and the Specific References as hereinafter specified.

11. In the event of discrepancies, refer all questions to the Engineer. Do not proceed with work in areas involving discrepancies until such discrepancies have been fully resolved.
12. Provide, procure and pay fees, permits, licenses, certificates and inspections required to carry on and complete the work.
13. Seismic restraints of piping and equipment.

### 1.03 RELATED WORK

- A. Finish painting of all exposed piping and equipment: as detailed in Paragraph 2.2 of this Section.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions, and Division I Specification Sections apply to this section.
- C. Cast-in-place concrete work except as specifically called for herein: Refer to Structural Drawings.
- D. Finish painting of all exposed piping and equipment: as detailed in Paragraph 2.2
- E. Utility Services: NOT APPLICABLE
- F. Electrical material and labor: NOT APPLICABLE
- G. Flashing sheet metal materials and labor: NOT APPLICABLE.
- H. Project close-out: Refer to Div 1.
- I. Electrical material and labor: NOT APPLICABLE

### 1.04 QUALITY ASSURANCE

- A. Qualifications of Workmen: Provide personnel who are thoroughly trained and experienced in this skills required, who are completely familiar with the requirements of the work, who shall be present during progress of the work, and who shall direct work performed.
- B. Work and materials shall be in full accordance with the latest rules of the California Administrative Code including Title 8 Department of Industrial Relations, Title 19 State Fire Marshal, and Title 24 Building Standards; the National Electric Code; the National Fire Codes, published by the National Fire Protection Association; the Uniform Plumbing and Mechanical Codes, published by the International Association of Plumbing and Mechanical Officials; the Uniform Building Code, published by the International Conference of Building Officials; and all other applicable County Ordinances, Codes, Laws and/or Regulations.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Pipe Hangers

1. See structural specification sections for the pipe hanger materials.

B. Pipe Protection

Penetrations of rated assemblies shall be fire-stopped. Fire stopping shall be an approved material, UL rated and which have been approved by the fire marshal for this purpose.

Thermal Hanger Shields model designations indicated below are manufactured by Pipe Shield, Inc. (PSI), or equal.

1. Insulated pipe shall be protected at the point of support by a 360 degree sheet metal shield. Insert to be same thickness as adjoining pipe insulation. Shield length and minimum sheet metal gauges shall be as recommended by manufacturer. Insulated lines shall use PSI Model CS.
2. Fire Wall and Outside Penetrations:
  - a. Bare pipe penetrating fire and outside walls shall be encased in adjoining sheet metal cans minimum 24 gauge, sized for maximum 1 inch spacing between pipe and can. Spacing shall be packed on high end with double neoprene coated silica fiber rope with positive fastening catch.
  - b. Insulated Pipe - Pipes penetrating fire and outside walls shall be encased in adjustable sheet metal cans, minimum 24 gauge sized for maximum 1 inch spacing between insulation and can. Insulation shall consist of a 360 degree waterproofed calcium silicate insert sized to extend a minimum of 1-inch beyond wall or floor penetration. Calcium silicate insert shall be the same thickness as the adjoining pipe insulation. Spacing between shield and can shall be packed on either end with double neoprene coated silica fiber rope with positive fastening catch.
  - c. Wall shields shall have the same fire rating as the walls and floors they are penetrating.
  - d. On insulated lines use PSI Model WFB-CS.

2.02 ACCESS DOORS

- A. NOT APPLICABLE

2.03 PAINTING AND COATING

- A. Exposed ferrous metals such as piping, conduit, panels, brackets, supports, braces, anchors, rods, hangers, and equipment shall be prime coated in accordance with the specific requirements specified. Also, refer to Specification Sections 09 90 00.
- B. Name plates, gauge faces, valve handles and stems, control devices, rotating shafts, and polished metal shall not be painted.

- C. Equipment furnished with a final coat at the factory need not be repainted except for touch-up of blemishes and scratches.
- D. Exposed, conduit, equipment hangers and support is defined as that which may be seen by a man standing on any floor, grade, roof, inside or outside of the building.

#### 2.04 MOTORS

NOT APPLICABLE

#### 2.05 FABRICATION

- A. Exposed ferrous metals such as piping, conduit, panels, brackets, supports, braces, anchors, rods, hangers, and equipment shall be prime coated in accordance with the specific requirements specified. All painting and coatings shall be compatible with marine environment.
- B. Provide prime coat of rust inhibiting paint on exposed ferrous metal surfaces. Red inhibitive primer type 6-208, Pittsburgh Paint Co., or equal. Application as recommended by the manufacturer and as reviewed by the Engineer.
- C. On insulated surface apply sealer coat to jacket in accordance with the manufacturer's instructions and as reviewed by the Architect.
- D. Prime coat painting shall be as follows:
  - 1. Exposed unprimed ferrous metal installed shall be wire-brushed, cleaned and primed with one coat of zinc chromate primer. Work exposed outdoors shall be given two prime coats. Welds shall be ground and wire-brushed before priming.
  - 2. Exposed galvanized metal shall be cleaned and washed with cleaning solution for galvanized surfaces, and primed with one coat of zinc chromate primer.
  - 3. Exposed piping, equipment and materials without factory prime coat, shall be given one primer coat.
- E. Name plates, gauge faces, valve handles and stems, control devices, rotating shafts, and polished metal shall not be painted.
- F. Equipment furnished with a final coat at the factory need not be repainted except for touch-up of blemishes and scratches.
- G. Exposed piping, conduit, panel, equipment hangers and support is defined as that which may be seen by a man standing on any floor, grade, roof, inside or outside of the building.

#### PART 3 EXECUTION

##### 3.01 INSPECTION

- A. Do not allow or cause any work to be covered up or enclosed until it has been inspected, tested and approved by the Engineer or other authorities having jurisdiction over the work.
- B. Should any of the work be enclosed, or covered up before such inspection and test, the Contractor shall, at his own expense, uncover the work, and after it has been inspected, tested and approved, make repairs with such materials as may be necessary to restore work disturbed by him to its original and proper condition.
- C. The Drawings and Specifications do not purport to list every item that will be installed. When an item is necessary for the satisfactory operation of the equipment or is required



by the equipment manufacturer, law, ordinance or rule, it shall be provided. Work called for in the Specifications, but not on the Drawings, or vice versa, shall be done as through required by both. Lack of specific mention of any work necessary for proper completion of the work in the Specifications and/or Drawings, shall not lessen the Contractor's responsibility to provide such work.

### 3.02 INSTALLATION

- A. The work shall be installed as indicated on Drawings; however, changes to accommodate installation of this work with other work or in order to meet architectural or structural conditions, shall be made without additional cost to the City.
- B. For the purpose of clarity and legibility, the Drawings are essentially diagrammatic to the extent that many offsets, bends, unions, special fittings and exact locations are not indicated. The Contractor shall make use of data in the Contract Documents, and shall verify this information at the site and install the various systems complete and finished in all respects.
- C. Dimensions and locations of equipment, doors, partitions, fixtures and grilles are to be taken from the plans, but shall be verified at in the field.
- D. Although the Drawings have endeavored to show underground stub outs, utilities and services at the site, such locations are not necessarily known nor shown. Without limitation, the Contractor shall be responsible for work, expense, or special precautions caused by the existence or proximity of utilities and services encountered at the site or in the performance of the work including, without limitation, repair of any damage that may result from exploratory openings. The Contractor shall be cautioned that the utilities or services encountered at the site or in the performance of the work including, without limitation, repair of any damage that may result from exploratory openings. The Contractor shall be cautioned that the utilities or services encountered at the site may include electrical cables conducting high voltage. When working in the vicinity of such cables, precautions shall be observed. The Contractor shall assume full responsibility for observing the proper safety regulations.
- E. There is no guarantee or warranty, either expressed or implied, that the site utility conditions indicated are representative of those actually at the site or any part of it or that unforeseen developments may not occur. The Contractor must satisfy himself through his own investigation as to the actual conditions to be encountered.
- F. Electrical Work  
NOT APPLICABLE
- G. Concrete Work
  - 1. Concrete work, where specifically made a part of the work, shall be in accordance with the sheet notes. In all cases coordination and supervision of placement of poured-in-place concrete for equipment bases and supports are a part of the work.
- H. Curbs, Flashings, Sleeves, Chases and Inserts
  - 1. The Contractor shall provide all required curbs, flashings, sleeves, chases, inserts, anchor bolts, and similar items.

2. Sleeves and chases shall be prohibited in structural members, except as shown on the Drawings.
  3. Locate and size openings for pipes through walls, roof, and other building components as part of the Work of this Division. The framing of any openings shall be provided as part of the Work of the Divisions in whose Work opening is made.
- I. Cutting and Patching
1. The Contractor shall perform all cutting and patching, including structural reinforcing, necessary for the Work of this Division.
  2. The Contractor shall assume responsibility for all damage to premises or Work of other Divisions caused by leaks or breaks in piping or equipment furnished or installed as part of the Work of this Division during both the construction and Warranty period.
- J. Damage
1. The Contractor shall assume responsibility for damage to any part of the premises or work of other Contractors and Trades caused by leaks or breaks in the piping or equipment furnished and/or installed during both the construction and Warranty period.
- K. Cleaning and Closing
1. Piping and equipment shall be inspected before placing and the interior cleaned before closing. Piping shall be closed at the end of each day's work.
- L. Fabrication
1. Location: The location of piping and equipment indicated on the Drawings is approximate and shall be changed to meet the architectural and structural conditions as required.
  2. Piping System: Such systems shall be worked into a complete and integrated arrangement with like elements arranged to make a neat appearing and finished piece of work with adequate headroom and passageway free from obstructions. Such systems shall be installed by labor experienced in the respective trades involved. The term "piping" as used in these Specifications or on the Drawings shall mean pipe, fittings, nipples, valves, unions, as may be required for a complete and functional system.
  3. Equipment:
    - a. Bearings and motors shall be accessible for removal and replacement.
    - b. No allowance of any kind will be made for negligence on the part of the Contractor to foresee means of bringing in and installing equipment into position inside the building.
    - c. Before the City assumes the full operation of the work, replace all air filters.

- d. Lubricate each item of equipment, including motors, if required, before operation.
  4. Manufacturer's Directions: Manufacturer's directions shall be followed in cases where the manufacturer of articles used in this contract furnishes directions covering points not specified or indicated on the Drawings.
  5. Furring and Pipe Spaces: Spaces provided in the design of the building shall be utilized, and the work shall be kept within the furring lines established on the Drawings.
  6. Piping Installation Requirements:
    - a. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
    - b. Welding procedures and testing shall comply with ANSI Standard B31.1.0 - Standard Code For Pressure Piping, Power Piping and the American Welding Society, Welding Handbook.
    - c. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code For Mechanical Refrigeration.
    - d. Provide U.L. fire rated sleeve/couplings for each pipe penetration or fixture penetration passing through walls, partitions, shafts and ceilings. All pipe penetrations shall comply with ATM E-814/U.L.-1479 Standards.
  7. Installation of Piping:
    - a. Pipe shall be cut accurately to measurements established by the Contractor at or in the building and shall be worked into place without springing or forcing.
    - b. Pipe lines shall be installed free from traps and air pockets, and true to line and grade.
    - c. Piping Branch take-offs: Made with reducing tees or with line size tees, reducers, except that branches less than half diameter of the main in steel piping may be made with forged branch welding outlet fittings.
    - d. As each piece of main pipe is completed, but before connecting branch piping, blow out with compressed air.
    - e. Install piping carefully, support firmly and uniformly at proper hanger points and to elevation and grade. Adjust adjacent lengths of pipe with reference to each other. Adjust fittings so as to give uniform space all around. If any pipe does not allow sufficient space for proper claming, replace by pipe of proper dimensions. Temporarily close open ends of pipe at end of each day's work where pipe can be fouled.
  8. Piping Joints:

- a. Properly ream screwed steel piping. Apply pipe joint compound to male threads only.
  - b. Weld steel piping according to Standard Procedure Specifications of National Certified Pipe Welding Bureau. Use long radius forged steel welding elbows.
  - c. Cut copper tubing with copper tube cutters, size with sizing tool and thoroughly clean before application of flux or solder.
  - d. Copper Tubing System: Have IPS red brass pipe or nipples at connections requiring rigidity (at equipment, at anchors and through roof).
  - e. Buried pressure piping with friction type joints (bell and spigot and Tyton) shall have adequate concrete thrust blocks installed at each change of direction (horizontal, vertical) at each tee or dead-end.
9. Reducers, Increases: Unless otherwise noted, valves and strainers shall be line size. Straight or eccentric reducers, to suit, shall be installed as close as possible to the connection of greater or smaller size than the pipe line. Branch take-offs shall be made with reducing tees or with line size tees and reducers.
10. Unions: Provide union or flange at each connection to equipment, on both sides of control valves, downstream of each valve and at each strainer and trap. Install unions at both ends of valves, and strainers, when the valves, could not be turned due to obstructions. When screwed valves, and strainers, are specified in welded steel piping, screwed flanges shall be installed.
11. Check valves and strainers shall be installed in horizontal position. Strainers shall be fitted with blow-off valves.
12. Copper to Steel Connections: Copper pipe connections to ferrous piping shall be made with dielectric couplings and unions or isolation flanges.
13. Escutcheons: Piping passing through finished floors, ceilings, partitions or walls exposed to view shall be provided with chrome plated escutcheons. Escutcheons for insulated pipe shall fit over the insulation.
- M. Flashing: Pipes passing through roof shall be flashed and counterflashed. Except where lead flashings are to be used, sheet metal material shall be 24-gauge galvanized steel (minimum thickness) zinc alloy.
- N. Hangers and Supports:
1. Piping shall be isolated from the supports and the supports isolated from the building construction.
  2. Piping shall not be supported or hung by wire, rope, plumber's tape or blocking of any kind. Double wrap copper pipe with heavy vinyl tape where pipe comes in contact with ferrous material.
  3. Supports from Wall: Steel brackets, hooks or clamps.
  4. Any bare (non-insulated) piping shall be resiliently isolated with pipe isolators.
  5. Each hanger shall be adjusted to carry its proper share of the load.

6. Additional supports and/or braces shall be installed if, during test or normal operation, the piping should sway, crawl or vibrate.
  7. Piping below any ductwork shall be supported from the walls or on a trapeze with hanger rods outside of ductwork.
  8. Piping, including valves, and equipment shall be supported independently of the equipment with no piping weight or stress due to expansion or contraction transmitted to the equipment. Contractors shall be responsible for proper alignment of piping at equipment conditions (maximum hot to minimum cold) and shall provide anchors, guides, bracing, spring supports, installed as required. Flexible connections, and/or expansion joints deflections shall always be within allowable limits. Piping at equipment shall not be insulated until inspected for alignment at extreme temperature conditions. No piping tubing or hoses shall be supported by other piping.
  9. Piping and equipment at the completion of the job shall be rigid and immobile. Install additional pipe supports, brackets, hangers and any other devices as required to accomplish rigid and immobile piping system. No piping shall be left loose without proper support. Pipes shall not be supported from, or braced to ducts, other pipes, conduit, or any materials except building structure unless this is specifically shown on the Drawings. Valves shall be the same size as the line in which they are installed. No valves shall be installed with the stem pointed below horizontal.
- O. Sound and Vibration Isolation:
1. Any equipment which is motor driven, shall be mounted on vibration isolators of 94 percent efficiency (6-percent transmissibility).
  2. Vibration equipment shall be sound isolated from supporting structure, using grommets (around bolts) washers and sound isolation pads.
  3. Provide complete catalog data for each vibration isolator proposed to be installed, including static deflection and weight loading for equipment in operation.
- P. Insulation, General Requirements:
1. The insulation shall be applied over clean, dry surfaces with joints butted firmly together.
  2. At each pipe hanger, use a section of rigid blocking.
  3. Provide weather jackets with vapor barrier over piping which is exposed outdoors.
  4. Tape transverse joints with material hereinafter specified.
- Q. Penetrations: Insulated piping through sleeves shall have uninterrupted insulation inside sleeves. Pack space between piping and sleeve with non-combustible material.
- R. Make piping penetrations through floors watertight with mastic even though concealed within wall, furred space. Caulk space between pipe and concrete to full concrete

thickness with silica-fiber rope or fire rated, mastic sealant. Make penetrations through any dampproofed/ waterproofed surfaces by approved means to maintain integrity of system penetrated.

### 3.03 SEISMIC RESTRAINTS

- A. All equipment supports, piping supports and all anchorages installed under this Contract shall conform to the seismic loading provisions of the 1993 Edition of the San Francisco Building Code, Zone 4 requirements.
  
- B. Piping
  - 1. Pipe bracing system shall conform to the requirements hereinafter listed and shall be as reviewed by the Engineer. The Contractor shall submit shop drawings indicating the location of seismic braces and provide a legend giving load information and model specification prior to installation. See piping detail for the exact material to be used.
    - a. Brace pipe sizes 2-1/2 inch inside diameter and larger.
    - b. Provide shop drawings to laterally brace the piping system in accordance with the SMACNA Restraint Guide.
    - c. Transverse bracing of one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 24 inches of the elbow or tee and similar size.
    - d. Do not use branch lines to brace main lines. Piping shall not be supported by other pipes.
    - e. Provide flexibility for piping systems with flexible pipe sections where pipes pass through building separation, seismic or expansion joints or where rigidly supported pipes connect to equipment with vibration isolators.
    - f. At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the center of gravity of the riser. Provide lateral guides at the top of bottom of the riser, and at intermediate points not to exceed 30 foot intervals.
    - g. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.
    - h. Do not fasten on rigid piping system to two dissimilar parts of the building that may respond in a different mode during an earthquake; for example, a wall and a roof.
    - i. No seismic bracing is required if the top of pipe is suspended 12 inches or less from the supporting structural member.
  
- C. Equipment

1. Equipment shall be accurately set and leveled; supports shall be neatly placed and properly fastened. Equipment shall be fastened in place with bolts and seismic restraints.
  2. Vibration isolators for equipment shall be the housed type and suitable for seismic supports.
  3. All anchoring devices covered under Division 15 which are designed to be embedded in concrete shall be cast in place at the time such concrete is poured.
  4. The Contractor shall note that cast in place anchoring devices and drill-through type concrete expansion anchors are not interchangeable. The use of drill-through type concrete expansion anchors shall not be permitted.
- D. Submittal & Approval: The Contractor shall submit shop drawings to the Engineer indicating the location of seismic braces and provide a legend giving load information and design and model selection (if applicable) prior to installation.

### 3.04 PROTECTION

- A. Materials shall be delivered in ample quantities from time to time as may be necessary for the uninterrupted progress of the work. They shall be stored so as to cause the least obstruction to the premises and distributed so as to prevent overloading to any portion of the structure.
- B. Provide temporary storage and shop areas that are required at the site for the safe and proper storage of materials, tools, and other items used in the performance of this work. These areas shall be constructed only in locations approved by the Engineer and shall not interfere with the work of any other Contractor and Trade.
- C. Protection of materials and equipment furnished, either storage or installed, shall be the responsibility of the Contractor until final acceptance of the project as a whole.

### 3.05 IDENTIFICATION

- A. Piping:
  1. Identify piping with symbol identification and directional flow arrows. Symbol identification to be Westline "Tel-A-Pipe" tape markers complying with ANSI A 13.1 color standards.
  2. Identify piping at approximately 25 foot centers but not less than once in each room, whether or not concealed.
  3. Where capped piping is provided for future connections, provide legible and durable metal tags indicating symbol identification.
- B. Valves:
  1. Identify main control valves with 1-1/4" x 3" Bemis Lamicoid identification tags installed on handwheels or stem with brass-beaded chain. Engrave identification tags indicating the service abbreviation and stating whether normally open (engraved on green) or normally closed (engraved on red).

C. Equipment

1. Provide manufacturer's nameplates on equipment, identifying manufacturer's name, model number, size, capacity, electrical characteristics, and pertinent information.
2. Leave manufacturer's nameplates clean and legible. Install equipment so that view of nameplates is not obstructed.
3. Refer to individual Specification Sections for equipment identification requirements.

3.06 NOISE

- A. The Contractor shall be responsible for correction and complete abatement of any objectionable sound or mechanical vibration emissions caused by equipment installed under this Contract. Substantial Completion shall not be granted until such abatement measures have been successfully fulfilled. The Engineer's decision as to whether or not such sound or mechanical vibration is objectionable shall be final.

3.07 ADJUSTING AND CLEANING

- A. The Contractor shall provide labor and test equipment and disconnect from the system any installed equipment that can be damaged by pressure.
- B. Thoroughly clean equipment, piping, free from rust, scale, filings, plaster and dirt before and after covering and painting is done or systems are put in operation.
- C. Equipment and piping shall be cleaned and purged before each test.
- D. The various systems shall be tested in sections as the work progresses. However, any system previously tested shall become part of any repeated test when it becomes part of the distribution or collection system.

3.08 PIPE TESTING

- A. Leaks shall be repaired by remaking with new material. No makeshift leak stopping methods are acceptable.
- B. Should any piece of equipment or material fail in any of the tests, it shall be immediately removed and replaced with new; the system shall again be tested by the Contractor. Damaged equipment and materials shall be considered as "totally damaged" and any variance from this clause shall be made only with written approval of the Engineer.
- C. Test pressures shall be maintained for the periods stated in Sections and 15400, or as directed, without loss in pressure except that due to the change in temperature and the atmospheric pressure during the test.
- D. Tests shall be in accordance with requirements and under supervision of authorities having jurisdiction.



- E. Should any equipment or material fail during testing, immediately remove and replace the defective material or equipment with new; retest system.
- F. After completion of testing and adjustment, operate systems and equipment under normal working conditions for five (5) days and show specified performance. If, in the opinion of the Engineer, performance of equipment or systems is not in accordance with specifications, equipment shall be adjusted or replaced at the Contractor's expense.
- G. Upon completion of Work, provide written certification that all systems have been installed according to Contract requirements and are functioning satisfactorily and without defects. Testing and Certification shall include the requirements where specified in other sections of this Division.

END OF SECTION



## SECTION 22 05 29

## PIPE HANGERS AND SUPPORTS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. This section covers the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the pipe hanger and supports as shown on the plans and as described in this specification.
- B. The Contractor shall provide pipe supports, hangers, guides, and anchors, complete and in place, in accordance with the Contract Documents.
- C. Where pipe support systems are not indicated on the Drawings, the Contractor shall design and provide the supports in accordance with this Section.

## 1.2 RELATED SECTIONS

- A. General Requirements for Plumbing - Section 22 04 00
- B. Common Work Results - Section 22 05 00
- C. Sanitary Utility Sewage Force Main – Section 33 34 00

## 1.3 REFERENCES

- A. American Society of Mechanical Engineers:
  - 1. ASME B31.9 – Building Services Piping
- B. American Society for Testing and Materials:
  - 1. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
  - 2. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes
  - 3. ASTM A314 – Standard Specification for Stainless Steel Billets and Bars for Forging
  - 4. ASTM A370 – Standard Test Methods and Definitions for Mechanical Testing of Steel Products
  - 5. ASTM A480 / A480M – Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
  - 6. ASTM A484 / A484M – Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings

7. ASTM A582 / A582M – Standard Specification for Free-Machining Stainless Steel Bars
  8. ASTM A751 – Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
  9. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
  10. ASTM F594 – Standard Specification for Stainless Steel Nuts
- C. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 – Pipe Hangers and Supports – Materials, Design and Manufacturer
  2. MSS SP 69 – Pipe Hangers and Supports – Selection and Application
  3. MSS SP 89 – Pipe Hangers and Supports – Fabrication and Installation Practices

#### 1.4 SUBMITTALS

- A. Product Data – Submit product data on all hanger and support devices. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.
- B. Shop Drawings: Shop Drawings must include the following information:
  1. Drawings of pipe supports, hangers, anchors, and guides.
  2. Calculations for special supports and anchors, stamped and signed by a registered professional engineer.

#### 1.5 QUALITY ASSURANCE

- A. Steel pipe hangers and supports shall have the manufacturer's name, part number, and applicable size stamped in the part itself for identification.
- B. Hangers and supports shall be designed and manufactured in conformance with MSS SP 58.

#### 1.6 PRE-INSTALLATION CONFERENCE

- A. Section 01 31 19 – Project Meetings: Pre-installation Conference
- B. Convene a minimum of 1 week prior to commencing work of this section.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

## PART 2 PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with these specifications, pipe hangers and support systems shall be as manufactured by the following:
  - 1. Cooper B-Line, 509 West Monroe Street, Highland, IL, 62249, USA. Phone: (618) 654-2184 or email [blineus@cooperindustries.com](mailto:blineus@cooperindustries.com)
  - 2. Engineer approved equivalent

### 2.2 PIPE HANGERS AND SUPPORTS

- A. Hangers
  - 1. Un-insulated pipes 2 ½ inch and larger:
    - a. Adjustable steel clevis hanger, B-Line B3102.
- B. Pipe Clamps
  - 1. When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, B-Line B3141 with B3200.
- C. Supplementary Structural Supports
  - 1. Design and fabricate supports using structural quality steel bolted framing materials as manufactured by Cooper B-Line. Channels shall be roll formed, 12 gauge A316 Stainless Steel, 1 5/8 inch by 1 5/8 inch or greater as required by loading conditions.

### 2.3 ACCESSORIES

- A. Hanger rods shall be threaded at both ends or be continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.

### 2.4 FINISHES

- A. Outdoor and Corrosive Area Finishes
  - 1. Hangers and struts located in corrosive areas shall be of type 316 stainless steel with stainless steel hardware. All hangers and struts inside sewage sump shall be type 316 stainless steel with stainless steel hardware.

## PART 3 EXECUTION

### 3.1 PIPE HANGERS AND SUPPORTS

- A. Pipe shall be adequately supported by pipe hanger and supports specified in PART 2 PRODUCTS.
- B. Support horizontal cast iron pipe adjacent to each hub, with 12 feet maximum spacing between hangers.
- C. Install hangers to provide a minimum of ½ inch space between finished covering and adjacent work.
- D. Place a hanger within 12 inches of each horizontal elbow.
- E. Do not support piping from other pipes, ductwork or other equipment that is not building structure.
- F. Provide double transverse braces at 6 feet maximum spacing and within 2 feet of each change of direction.
- G. Provide longitudinal braces at 20 feet maximum.

END OF SECTION

## SECTION 22 05 53

## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Contractor shall provide and install the following equipment identification:
  - 1. Nameplates
  - 2. Pipe Markers
  - 3. Valve Seal

## 1.2 RELATED SECTIONS

- A. Section 09 90 00 – Painting and Coating
- B. Division 22 - Plumbing
- C. Division 26 - Electrical

## 1.3 SUBMITTALS

- A. The Contractor shall submit details of proposed nameplates and pipe/duct markers including a sample of each showing sample symbols, lettering style and size, color coding and banding.
- B. Upon approval of this submittal, the Engineer will furnish the Contractor a complete listing of wording, lettering and numbering for each equipment item to be identified by nameplate.
- C. The Contractor shall furnish and install 16-gauge type 316 stainless steel identification plates for all equipment required by individual Specification Sections to be identified. The plates shall be securely mounted on the equipment in readily visible locations. The plates shall bear, in 1/4-inch die-stamped lettering, the equipment identification numbers indicated in the Specifications and as shown on the Drawings.

## 1.4 REFERENCE STANDARDS

- A. ANSI Standard Z35.1 1968 Signage Standards
- B. OSHA Standard 1910:45 Signage Standards
- C. Uniformed Plumbing Code, Appendix J

## 1.5 WARRANTY

- A. The Contractor shall provide a two (2) year Warranty for all work covered under this Section per the requirements of Section 01 78 36.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Stainless Steel engraved nameplates with lettering 3/4" high, minimum, shall be applied to all HVAC equipments, pumps, valves over 2 inches, instrumentation and control panels.
- B. Nameplates and adhesive shall be resistant to oils, vibration moisture, solvents and weathering.

2.2 PIPE MARKERS

- A. Shall include directional flow arrows and pipe markers, color coded for the marked fluid stream.
- B. Marker lettering sizes to be as 1 1/4 inches high.
- C. Pipe markers shall be 2-1/4 inch by 9 inch vinyl, weather resistant with the following legends shown below.
- D. Reclaimed water pipes and equipment markers and lettering shall be in accordance to 1994 version of the UPC, Appendix J.
- E. Pipe marker background colors, bands and legends listed below shall be installed on the entire length of the piping system as specified herein. Contrasting text color shall be used against the pipe marker background colors. The Contractor shall submit pipe marker samples to the Engineer for approval.

	<u>Pipe/duct Line</u>	<u>Legend</u>	<u>Pipe Marker Background Color</u>	<u>Band Color</u>	<u># Bands</u>
1.	No. 1 Water	W 1	Blue	None	None
2.	No. 2 Water	W 2	Blue	Blue	1
3.	No. 3 Water	W 3	Blue	Blue	2
4.	No. 4 Water	W 4	Blue	Blue	3
5.	Dewatering	DEW	Yellow-Orange	Yellow-Orange	1
6.	Process Drain	PD	None	None	None
7.	Reclaimed/Rain Water	RCW/RW	Purple	None	None
8.	Roof Drain	RD	None	None	None
9.	Overflow Roof Drain	ORD	None	None	None
10.	Sanitary Vent	SV	Yellow	None	None
11.	Sanitary Sewer	SEWER	Yellow	None	None

- E. Manufacturer to be Seton "Weather-Code" outdoor pipe markers; Brady or equal.
- F. Lettering, coloring and nomenclature shall conform to ANSI A13.1-1981

2.3 VALVE SEAL



- A. The valve seals shall be provided at every reclaimed water valve as specified under the UPC, Appendix J. and shall be, as a minimum, of a crimped lead wire, or a plastic break-away seal. The seals shall be purple with the words "Reclaimed Water".

#### 2.4 MYLAR TAPE IDENTIFICATION

- A. The tape shall be as specified under the UPC, Appendix J. and shall be, as a minimum, fabricated of polyvinyl chloride with synthetic rubber adhesive and a clear polypropylene protective coating or approved equal. The tape shall be purple in color (Pantone color #512) and shall be imprinted in nominal one-half (1/2) inch high, black, uppercase letters, with the words "CAUTION: RECLAIMED WATER, DO NOT DRINK".

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. All accessories shall be carefully inspected for damage prior installation. All damaged material shall be replaced or patched with material similar to the original.
- B. All dirt and foreign material shall be removed from piping prior to installation.
- C. Unless otherwise indicated, the entire length of all exposed piping systems, except for the Reclaimed Water System, shall be painted GRAY with the paint specified in Section 09 90 00.
- D. All reclaimed piping and fittings shall be painted purple (Pantone #512) or continuously wrapped with purple-colored Mylar tape in accordance to 1994 UPC, Appendix J.
- E. Complete safety coating specified in Section 09 90 00.

#### 3.2 INSTALLATION

- A. Nameplates: Securely mount the identification plates on the equipment in readily visible locations. Apply to plumbing equipments, pumps, valves over 2 inches, instrumentation and control panels.
- B. Pipe markers: Place in the following locations:
  - 1. Adjacent to each branch and fitting.
  - 2. At each branch and riser take-off.
  - 3. At each pipe passage through walls, floors and ceilings.
  - 4. On above-grade straight pipe runs every 20 feet.

END OF SECTION



**SECTION 26 04 00****GENERAL REQUIREMENTS FOR ELECTRICAL****PART 1 – GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and General Provisions of Contract, including Special Provisions, General and Supplementary Conditions, and Division 1 Specification Sections, apply to the work of this Section.
- B. This Section applies to all other Sections of Division 26.
- C. The requirements of this Section apply to all electrical work for equipment specified under other divisions of these specifications.

**1.02 WORK INCLUDED**

- A. Provide all required labor, equipment, materials, tools, transportation and test equipment to satisfactorily complete all electrical work shown on the Drawings and specified herein and in other Divisions.
- B. Furnish and install all incidental items not actually shown or specified but which are required by good practice, or otherwise, to provide complete functional systems.
- C. Make all electrical field connections to control panels, motors, electric valves, instrumentation, etc., furnished under other Divisions of these Technical Specifications.
- D. Mount and make field connections to “package” equipment furnished under other Divisions of these Technical Specifications.
- E. Special wiring for Instrumentation and Control Systems specified in Division 40 shall be furnished and installed under this Section.
- F. The work included under this Division shall include the review of shop drawings of other Technical Specification Sections. These drawings shall be reviewed for both physical and electrical deviations from the details shown on the Electrical Contract Drawings. Shop Drawings from other Technical Specification Sections detailing equipment, which will be incorporated into the project and that have either more specific or altered details, shall supersede the details shown on the Electrical Drawings after they have been reviewed by the City Representative. The Contractor shall coordinate and submit to the City Representative any required electrical changes, including but not limited to number and size of conduits and wires; starter and circuit breaker sizes; conduit stub up locations; and control modifications. Additional pull boxes required to meet conduit bending requirements and to facilitate the concentration of conduit stub ups towards any control panel with limited space, shall be furnished and installed at no additional cost to the City.
- G. Under Division 26, Electrical, related to Division 23 and 40, interface shall be as shown on Drawings and as follows:
  - 1. Furnish and install all instrumentations and alarm signal raceway and terminals for all control panels under the direction of the System Integrator.

2. Furnish and install all 240 volts or 120 volts power branch circuits up to the locations required by the control panel, instrument, starter, or various elements provided under other Sections of the Contract.
3. Wire and conduit to devices such as pressure switches, flow switches, control contacts, furnished under Division 40, which connect directly to motor starters control circuits.
4. Furnish and install all wire and cable required to interconnect the instrumentation and alarm system specified under Division 40.
- I. Verify location of existing underground utilities and protect these during construction. Coordinate with all agencies involved. In case of conflict, notify the City Representative.
- J. Furnish and install seismic restraint, anchorage, and bracing of electrical equipment and conduits.
- K. Contractor shall obtain required electrical permits from the local Authority Having Jurisdiction and shall full comply with requirements of installation and inspection.
- L. Contractor to provide label with maximum available fault current on the service equipment per NEC 110.24. If the service is updated or modified, the maximum available fault current would need to be updated accordingly.

### **1.03 QUALITY ASSURANCE**

- A. Codes, Regulations, and Requirements: All electrical equipment and materials, including installation and testing, shall conform to the following applicable codes, regulations and requirements, year of edition in conformance to the requirement of the local authority having jurisdiction or latest edition, whichever is more restrictive:
  1. 2022 California Electrical Code
  2. National Electrical Code (NEC)
  3. 2022 Port Building Code
  4. Occupational Safety and Health Act (OSHA) standards
  5. Public Utilities Commission of the State of California General Orders 95 and 128.
  6. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, International Electrical Testing Association (NETA).
  7. California Building Code
  8. California State Electrical Code Title 24
  9. California Administrative Code Title 8, Chapter 4, Subpart 5 Electrical Safety Orders
  10. Americans with Disabilities Act Accessibility Guidelines
  11. Requirements of the Pacific Gas and Electric Company

12. NFPA – National Fire Protection Association
  13. National Electrical Contractors Association (NECA); NEIS National Electrical Installation Standard
  14. National Electrical Safety Code (NESC)
- B. Standards: Equipment shall conform to applicable standards of American National Standards Institute (ANSI), Electronics Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), Insulated Power Cable Engineers Association (IPCEA), National Electrical Manufacturers Association (NEMA), and International Society of Automation (ISA). The revisions of these standards in effect on the date of issuance of the Contract Documents shall apply.
- C. Underwriters Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. The Contractor shall have all unique electrical products approved for safety and compliance to NEC by an independent testing laboratory approved by Department of Building Inspection, per National Electrical Code 90-7, 110-3. Unique electrical products are products for which there is no listing available from an approved testing laboratory and for which there are no nationally recognized standards of safety. Provide service entrance labels for all equipment required by the NEC to have such labels.
- D. Variances: Advise the City Representative of conflicting codes or conflicts between codes and the Drawings and Specifications. When the requirements of the Drawings or Specifications are more stringent than the codes, regulations or standards, the Drawings or Specifications shall apply. Where two or more codes are at variance, the most restrictive requirements shall apply as determined by the City Representative.

#### 1.04 QUALIFICATIONS

- A. All electrical work shall be performed by State Certified and experienced journeymen electricians and qualified apprentices in strict compliance with California Labor Code 3099 – 3099.5. Uncertified electricians who have completed apprenticeship training or apprentice electricians in an approved program by the California Division of Apprentice Standards shall be supervised by certified electrician in strict accordance with labor code noted earlier. Electricians shall have a minimum of five years of journeyman level experience performing similar electrical work in similar facilities. Workers performing electrical work on the Instrumentation Control Systems portion of the contract shall have a minimum of five years experience performing similar type of wiring and termination work including the ability to read P&ID drawings and interconnection diagrams. The Contractor shall require the workers hired to perform electrical work on this Contract to submit documentation proving that these training and experience requirements are met. Prior to engaging the workers on the electrical work, the contractor shall submit an affidavit to the Engineer identifying the workers and stating that each of the electrical workers meet these minimum requirements. The Contractor shall make such documentation available to the City Representative upon request at any time during the course of the construction Contract.”
- B. Work governed by this Section shall be performed by a Contractor having a C-10 contracting license and experience listed in 1.04.C below.
- C. Electrical subcontractor shall have a minimum of 10 years experience performing work similar in size (\$300K-\$800K) and complexity to the work shown in the contract documents.

Subcontractor must also have one completed project doing retrofit electrical work in an actively running wastewater treatment facility. General Contractor is advised to check credentials of the Electrical Subcontractor to ensure subcontractor meets these minimum qualifications.

### 1.05 INTENT OF CONSTRUCTION DRAWINGS

- A. The Electrical Drawings are diagrammatic unless specifically dimensioned; exact locations shall be verified in the field with the City Representative. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict:
1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, conduits, stub-ups, fittings, lighting fixtures, power and convenience outlets, exterior lighting units, smoke detectors, fire alarm control panel, visual/audio annunciators, manual pull stations, disconnect switches, and ground wells are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.
  2. Conduit and ground connections are shown diagrammatically only. The Contractor shall be responsible for the proper routing of conduit due to actual field conditions, subject to the approval of the City Representative. Layout does not necessarily show total length or total number of conduits or conductors for circuits required and should not be used for obtaining quantities for linear runs of conduits or wires. Locations of indicated runs are only approximate. Provide additional conduits and wire wherever needed to complete installation of specific equipment furnished.
  3. Electrical Drawings do not attempt to show complete details of building construction that affect installation. Diagrams are schematic only and do not necessarily show physical arrangement of equipment. Refer to the Drawings and Specifications of other trades for additional details, which affect work. Perform the electrical work that is required for the installation.
  4. Changes such as offsetting conduit runs, moving outlets, or other minor changes necessary to facilitate installation shall be made at no additional expense to the City.
  5. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the City Representative for review.
- B. As-Built Drawings:
1. Maintain a complete and accurate record set of full size "working drawings" during construction at all times. "Working drawings" shall use contract drawings legend.
  2. Record all work that is installed differently than shown on the Drawings.
  3. Upon completion of the work, contractor shall submit a set of "As-Built Drawings" reflecting all changes made during construction. Submit one "As-Built" set of redline drawings and AutoCAD (2022) "As-Built" files on one or more CDs. AutoCAD as-built drawings shall be done to the following format:
    - a. All changes made during construction shall be identified with bubbles and a letter "AB" inscribed inside a triangle.

- b. Complete the revision title in the title block.
- c. The final set of the drawings shall be marked "as-built drawing" and shall become the owner's record of the work.

#### 1.06 SUBMITTALS

- A. If a Short Circuit and Coordination Study is required by the Contract, no electrical equipment will be approved until Study is submitted, reviewed and approved; to assure proper rating of equipment.
- B. Substitutions shall be per Division 1 requirements.
- C. Materials List: Submit manufacturer's catalog cuts as product data for each item for which shop drawings are not required. The catalog cuts shall include the manufacturer's name, be identified by reference to the applicable Specification paragraph or Drawing number and provide sufficient information to show that the materials meet the requirements of the Drawings and Specifications. Where more than one item or catalog number appears on a catalog cut, clearly identify the specific item(s) or catalog number(s) proposed.
- D. Shop Drawings: Submit product review shop drawings for equipment for which shop drawings are specified in the equipment Specification Section. Include any data specifically required by the equipment Specifications.
- E. Certified evidence shall be submitted confirming sample testing of the cable which shall include mechanical integrity, bonding test, dielectric power loss, power factor and a high voltage time test as required in NEMA and, IPCEA.
- F. As-Built Shop Drawings: Revise manufacturer's shop drawings to show any construction changes. Prior to final acceptance, deliver one complete set to the City Representative for review.
- G. Manuals:
  - 1. Furnish six (6) copies of manuals for equipment where manuals are specified in the equipment Specifications.
  - 2. In each manual, include equipment descriptions, record shop drawings; installation, operation and maintenance instructions; parts ordering data and ratings for the equipment furnished for this project.
  - 3. Include specific power and control wiring diagrams.
  - 4. Include in front section, manufacturer and distribution contact information with equipment model and serial nos.
- H. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.
- I. Equipment mounting: Submit seismic bracings, anchorage details and calculations. See Seismic Requirements in Part 2.
- J. Factory and Field test reports. See Paragraph 3.07-I.
- K. Documentation of electrical crew apprenticeship program completion or enrollment and years of experience.

**1.07 FACTORY TESTS**

Submit certified factory test reports adjustments performed by equipment manufacturers to the City Representative prior to field testing and adjustment of the equipment. These reports shall identify the equipment and show dates, results of tests, measured values and final adjustment settings.

**1.08 INSPECTIONS**

- A. The City Representative may inspect the fabricated equipment at the factory before shipment to job site, if required in equipment specification. Provide the City Representative with sufficient prior notice, one month in advance, so that an inspection can be arranged at the factory.
- B. Inspection of the equipment at the factory by the City Representative shall be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory start-up operation of the equipment to the satisfaction of the manufacturer and the City Representative.
- E. All electrical work shall meet SFEC requirements. A City Inspector representing the Authority Having Jurisdiction shall be notified to inspect the work for code compliance and approval. If any work does not meet the City Inspector requirements, it shall be the responsibility of the Contractor to correct any deficiencies at the Contractor's expense.

**1.09 COORDINATION**

- A. Coordinate the electrical work with the other trades, code authorities, utilities, and the City.
- B. When two trades join together in an area, make certain that no electrical work is omitted.
- C. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other Sections of these Specifications but to be electrically connected under these electrical Sections.
  - 1. Determine connection locations and requirements.
  - 2. Sequence rough in of electrical connections to coordinate with installation schedule for equipment.
  - 3. Sequence electrical connections to coordinate with start-up and cut over schedule for equipment
  - 4. Shutdown schedule – Use Port of San Francisco's system outage request process. Coordinate in writing two (2) weeks in advance.

**1.10 RESPONSIBILITY**

The Contractor shall be responsible for:

- A. Furnishing and installing complete systems in accordance with intent of these Contract Documents.



- B. Coordinating the details of facility equipment and construction for all Specification Divisions that affect the work covered under Division 26.
- C. Verify location of existing underground utilities and protect these during construction. Coordinate with all agencies involved. In case of conflict, notify the City Representative.
- D. Obtain construction power and temporary power for testing and startup without any cost or obligations to the City.
- E. Obtain and satisfy electrical permit process.

### 1.11 LOCATIONS

- A. Use equipment, materials and wiring methods suitable for the types of locations in which they are located, as defined in Paragraph B. herein.
- B. Definitions of Types of Locations:
  - 1. Dry Locations: All those indoor areas which do not fall within the definitions below for Wet, Damp, Hazardous, or Corrosive Locations and which are not otherwise designated on the Drawings.
  - 2. Wet Locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.
  - 3. Damp Locations: All spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, unless otherwise designated on the Drawings.
  - 4. Corrosive Locations: All spaces exposed to the corrosive influence of chemicals, chemical fumes or sludge splash.
  - 5. Hazardous Locations: All locations requiring specialized electrical installation to mitigate the possibility of explosive atmosphere as defined by NFPA.

## PART 2 – PRODUCTS

### 2.01 GENERAL

- A. Unless otherwise indicated, provide all first-quality, new materials and equipment, free from any defects, in first-class condition, and to fit in the space provided. Provide materials and equipment listed by UL wherever standards have been established by that agency or provide approved material per paragraph 1.03-C this Section.
- B. The Drawings have been prepared based on the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design may be required to accommodate this equipment into the final construction. The Contractor desiring to use the second named equipment, or any equal equipment must pay all costs including cost of any additional engineering, material or installation incurred by using anything other than the first named equipment.
- C. Changes from the layout shown to facilitate use of second named or substituted equipment shall not be a basis for additional payment; neither shall changes in electrical controls or wiring or piping caused by the use of second named or equal equipment be a basis for additional payment.

- D. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- E. Whatever is indicated on Contract Drawings shall be deemed to be a part of this Specification also.

## **2.02 STANDARD OF QUALITY**

- A. **Manufacturer Qualifications:** Unless specifically exempted in the detailed specifications for any specific electrical product, the manufacturer shall have similar products in successful installation under similar installation conditions for at least 3 years, and shall, if requested, submit a list of representative installations.
- B. Products that are specified by manufacturer, trade name or catalog number, establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the City Representative prior to installation.
- C. It is the intent of these Specifications and Drawings to secure high quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new, and the products of reputable manufacturers regularly engaged in the manufacture of these particular items. Provide the manufacturer's latest standard design modified as required to conform to these specifications. For uniformity, only one manufacturer will be accepted for each type of product. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses, which may occur during fabrication, transportation, erection, and continuous or intermittent operation.
- D. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, which shall be of sturdy and durable construction and be suitable for long, trouble-free service. Light-duty, fragile and competitive grade devices of doubtful durability shall not be used.

## **2.03 NAMEPLATES**

- A. For each piece of electrical equipment, provide a manufacturer's nameplate showing its' name, location, the pertinent ratings and model designation.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the City, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the City upon prior request by the Contractor.
- C. See Section 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS for additional requirements.

## **2.04 EXISTING CONDITIONS**

- A. The electrical drawings were developed from past record drawings and information supplied by the City.
- B. Carry out any work involving the shutdown of existing services to any piece of equipment now functioning or the tie-in of equipment to the existing system at such time as to

provide the least amount of inconvenience to the City. Do such work when directed by the City Representative or the Inspector.

- C. After award of Contract, confer with City Representative /Inspector to verify at each area of construction activity the location of existing underground utilities. Protect all existing underground utilities during construction.
- D. No work shall be started that involves the existing electrical system without first obtaining and completing all coordination forms required by the facility. All such coordination forms shall be submitted with drawings and procedures showing information about what, where, why and how the work will be done in accordance with the General Requirements.
- E. Prior to starting any underground work the Contractor shall obtain all the information of the underground utilities or obstructions from the City Representative and take proper precautions to locate the utilities by potholing or other approved means in accordance with Protection of Persons and Property and Restoration of Existing Improvements of the General Conditions, and Potholing of the General Requirements.
- F. Tagging of existing wires and cables.
  - 1. Identify all existing wires and cables in the manholes, pull boxes, and load centers that interface to new work or that share the same manhole, pull box or load center.
  - 2. Provide all work necessary to obtain access to these facilities including pumping out water in manholes and vaults that may be flooded.
  - 3. Furnish and utilize tag per City requirement. Provide 10 working days prior notice to the City Representative that tags are needed.
  - 4. See Section 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS for additional requirements.

## **2.05 FASTENERS**

Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel. Provide 316 stainless steel fasteners in Wet, Damp and Corrosive Locations. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size expansion anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8- inch.

## **2.06 PAINTING**

Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish per manufacturer's instructions and satisfaction that has been damaged or is otherwise unsatisfactory to the City Representative.

## **2.07 ENCLOSURES**

- A. Unless otherwise noted on Drawings or in these Specifications, provide enclosures as follows:
  - 1. Dry Locations: NEMA Type 12
  - 2. Wet Locations: NEMA Type 4X
  - 3. Damp Locations: NEMA Type 4X

4. Corrosive Locations: NEMA Type 4X
5. Hazardous Locations: NEMA 7

## 2.08 EQUIPMENT HARDWARE

Hardware for outdoor equipment shall be stainless steel unless otherwise indicated on drawings. Hardware for indoor equipment shall be galvanized steel or stainless steel. Zinc or cadmium plated hardware is not acceptable. Hardware shall include, but not be limited to, door handles, hinges, latches, bolts, nuts and other items. This provision shall take precedence over hardware provisions specified in other sections of Division 26.

## 2.09 SEISMIC REQUIREMENTS

- A. All panel boards, switchgear, motor control center, transformers, luminaires and other equipment, including supports and attachments, shall be designed and tested to the 2010 California Building Code. All calculations shall be done by a Registered California Civil Engineer.
- B. For all electrical equipment and enclosures, including but not limited to panels, instrumentation equipment, switchgear, motor control centers, transformers, generator, and other assemblies with an operating weight of 500 pounds or more (250 pounds in the case of vibration isolated equipment having seismic restraints) in addition to the above requirements, the Contractor shall submit detailed lateral force support calculations for review by the Engineer which demonstrates that neither the anchor bolting nor the element of the equipment to which the bolts are attached will fail in shear or in tension. Calculations shall be signed by a civil or structural engineer registered in California. Calculations shall include the following steps as a minimum:
  1. Determination of the operating weight and centroid of the equipment, if not already calculated.
  2. Determination of the shear and overturning forces at each anchorage due to a force being applied at the centroid in each direction along the three principal orthogonal axes (use the values obtained in the dynamic analysis in the case of seismically restrained vibration isolated equipment). Refer to 2010 California Building Code to design equipment support and anchorage.
  3. Determination of the shear and tension forces which must be developed by the anchor bolts at each support to resist the forces calculated in Step 2.
  4. Selection of anchor bolting details based on the maximum shear and tension forces calculated in Step 3. As a minimum, details shall include number of bolts, materials, diameter, total length, and embedded length.
- C. Vibration-isolated equipment shall be provided with snubbers capable of retaining the equipment in its designated locations without any material failure or deformation of the snubbers when exposed to a vertical or horizontal force at the contact surface equal to 100 percent of the operating weight of the equipment. Air gaps between retainer and equipment base shall not exceed 1/4-inch.
- D. When anchorage to equipment is to be made of cast-in-place concrete elements, it is imperative that installation of anchorage be coordinated by the Contractor so that anchorage may be installed at time of pouring. If calculations and anchorage details are not submitted prior to placement of concrete, the Contractor shall become responsible for any strengthening of concrete elements because of superimposed seismic loading.

- E. All raceways, ductworks, accessories, appurtenances, etc., furnished or not with equipment shall be anchored to resist a lateral seismic force. This force shall be considered acting at the center of gravity of the piece under consideration. Refer to California Building Code 2010 to design equipment support and anchorage.
- F. Piping with flexible connection and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system.

## **2.10 EQUIPMENT SUPPORTS**

Provide equipment supports for all equipment in accordance with the Contract. All floor mounted electrical equipment shall be mounted on 4-inch concrete pads that extend 4-6 inches all around beyond the plan dimensions of the equipment, except front face shall be 3-inch-maximum. The concrete pad shall have chamfered edges.

## **2.11 OUTDOOR EQUIPMENT**

Provide equipment and devices to be installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 20-degree F to 105-degree F.

## **2.12 CORROSIVE AREA EQUIPMENT**

For all equipment mounted exposed in corrosive areas, including conduits, cabinets, disconnects, etc. provide anti-corrosive paint suitable for the specific corrosive agent and/or enclosures of type NEMA 4X, non-metallic. Refer to Section on Painting.

## **2.13 EQUIPMENT FINISH**

Provide materials and equipment with manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with Section on Painting and with ANSI No. 61, light gray color. Provide two (2) quarts of touchup paint.

# **PART 3 – EXECUTION**

## **3.01 REQUIREMENTS**

All electrical installations shall conform to the codes and standards outlined in this Section. In general, and unless otherwise indicated on drawings, follow equipment manufacturer's written instruction for installation of electrical equipment. Whenever any conflict arises between the manufacturer's instruction, codes and regulations and these contract documents, follow the City Representative's decision. Keep a copy of the manufacturer's installation instructions on the job site available for review at all times.

## **3.02 WORKMANSHIP**

- A. All materials and equipment shall be adequately stayed, braced and anchored and installed in a workmanlike manner, utilizing craftsmen skilled in the particular trade. Appearance and safety, as well as utility, shall be given consideration in the design of details. Provide work that has a neat and finished appearance.
- B. Assign a qualified representative who shall supervise the electrical construction work from beginning to completion and final acceptance.

- C. Qualifications: See Paragraph 1.04.
- D. Ensure that all equipment and materials fit properly in their installations.
- E. Perform any required work to correct improperly fit installations at no additional expense to the City.

### **3.03 EXCAVATION AND BACKFILL**

- A. Excavation, trenching, backfilling, compaction, surface repair shall be in accordance with Division 2 Specification Sections.
- B. Provide the excavation trenching, backfilling, compaction and surface repair for electrical equipment foundations and trenches for conduits as shown on the Drawings.
- C. Exercise caution during all excavation work and avoid damage to existing underground pipes. Exercise extreme caution when working near existing utilities. Field verify the location of all utilities before proceeding with any nearby work.
- D. Call before you dig: 1-800-227-2600 Underground Service Alert (USA).

### **3.04 CONCRETE**

Where shown on the Drawings or specified, provide the required concrete installations for conduit encasement and equipment foundations, in accordance with Division 3 Specification Sections. Concrete shall be of 2000 psi strength for encasement and of 3000 for foundations, unless otherwise indicated in the Civil-Structural Drawings or Division 3 of the Specifications.

### **3.05 INSTALLING EQUIPMENT**

- A. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports per manufacturer's instructions and seismic requirements.
- B. No electrical equipment scheduled for indoor installation shall be installed within a room unless the concrete floor is finished. Storage conditions must be per manufacturer's written direction. Submitted proof of proper storage facilities provision will be required.

### **3.06 CUTTING, CHISELING, DRILLING, AND WELDING**

- A. Provide the required cutting, chiseling, drilling, and welding that are required for the electrical construction work.
- B. Structural members shall not be cut or drilled, except when approved by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry. Use non-destructive methods such as X-ray or pachometer to locate existing structural steel, rebars, and conduits embedded in concrete and masonry.
- C. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel.
- D. Perform patch work with the same materials as the surrounding area. Restore surfaces neatly to original condition. Use skilled craftsmen of the trades involved.

### **3.07 FIELD TESTS**

- A. Tests shall be in accordance with applicable procedures as described in NETA Acceptance Testing Specifications. All medium voltage equipment, including cables, shall be field tested by a qualified independent testing agency.
- B. Give sufficient notice to the City Representative prior to any test so that he may witness the test. All testing shall be documented, and results submitted to City Representative.
- C. Provide the services of a City-approved and recognized independent testing laboratory and pay all costs for performing the inspections and tests as specified herein and in other section of the Contract.
- D. The testing laboratory shall provide all materials, equipment, labor and technical supervision to perform such tests and inspections. It is the intent of these tests to assure that all electrical equipment is operational within industry and manufacturer's tolerances and is installed in accordance with the Contract Documents and manufacturer's instructions. The tests and inspection shall determine the suitability for energization.
- E. The testing laboratory shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907. Membership in the International Electrical Testing Association (NETA) constitutes proof of meeting such criteria. The testing laboratory shall submit proof of these qualifications to the City Representative for review.
- F. Perform routine insulation resistance, continuity and rotation tests for all distribution and utilization equipment prior and in addition to tests performed by the testing laboratory specified herein. Supply a suitable and stable source of test power to the testing laboratory at each test site. The testing laboratory shall specify requirements. Notify the testing laboratory when equipment becomes available for acceptance tests.
- G. Work shall be coordinated to expedite project scheduling. All testing shall be performed in the presence of the City Representative. The testing laboratory shall be responsible for implementing all final settings and adjustments on protective devices and tap changes. Any system material or workmanship, which is found defective based on acceptance tests, shall be reported directly to the City Representative. The testing laboratory shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.
- H. The testing laboratory shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:
1. Field instruments - 6 months maximum.
  2. Laboratory instruments - 12 months.
  3. Leased specialty equipment - 12 months.
- Date calibration labels shall be visible on all test equipment.
- I. Where testing pursuant to NETA requirements is required to these specifications, submit a test report which includes the following:
1. Summary of project
  2. Description of equipment tested
  3. Description of test
  4. List of test equipment used in calibration and calibration date.
  5. Test results
  6. Conclusions and recommendations
  7. Appendix, including appropriate test forms

The test report shall be bound and its contents certified. Submit five (5) copies of the completed report directly to the City Representative no later than thirty (30) days after completion of the test unless directed otherwise. Number of reports to be submitted for review shall be the same as the number required for shop drawing submittals.

- J. Safety practices shall include, but are not limited to, the following requirements:
1. Compliance with NFPA 70E – Standards for Electrical Safety Requirements of Employee workplaces.
  2. Occupational Safety and Health Act - OSHA.
  3. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
  4. Applicable state and local safety operating procedures
- K. All field tests shall be performed with apparatus de-energized except where otherwise specifically required by the latest Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems published by NETA. The testing laboratory shall have a designated safety representative who shall be present on the project and supervise operations with respect to safety. Circuits operating in excess of 600 volts between conductors shall have conductors shorted to ground by a hot-line grounded device approved for the purpose. In all cases, work shall not proceed until the safety representative has determined that it is safe to do so. The testing laboratory shall have available sufficient protective barriers and warning signs to conduct specified test safely.
- L. Electrical equipment and materials furnished and installed by the Contractor and the testing equipment listed below shall be tested in accordance with the "Inspection and Test Procedures" and "System Function Tests" of the latest Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems published by NETA. Tests shall not include any tests listed as optional in the aforementioned NETA Specifications unless specifically noted in respective equipment specifications for this project.
- M. Retesting shall be required for all unsatisfactory tests after the equipment or system has been repaired or replaced. Retest all related equipment and systems if required by the City Representative. Repair and retest equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained. Repairs shall be per manufacturer's instruction and approval.
- N. Putting Equipment and Cables into Service: Submittal and favorable review of the specified factory and field tests shall occur before the Contractor is permitted to place the representative equipment or cable into service.

### **3.08 LOAD BALANCE**

Balance electrical load between phases, as nearly as possible, on panelboards, etc.

### **3.09 MOTOR ROTATION**

After final service connections are made, check and correct the rotation of all motors.

### **3.10 CLEANING EQUIPMENT**

Thoroughly clean all soiled surfaces of installed equipment and materials.

### **3.11 CLEAN-UP AND TOUCHUP**



Always keep the premises free from accumulation of waste material, litter and rubbish. Upon completion of daily work, remove all materials, scraps and debris from premises and from interior and exterior of all devices and equipment. The interior of all electrical equipment shall be vacuumed and wiped free of dust just before final acceptance. Energization of equipment shall be approved by the City. Touchup scratches, scrapes or chips in interior and exterior surfaces of devices and equipment with finishes matching the type, color, consistency and type of surface of the original finish.

If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications and that is acceptable to the City Representative. Painting shall be in accordance with Section on Painting. Unpainted boxes, cabinets and raceways that are mounted on walls that are painted or to be painted shall be painted the same color as the wall.

### **3.12 SAFETY REQUIREMENTS**

- A. The Contractor shall conduct his/her operations in accordance with the rules and regulations of the California Division of Industrial Safety and the current requirements of the California Occupational Safety and Health Administration (Cal. OSHA).
- B. The Contractor shall have full responsibility for the safety of his/her personnel, and shall ensure that conductors, which could become energized through operation of existing equipment, are properly grounded while work is being performed on them, and that such grounds are removed after the work is completed.
- C. Electrical clearances necessary for performance of the Contractor's work shall be arranged through the City Representative. At least 48 hours advance notice shall be required. Such work shall not proceed until approval has been given by the City Representative.

### **3.13 ELECTRICAL CONNECTIONS FINAL CHECK**

Contractor shall verify all bolts torque connections of all MCCs, and switchboards, 30 days after energization. This work shall be coordinated with the plant so the plant can be run without interruption. This must be witnessed by City Representative.

**END OF SECTION**

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**SECTION 26 05 00****COMMON WORK RESULTS FOR ELECTRICAL****PART 1 – GENERAL****1.01 DESCRIPTION**

- A. This Section specifies the requirements for basic materials and methods for electrical work as necessary to support the Sections in Division 26 which specify particular categories of electrical work.
- B. The Contract Drawings show facilities diagrammatically and do not show offsets, fittings, and accessories that may be required. Investigate carefully the structural and finish conditions affecting the work, and provide such fittings and accessories as required.

**1.02 INTERFACE AND COORDINATION**

- A. Interface and coordinate the work of this Section with the other Sections of this Division 26, Electrical, as required to provide a complete and operable electrical installation.

**1.03 REFERENCE STANDARDS**

- A. American National Standards Institute (ANSI) C80.1: Rigid Steel Conduit-Zinc Coated.
- B. ASTM International (ASTM):
  - 1. ASTM A 123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 2. ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 3. ASTM A 386: Zinc Coating (Hot-Dip) on Assembled Steel Products.
  - 4. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - 5. ASTM D 1000: Pressure-Sensitive Adhesive Coated Tapes Used for Electrical Insulation.
  - 6. ASTM D 3005: Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

- C. Institute of Electrical and Electronics Engineers (IEEE).
- D. International Conference of Building Officials (ICBO): Uniform Building Code (UBC).
- E. National Electrical Testing Association (NETA): Acceptance Testing Specification.
- F. National Electrical Manufacturers Association (NEMA):
  - 1. NEMA KS1: Enclosed Switches.
  - 2. NEMA RN1: Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - 3. NEMA WC 7: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
  - 4. NEMA WD 1: General Requirements for Wiring Devices.
  - 5. NEMA FB 1: Fittings and Supports for Conduit and Cable Assemblies.
- G. National Fire Protection Association (NFPA): NFPA 70 National Electrical Code (NEC).
- H. Underwriters Laboratories, Inc. (UL):
  - 1. UL 5: Surface Metal Raceways and Fittings.
  - 2. UL 6: Rigid Metal Conduit.
  - 3. UL 20: General-Use Snap Switches.
  - 4. UL 50: Cabinets and Boxes.
  - 5. UL 486: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
  - 6. UL 498: Attachment Plugs and Receptacles.
  - 7. UL 514A: Metallic Outlet Boxes.
  - 8. UL 514B: Fittings for Conduit and Outlet Boxes.

#### **1.04 REGULATORY REQUIREMENTS**

- A. California Code of Regulations, Title 24, Part 2.

- B. California Electrical Code, Title 24, Part 3.
- C. CAL/OSHA Standards and California Electrical Safety Orders, Title 8.
- D. National Electrical Safety Code (NESC).
- E. City and County of San Francisco Department of Public Works Bureau of Engineering Standard Specification Part 6 Electrical Work.
- F. City and County of San Francisco Electrical Code.

### 1.05 LABELING REQUIREMENTS

- A. All equipment and devices furnished shall be listed and labeled by the Department of Building Inspection (DBI) approved testing agency.
- B. All existing panels shown to be retrofitted or modified shall be relabeled by using a DBI approved testing agency.

### 1.06 SUBMITTALS

- A. In addition to the requirements of the Standard Specifications, Bureau of Engineering, Submittals shall be made in accordance with the following provisions of the GENERAL CONDITIONS:
  - 1. Section 01 33 00 – Submittal Procedures
  - 2. Section 01 75 60 – Testing Coordination and Start-up Testing
  - 3. Section 01 77 00 – Closeout Procedures
  - 4. Section 01 78 23 – Operations and Maintenance Data
  - 5. Section 01 78 36 – Warranties
  - 6. Section 01 78 39 – Project Record Documents
- B. List of Materials: At least 30 days before beginning the work of this Section, submit a list of materials and equipment proposed for use together with applicable standards. Give name of manufacturer, brand name, and catalog number of each item. Submit the list complete at one time, with items arranged and identified in numerical sequence by Specification Section and Paragraph Number.
- C. Compliance with Applicable Standards:
  - 1. Where equipment or materials are specified to conform to the standards of organizations such as ANSI, ASTM, IEEE, NEMA, and UL, submit evidence of such conformance for review and record purposes.
  - 1. The label or listing of the specified agency will be acceptable evidence.

2. Where an equipment does not have a label or listing by an approved agency, the Contractor may submit a written certificate from an approved, nationally recognized testing organization, adequately equipped and competent to perform such services, stating that the items have been tested and that the panels conform to the specified standards. Note, UL recognized components in UL listed enclosure will not satisfy panel listing requirements. Nationally recognized testing organizations shall be as approved by the Department of Building Inspection of the City and County of San Francisco. Up-to-date list of approved agencies can be obtained by contacting the Department of Building Inspection.
  3. Submit evidence of compliance to seismic safety requirements in accordance with the California Building Code, Title 24.
- D. Factory Test and Inspection Certification:
1. Except as otherwise specified herein, where factory tests and inspections for materials and equipment for which tests and inspections specified in referenced documents are waived, provide certified copies of reports for tests performed on previously manufactured identical materials or equipment within the previous 12 months.
  2. Accompany test reports by signed statements from the manufacturer certifying that the previously tested material or equipment is physically, mechanically, and electrically identical to that proposed for the project. Include wiring and control diagrams.
  3. All factory tests report and associated manufacturer's certifications shall be included in the final Operations and Maintenance Manuals for the respective equipment and materials.
- E. Shop Drawings: Showing the exact location and arrangement of conduits stubbed into future equipment, cabinet, pull boxes and assigned spaces, conduit sleeves for future exposed conduits, and for fabricated work being furnished and installed under these Specifications. Submit such drawings before rough-in work, fabrication, and within ample time to prevent delays in the Work. Include electrical diagrams for equipment and equipment installation.
- F. Field Test Reports: Certified field test reports of field tests, verifying performance of equipment and systems with Specification requirements.

## PART 2 – PRODUCTS

## 2.01 GENERAL

- A. Furnish materials and equipment of design, sizes, and ratings as indicated.
- B. Furnish materials and equipment bearing label or classification listing of a national recognized testing laboratory where UL standards exist, and such product labeling or listing is available. Electrical materials shall comply with NFPA 70 and NFPA 130 as required.
- C. Methods of fabrication, assembly, and installation are optional unless otherwise indicated.
- D. Provide products that are free from defects which may impair performance, durability or appearance, and of the industrial grade best suited for the purpose indicated or specified in these specifications.
- E. Materials manufactured for use as raceways (except PVC coated conduit), boxes, cabinets, equipment enclosures, and their surface finish material shall be capable of being subjected to temperatures up to 932 degrees F (500 degrees C) for one hour and shall not support combustion.
- F. The type of raceway(s) to be used in a specific project or designated area of a specific project shall be as noted on the drawings. The Contractor is hereby warned to study the accompanying drawings to determine the type of raceway(s) that will be used in the project and determine the type of material and associated costs prior to submitting the bid. Failure to determine the specific type of raceway(s) to be used in the specific project shall not make the Contractor eligible for additional compensation to do the contract work.

## 2.02 CONDUIT AND FITTINGS

- A. Galvanized Rigid Steel (GRS) Conduit and Accessories: Used in existing Electrical and Control Rooms only
  - 1.. Where indicated on the plans, provide GRS conduit, couplings, elbows, bends, sealing fittings, and nipples conforming to ANSI C80.1 and UL 6, with each length bearing manufacturer's stamp and UL label.
  - 2. Fittings and Accessories:
    - a) Provide separable watertight hub fittings with a gasket, separate nylon insulated throat, and a case-hardened locknut.
    - b) Provide bushings of nylon-insulated metallic and grounding type.
    - c) Provide conduit straps, clamps backs made of galvanized malleable iron.

- d) Minimum trade size shall be 3/4-inch diameter.
- B. PVC Coated Rigid Steel Conduit and fittings: See Section 26 05 33.26
- C. Liquid tight Flexible Metallic Conduit and Fittings:
- 1. Provide conduit consisting of a core of flexible galvanized steel with an extruded liquid tight plastic or neoprene jacket overall. Jacket shall be moisture- and oil-proof, capable of conforming to the minimum radius bends of flexible conduit without cracking.
  - 2. Provide conduits with a continuous copper bonding conductor spiral wound between the convolutions, as required by NEC Article 351-9.
  - 3. Provide fittings conforming to UL 514B, cadmium-plated or zinc-coated, and approved for grounding in conformance with NEC article 351-9.
- D. Conduit Expansion Fittings:
- 1. Fittings shall provide for a movement of 3/4-inch from normal in all directions.
  - 2. Fittings shall allow for an angular deflection of 30 degrees in any direction.
  - 3. Fittings shall be provided with flexible copper braid bonding jumper with thermal capacity to carry ground fault currents equal to wire sizes required by UL Standard 467 and the National Electric Code.
  - 4. Fittings shall be O.Z. Gedney Type DX, Crouse-Hinds Type XD, or approved equivalent product.

### 2.03 CONDUIT HANGERS

- A. Provided trapeze type multiple pipe or conduit hangers and supports as indicated or required.
- B. Fabricate hangers from two or more steel hanger rods, a steel horizontal member, U-bolts, clamps, and other attachments as necessary for securing hanger rods, and conduits.
- C. Stainless steel or hot-dipped galvanized hangers shall be used in wet or corrosive areas.
- D. Provide galvanized hanger rods not smaller than 3/8-inch diameter, threaded either full length or for a sufficient distance at each end to permit at least 1-1/2 inches of adjustment.



- E. Provide horizontal member meeting the following requirements:
1. Standard structural steel shapes such as angles or channels, 1-1/2 by 1-1/2 or 1-5/8 by 1-5/8 inches, 12 gauge, cold-formed, lipped channel, and designed to accept special spring-held hardened nuts for securing hanger rods and other attachments. Nuts and clamps shall be compatible with the channel.
  2. Two or more channels may be welded together to form horizontal members of greater strength.
  3. Galvanize after fabrication in accordance with ASTM A 123 or ASTM A 153, as applicable.
- F. Design of conduit hangers shall meet the following requirements:
1. Capable of supporting a load equal to the sum of the weights of the conduits and wires, the weight of the hanger itself, plus 200 pounds.
  2. The stress at the root of the thread of the hanger rods shall be not more than 9,475 psi at design load.
  3. Size the horizontal member such that the maximum stress will be not more than 12,650 psi at design load.

## 2.04 INSERTS

- A. Channel Inserts:
1. Fabricate from not less than 12-gauge steel channel having an overall size of 1-5/8 by 1-5/8 inches with continuous 7/8-inch wide slot, in lengths as indicated. Galvanize after fabrication.
  2. Inserts for embedding in concrete shall conform to the following requirements:
    - a) Fabricate from channels having a solid base.
    - b) Weld concrete anchors to the channel during fabrication and before coating.
    - c) Clean and galvanize after fabrication.
    - d) Provide assemblies with a minimum pull-out load rating of 2,000 pounds per linear foot uniformly distributed, with a safety factor of

three.

- e) Furnish channel inserts for installation embedded in concrete with the channel interior completely filled with styrofoam to prevent seepage of concrete into the channel during installation.
3. Inserts for surface mounting shall conform to the following requirements:
- a) Fabricate from channel having 3/8-inch by three-inch slots on four-inch centers in the base.
  - b) Galvanize, ASTM A 153, inserts for surface mounting on concrete surfaces and for installation in damp or wet areas.
- B. Spot Inserts for Embedding in Concrete:
- 1. Steel galvanized after fabrication, ASTM A 153.
  - 2. Design for a maximum loading of 800 pounds with a safety factor of three.
  - 3. Knockout openings to accommodate either square or rectangular nuts.

## 2.05 WIREWAYS AND FITTINGS

Where indicated on the drawings, provide lay-in wireway made of 12-gauge galvanized steel bodies with 14-gauge cover and 10-gauge end flanges conforming to NEMA/EEMAC Type 12 requirements. Unit shall be as manufactured by Hoffman or equal. Unit shall be continuously welded and ground smooth, with no holes or knockouts. Edges on all sections and fittings shall be made to prevent damage to insulation. Covers shall have stainless steel quick-release latches to permit immediate access to interior of unit. Size of wireway is as noted on the drawings. Units shall be installed supported by stainless steel unistruts anchored to the existing floors unless otherwise noted in drawings.

## 2.06 OUTLET, JUNCTION, AND PULL BOXES

- A. Provide outlet boxes, junction, and pull boxes conforming to NFPA 70, Article 370.
- B. Electrical boxes shall conform to UL 50, Cabinets and Boxes, and UL 514B, Fittings for Conduit and Outlet Boxes.
- C. Provide electrical boxes of the material, finish, type, and size indicated and as required for the location, kind of service, number of wires, and function. Boxes shall have mounting holes for No. 10-24 machine screws.

- D. Provide boxes complete with accessible covers designed for quick removal and suitable for the purpose for which they will be used, except boxes in which, or on which, no devices or fixtures are to be installed shall be equipped with flat or raised blank covers as required.
- E. Boxes below 100 cubic inches in size shall be cast metal. Boxes over 100 cubic inches in size shall conform to the requirements for cabinets, except boxes in interface pull boxes shall be cast metal boxes with gasketed cast metal covers.
- F. Covers shall be of same thickness as boxes and shall be secured in position by means of No. 10-24 stainless steel machine screws. Arrange covers to be readily and conveniently removed.
- G. Provide brackets, supports, hangers, fittings, bonding jumpers, and other accessories as required.
- H. Provide neoprene gaskets 1/8-inch thick for boxes subjected to weather. Provide fire resistant gaskets for pull boxes installed at the conduits for emergency equipment, feeder cables and fire protection circuits.
- I. Provide each box with a grounding terminal as follows:
  - 1. Provide grounding terminal of either a green-colored washer-in-head machine screw not smaller than No. 10-32 in a drilled, tapped, and threaded hole in the back of the box, or a grounding bushing with green-colored machine screw terminal attached to one of the conduits.
  - 2. Provide grounding terminals in motor connection boxes.
  - 3. Install grounding jumpers as specified in Section 26 05 26 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- J. Junction boxes shall be stainless steel inside and outside unless otherwise noted on drawings. Where outlet boxes are used as junction boxes, they shall not be smaller than four inches square by 1-1/2 inches deep. Provide such boxes with gasketed cast metal flat blank covers.

## **2.07 CONNECTORS AND INSULATING TAPES**

- A. Splice and Terminal Connectors:
  - 1. Provide termination fittings for use with the cable furnished, NEMA standard, and UL 486 listed.
  - 2. Termination and splice fittings for No. 10 and smaller conductors shall be compression type. Wires to be connected together shall be grouped and

fitted into an appropriately sized tin-plated copper sleeve. After compressing with an appropriate tool, cover the connector with a nylon insulating cap. Wire splices shall comply with UL 486C. Screw-on and spring pressure type connectors shall not be used.

3. Termination and splice fittings for No. 8 and larger conductors shall be tool-applied compression connectors of material and design compatible with the conductors for which they are used.
4. Terminal connectors for conductor size No. 4/0 and larger shall be long-barrel, double-compression type, and shall be furnished with two NEMA standard bolting holes in the pad.
4. Provide heat-shrinkable insulator for every compression type connector.

B. Insulating Material for Splices and Terminations:

1. Provide insulating material for splices and termination of type accepted by the City Representative for the particular use, location and voltage, of 3/4-inch nominal width.
2. Plastic electrical insulating tape for general use shall be vinyl plastic with rubber-based pressure-sensitive adhesive, and shall be pliable at temperature of minus 18 degrees C to 105 degrees C. When tested in accordance with ASTM D 3005, the tape shall have the following minimum properties:
  - a) Thickness: Seven mils.
  - b) Breaking Strength: 15 pounds per inch.
  - c) Elongation: 200 percent.
  - d) Dielectric Strength: 10,000 volts/mil.
  - e) Insulation Resistance (Direct method of electrolytic corrosion): Ten megohms.
3. Rubber electrical insulating tape for protective overwrapping shall be silicone rubber with a silicone pressure-sensitive adhesive. When tested in accordance with ASTM D 1000, the tape shall have the following minimum properties:
  - a) Elongation: 525 percent.
  - b) Dielectric Strength: 13,000 volts.

- c) Insulation Resistance (Indirect Method of Electrolytic Corrosion): Ten megohms.
4. Arc proof tape shall be flexible, comfortable organic fabric, coated one side with a flame-retardant flexible elastomer, self-extinguishing, with the following minimum properties:
  - a) Thickness, ASTM D 1000: 55 mils.
  - b) Tensile Strength, ASTM D 1682: 50 pounds per inch.
  - c) Thermal Conductivity, ASTM D 1518: 0.0478 Btu/hour/square foot/ degree F.
  - d) Electrical Arc Resistance: Withstand 200 ampere arc for 40 seconds.
5. Mark each tape package to indicate shelf-life expiration date.

## 2.08 WIRING DEVICES

### A. General:

1. Provide wiring devices conforming to NEC Article 410-57 requirements for wet locations.
2. Provide heavy-duty cast iron alloy or die cast copper free aluminum single-gang and multi-gang boxes for wiring devices, Crouse-Hinds Type FD, Hubble 273-L, Appleton Electric, or approved equivalent product.

### B. Switches:

1. Provide AC tumbler-toggle switches conforming to minimum requirements of UL 20 and the requirements herein specified, of specification grade and heavy-duty type, Hubble No. 1221, Bryant No. 4901, General Electric No. GE5951-1, or approved equivalent product.
2. Switches for use on incandescent or fluorescent lighting circuits shall be fully rated 20 amperes at 120 or 277 volts.
3. Switches controlling straight resistance loads may be snap switches as specified herein, of the proper rating up to 30 amperes at 120-277 volts.
4. Provide ac 120-277 volt snap switches capable of withstanding tests as outlined in NEMA WD 1, Paragraphs WD 1-2.04, WD 1-2.05A, WD 1-2.05C, WD 1-2.05E2, WD 1-2.05F2, and WD 1-2.05G. If requested by

the Engineer, submit evidence that the types of switches proposed have satisfactorily withstood these tests.

5. Provide heavy-duty cast-iron alloy or die cast copper free aluminum raintight covers for switches, Crouse-Hinds DS181, Appleton Electric, or approved equivalent product.

C. Receptacles:

1. Provide convenience outlet and power outlet receptacles conforming to UL 498 and NEMA WD 1 for heavy duty general use type.
2. 120 volt convenience outlet receptacles shall be NEMA 20R configuration single or duplex receptacles as indicated.
3. Provide heavy die cast iron alloy or die copper free aluminum cover plates for receptacles, UL listed for wet locations and conforming to NEC Article 410-57, Crouse-Hinds Type WLRS or WLRD, Hubble 7420, or approved equivalent product. Cover plates shall have gasketed self closing spring door.
4. For special purpose outlets commercially produced using special material, configuration and size, provide heavy duty cover plates designed for the particular application.

## 2.09 LOCAL CONTROL STATIONS

Where indicated on the drawings, Provide heavy duty local selector switches, hand-off-automatic control stations, and push button (Start/Stop) stations rated as 600 volts and conforming to UL Standard 698, Crouse-Hinds Type EFS, Appleton Electric, or approved equivalent product. Push-button stations for local control of equipment shall have maintained contacts or be manually lockable in the Stop position.

## 2.10 INDICATING LIGHTS AND SELECTOR SWITCHES

A. Indicating Light, Single

1. Units shall be heavy-duty industrial push-to-test type indicating lights rated for 150-volt, oil tight service. Units shall be single-hole mounting, accommodating panel thickness from 1/16-inch minimum to 1/4-inch maximum. All indicating lamps shall be push-to-test LED type.
2. Units shall be approximately 1-1/2 inch square with a legend illuminated by a minimum of two lamps energized in parallel. The legend shall be permanently marked as indicated, with lens color as specified.

3. Units shall have an integrally mounted transformer for each lamp to step down the 120-volt, 60-Hz input voltage to 6-volt lamp excitation voltage, unless otherwise noted.
  4. Units shall be Allen Bradley Bulletin 800T; Idec, TW Series, Cutler-Hammer, File 10250T or equal.
- B. Selector Switches
1. Units shall be heavy-duty, oil tight, industrial type selector switches with contacts rated for 120V ac service at 10 amperes continuous. Units shall have standard size, black field, legend plates with white markings, as indicated. Operators shall be chrome bezel black knob type. Provide switches with the number of positions and contact arrangements and spring return function (if any) as shown on the drawings. Units shall be single-hole mounting, accommodating panel thicknesses from 1/16-inch minimum to 1/4-inch maximum.
  2. Units with up to four selection positions shall be Allen Brandley Bulletin 800T; Idec, TW Series; Cutler-Hammer File E22, or equal.

## 2.11 DISCONNECTING DEVICES

- A. Safety Switch Type Disconnecting Devices: Provide safety switch disconnecting devices, enclosed, conforming to IEEE C37.35.
- B. Heavy-duty Safety Switches (600 Vac):
1. Provide heavy-duty safety switches having electrical characteristics, ratings, and accessories as indicated, on the Drawings.
  2. Provide switches with appropriate enclosures, and with metal nameplates, front cover mounted, containing a permanent record of switch type, catalog number, and hp ratings.
  3. Provide handle visible blades, nonteasible, positive, quick-make quick-break mechanism, and padlockable in the OFF and ON positions.
  4. Provide switches meeting NEMA KS 1 requirements.
  5. Provide explosion proof switch in hazardous area as required for Class 1 Division 2 Group C&D application.

## 2.12 DRY-TYPE TRANSFORMERS

- A. Transformer: Provide two-winding, Class H transformer with full capacity taps on the high voltage winding with size as indicated on the Drawings. Conform to NEMA ST 20 and NFPA 70 as applicable. Autotransformer type is not acceptable.
- B. Terminals: Extend terminals of transformer winding from the coil for external connection. Provide proper terminal identification.
- C. Noise Level: Noise level shall not exceed 45 dbA when measured in accordance with NEMA ST 20.
- D. Enclosure: Provide totally enclosed, NEMA 12 enclosure for damp or dust indoor locations unless noted otherwise on plans.
- E. Finish: Thoroughly clean, degrease, and prime metallic surfaces with an approved galvanized primer, and finish with ANSI Z55.1-67 enamel, Color No. 61.

### **2.13 EQUIPMENT IDENTIFICATION**

Provide identification tag for each switch, outlet, junction box, local control station, control panel, panelboard, disconnecting device, and dry-type transformer. Identify the system, component, circuit, and location being served.

### **2.14 METER PEDESTAL**

- A. The meter pedestal shall be built to UL 508A standards and meet PG&E standard requirements.
- B. This unit shall be constructed of 316 stainless steel, NEMA 3RX rated, no exposed fasteners, durable all continuous welded seams construction, vandal-resistance door with hasp.
- C. Finish: Thoroughly color coatings that will withstand most stringent testing applied to outdoor environments. The color shall match to the existing meter pedestal nearby.
- D. Acceptable manufacturer: TESCO Controls, Inc, Millbank, approved equal.

### **2.15 PORTABLE GENERATOR POWER INLET**

- A. The power inlet for portable generator shall be twist locked and suitable for outdoor environment.



- B. This unit shall be constructed of stainless steel 316 with superior painting provided excellent corrosion protection.
- C. This unit shall be all in one construction with factory assembled termination and rolled edge door for cord protection. Dead front construction prevents accidental contact with live parts.
- D. The cover shall be provided to allow power cords to exist while still maintaining NEMA 3R integrity of the housing.
- E. Padlock provision shall be provided to prevent unauthorized access by unauthorized personnel.

## 2.14 ELECTRIC MOTORS

- A. Unless otherwise specified, motors for general purpose use shall be Squirrel Cage induction, totally enclosed fan cooled meeting the following requirements:
 

1.	Volts	460 or 208 volts as required
2.	Frequency	60 Hertz
3.	Phase	3
4.	Insulation	Class B
5.	Service Factor	1.15
6.	Duty --	Continuous
7.	Position	Horizontal
8.	Starting	Full Voltage
9.	Bearings	Ball, rated for 30,000 hr. operation
- B. Explosion proof motor shall meet all the above requirements except the motor shall be totally enclosed non-ventilated type with Class F insulation. Motor nameplate shall indicate for which group of explosion proof classification the motor was listed for by the approved listing agencies.
- D. All motors furnished shall be designed and constructed to give satisfactory performance at any value or frequency and/or voltage 10% above or below normal. The motor shall be as manufactured by General Electric Co., U.S. Motors, Reliance or equal.
- D. Frames, End Bells, Fan Guards and Rain Guards:
  - 1. Frames, including feet, bearing housings, and end bells shall be cast iron. Fan covers shall be cast iron or a proven plastic fiberglass equivalent. Cover openings shall be per NEMA MG1-1.26.10 "Guarded" requirements. Vertical motors shall be equipped with corrosion resistant rain guards.

2. Fans shall be non-sparking, corrosion resistant bronze alloy approved plastic. Cast iron fans may be used for non-explosion proof motors with the approval of the City Representative. All fans shall be bi-directional.
3. Fans shall be fastened to the shaft by key; band type clamping is not acceptable. A metal hub design shall be used for all plastic fans to assure positive attachment to the shaft.
- E. Rating, Performance and Tests comply with all applicable Sections of NEMA MG1- 1987.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION – GENERAL**

- A. Install electrical materials, equipment, and accessories in locations as indicated, rigid and secure, plumb and level, and in alignment with related and adjoining work to provide a complete and operable system. Do not weld electrical materials for attachment or support.
- B. Control erection tolerance requirements to not impair the strength, safety, serviceability, or appearance of the installations. Determine exact locations of conduit. Route conduit parallel to building lines unless otherwise indicated.
- C. The trade size, type, and general routing and location of conduits, raceways, and boxes shall be as indicated or specified.
- E. Install exposed conduit to avoid conflicts with other work. Install horizontal raceways close to the ceiling or ceiling beams, and above water or other piping wherever possible.
- F. Install individual conductors and multiple-conductor sheathed cables in conduits, raceways, cable trays, ducts, and trenches as indicated to complete the wiring systems.
- G. Install switches, receptacles, special purpose outlets, and cover plates complete in a neat manner in accordance with the NFPA 70 and local electrical codes. Plug unused opening in boxes, cabinets, and equipment.
- H. Use of explosive fasteners is prohibited.

### **3.02 CONDUIT AND FITTINGS**

- A. Electrical Conduit - Installation Requirements:

1. Install conduit in accordance with NFPA 70, NFPA 130, and as indicated. Prevent concrete and other materials from entering and obstructing the conduit, outlets, and pull and junction boxes. Do not use conduit smaller than 3/4-inch size.
2. Unless otherwise indicated, make conduit bends in accordance with NFPA 70, with not more than three quarter bends, 270 degrees total, per run of conduit for communications and four quarter bends, 360 degrees total otherwise. Where more bends are required in a particular run, install pull boxes as required to facilitate pulling conductors even if not indicated.
3. Provide and install metallic numbering tags indicating the conduit number on both ends of all conduits. Identify the control and communication conduit and provide them with plug for open end.
4. Install conduit so that moisture collecting in the conduit will be drained to the nearest outlet or pull box.
5. Whenever exposed or buried conduit passes through an expansion or contraction joint in the structure, install the conduit at right angles to the joint, and provide an approved conduit expansion fitting at the joint.
6. Paint the conduit with an approved bituminous compound for one foot on each side of the expansion couples.
7. Provide expansion fittings in conduit runs where required to compensate for thermal expansion.
8. Rod and swab embedded conduit after installation to remove foreign matter. If obstructions are encountered which cannot be removed, or if conditions exist which may result in damage to wires and cables pulled through the conduit, install new conduit at no additional cost to the City.
9. After the conduit has been rodded and swabbed, install covers on boxes and protect conduit ends to prevent foreign material from entering the conduit.
10. Where conduit is exposed to different temperatures, seal the conduit to prevent condensation and passage of air from one area to the other.
11. Metallic conduits shall be electrically and mechanically continuous and connected to ground by bonding to the grounding system where required.
12. Apply conductive compound to the threads of threaded rigid conduit joints. Do not use compounds containing lead. Terminate the conduit in

appropriate boxes at motors, switches, outlets, and junction points.

13. When field cutting of conduit is required, thread and ream the conduit to remove rough edges. Where a conduit enters a box or other fitting, provide a bushing to protect the wire from abrasion. Provide insulation type bushings and double locknuts on ends of rigid conduits terminating at steel boxes, panelboards, cabinets, motor starting equipment, and similar enclosures.
14. Support individual horizontal conduits not larger than 1-1/2 inches in diameter by means of one-hole conduit strap with back spacers or individual conduit hangers.
15. Space conduits installed against concrete surfaces 1/4 inch away from the surface by clamp backs or other approved means.
16. Support individual horizontal conduits larger than 1-1/2 inches in diameter by individual hangers and forged steel conduit strap for vertical runs.
17. Hanger rods used in connection with spring-steel fasteners, clips and clamps shall be either 3/8-inch diameter galvanized steel rods or, if concealed above a suspended ceiling, galvanized perforated steel strapping. Do not use wire for support of conduit.
18. Provide metallic tags indicating numbers and total angle of bends in conduits embedded in concrete.
19. In areas of floating slabs, install horizontal runs of conduit beneath the floating slab. Conduit shall pass through the floating slab only where required to terminate in a vertical direction as indicated. Provide a sleeve with an all around 1/4-inch clearance between sleeve and vertical conduit riser. Fill the space around the conduit with rubber-base waterproofing compound.
20. Tag unscheduled conduit in a manner acceptable to the City Representative. All outside or potentially wet areas installations shall be PGRS.

B. Galvanized Rigid Steel (GRS) Conduit:

1. Terminate conduit installed for future extension with flush threaded couplings set to finished floor level or wall, unless otherwise indicated. Provide plug for open end. Extensions to existing work shall match existing size.

2. Properly support and anchor conduit to be embedded to maintain correct location and spacing and to prevent flotation during concreting operations. If necessary, provide, suitable metal supports.
- C. PVC Coated Galvanized Rigid Steel (PGRS) Conduit and System Components:  
See Section 26 05 33.26.
- D. Liquid tight Flexible Metal Conduit: Install liquid tight flexible metal conduit at structural construction joints, at motor connections, and where required so that liquids tend to run off the surface and not drain toward fittings. Provide sufficient slack to reduce the effects of vibration. Running threads are not acceptable. Where necessary for connecting to rigid conduits, use right and left hand couplings.
- E. Pull Cords:
1. Provide nylon pull cords of tensile strength not less than 240 pounds in each conduit and duct. Leave pull cords in ducts and conduit.
  2. Splices in pull cords will not be permitted.
  3. Leave ample slack length at each end of pull cords.
- F. Filling of Openings: Wherever slots, sleeves, or other openings are provided in floors and walls for the passage of raceways, conduits, and bus ducts, fill such opening as follows:
1. Provide fire-resistive filling material and installation for openings.
  2. Where conduits passing through openings are exposed in finished rooms, use surface filling material that matches, and is flush with, the adjoining finished floor, ceiling, or wall.

### 3.03 CONDUIT HANGERS

- A. Provide anchor bolts and anchorage items as required, and field check to ensure proper alignment and location. Provide templates, layout drawings, and supervision at the jobsite to ensure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.
- B. Install supporting members, fastenings, framing, hangers, bracing, brackets, straps, bolts, and angles as required to set and connect the work rigidly. Conform to UBC requirements for Seismic Zone 4 location.

- C. Support parallel conduits at the same elevation on multiple conduit hangers or channel inserts. Secure each conduit to the hanger or channel insert member by U-bolt, one-hole strap, or other specially designed and approved fastener suitable for use with the hangers or channel inserts.
- D. Space supports not over 10 feet on center for vertical conduits spanning open areas. Securely anchor conduit at each end and run so as not to interfere with the installation and operation of equipment at the location.
- E. Support conduits and raceways above suspended ceilings from either the floor construction above or from the main ceiling support members, by using the applicable methods specified herein.

### **3.04 INSERTS**

- A. General: Install inserts in concrete so as to prevent contact between inserts and rebar and to prevent damage to the rebar coating during installation and placing of concrete.
- B. Channel Inserts: Install embedded channel inserts with the slotted face flush with the finished concrete surface.
- C. Sports Inserts: Install with the insert face flush with the finished concrete surface, firmly embedded, with no evidence of movement.
- D. Field Tests: Test selected inserts, as required by the Engineer, by suspension of 800 pounds of weight from the insert. If there is evidence of failure, replace the inserts in a manner satisfactory to the Engineer at no change in the Contract Price and retest.

### **3.05 NOT USED**

### **3.06 OUTLET, JUNCTION, AND PULL BOXES**

- A. Install so that covers are readily accessible after completion of the installation.
- B. Do not install boxes above suspended ceilings, except where the ceiling is of the removable type or where definite provisions are made for access to each box.
- C. Boxes Set in Concrete:
  - 1. Support boxes to prevent movement during placement of concrete.
  - 2. Locate boxes and box knockouts in concrete so as not to interfere with the reinforcing steel.

3. Unused nailing holes or other holes in the side or bottom of the boxes shall be plugged or masked.
4. After installation, clean boxes placed in concrete and provide covers to prevent entry of dirt and debris.

### **3.07 GROUNDING AND BONDING**

Install as specified in Section 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

### **3.08 WIRING DEVICES**

- A. Unless otherwise indicated on the Drawings, mount outlet and switch boxes on the surface of finished wall or ceiling.
- B. Mount boxes so that the long axis of the devices will be vertical, unless otherwise indicated on the Drawings.
- C. The mounting height indicated for a wall-mounted outlet or switch box shall be construed to mean the height from the finished floor to the horizontal centerline of the cover plate.
- D. Install boxes located near doors on the lock side, even where the symbols appear on the hinge side as indicated, unless other locations are approved by the Engineer.
- E. Locate switches 4 feet above finish floor and general purpose receptacles 2 feet above finished floor, except as otherwise indicated on the Drawings.

### **3.09 WIRING**

Install wiring as specified in Section 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

### **3.10 DISCONNECTING DEVICES**

Mount disconnecting devices so as to provide free and clear access to the disconnect mechanism and to allow opening and maintenance of the device.

### **3.11 DRY-TYPE TRANSFORMERS**

Install dry-type transformers as indicated on the Drawings, in accordance with NEMA criteria, and as recommended by the manufacturer. Installation shall conform to California Building Code for Seismic Zone 4 location.

### **3.12 EQUIPMENT IDENTIFICATION**

- A. Mount equipment identification tags as specified in Division 22 and 23 and Section 26 05 53- IDENTIFICATION FOR ELECTRICAL SYSTEMS.
- B. Mount equipment identification tags on or near the front cover of each switch, outlet, junction box, local control station, control panel, panelboard, disconnecting device, and dry-tape transformer. Do not cover existing equipment nameplates or other existing labeling.
- C. Mount equipment identification tags only on flat, smooth surfaces.

**END OF SECTION**



**SECTION 26 05 19****LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 – GENERAL****1.1 DESCRIPTION**

- A. This Section specifies the requirements for furnishing, installing, and testing all low voltage power cables and wires, process control and instrumentation cables, and the respective accessories as required.
- B. Interface and coordinate the work of this Section with Section 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL.

**1.2 RELATED SECTIONS**

- A. Section 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL
- B. Section 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

**1.3 REFERENCE STANDARDS**

- A. American National Standards Institute (ANSI):
- B. ASTM International (ASTM):
  - 1. ASTM B 3: Soft or Annealed Copper Wire.
  - 2. ASTM B 8: Soft or Annealed Copper Wire Concentric Lay Stranded Copper Conductors, Hard, Medium Hard, or Soft.
- C. Insulated Cable Engineers Association, Inc. (ICEA):
- D. National Electrical Manufacturers Association (NEMA):
  - 1. NEMA WC5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
  - 2. NEMA WC7: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

3. NEMA WC8: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- E. National Fire Protection Association (NFPA) 70: National Electrical Code (NEC).
- F. Underwriters Laboratories, Inc. (UL): 62 Flexible Cord and Fixture Wire.
- G. Rural Electrification Admission Standards (REA): PE 39.
- H. Pacific Gas and Electric Company (PG&E): Engineering Standard No. 33.

#### **1.4 SUBMITTALS**

- A. In addition to the requirements of the Standard Specifications, Bureau of Engineering, Submittals shall be made in accordance with the following provisions of the GENERAL CONDITIONS:
  1. Section 01 33 00 – Submittal Procedures
  2. Section 01 77 00 – Closeout Procedures
  3. Section 01 78 36 – Warranties
  4. Section 01 78 39 – Project Record Documents
- B. Records of the installed length for each type of cable run.
- C. Contractor's cable pulling plan, prior to pulling in cables.
- D. Certified reports for insulation resistance tests of low voltage power and control wires within one week of performing such tests, as referenced in Article 3.3, Field Quality Control, below.
- E. Diagram showing any proposed variations in duct-occupancy from that shown on the Drawings of all new and existing feeders under this Contract for approval.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Provide markings on wire and cable in accordance with applicable NEMA and NEC requirements. Label each item with UL listing approval.
- B. Ship each material securely wrapped, packaged, and labeled for safe handling during shipment and storage.
- C. Store wire and cable in secure and dry storage facility.

#### **PART 2 – PRODUCTS**

## 2.1 WIRE AND CABLE

### A. Low Voltage Power and Control Wires:

1. General: All low voltage power and control wires shall be rated 600 volts.
2. Single Conductor Wire:
  - a. Conductor Material: ICEA stranded or solid, copper meeting requirements of ASTM B 3, soft drawn.
  - b. Insulation Rating: 600 volts, flame and moisture resistant thermosetting dielectric.
  - c. Conductor Type:
    - 1) Size 12 AWG and smaller: solid conductor for Lighting and Receptacles, stranded for others.
    - 2) Size 10 AWG and larger. Class B stranded.
  - d. Size 14 AWG to 1/0 AWG: NFPA 70, Type XHHW, cross-linked-thermosetting-polyethylene-insulated in accordance with NEMA WC7; or NFPA 70, Type RHH, ethylene-propylene-rubber-insulated neoprene jacketed in accordance with NEMA WC 8.
  - e. Size 2/0 AWG and larger: NFPA 70, Type RHH, ethylene-propylene-rubber-insulate neoprene jacketed in accordance with NEMA WC8.
  - f. Temperature Rating: Temperature ratings of cables shall be not less than 90 degrees C at continuous load.
  - g. Color Coding of Conductors:
    - 1) 120/208 Volts:
      - a) A: Black.
      - b) B: Red.
      - c) C: Blue.
      - d) Neutral: White.
      - e) Ground: Green.
    - 2) 480/277 Volts:
      - a) A: Brown.
      - b) B: Orange.
      - c) C: Yellow.
      - d) Neutral: White.

- e) Ground: Green.
  - 3) Branch circuit phase conductors No. 10 and smaller and all neutral and equipment conductors shall be solid color insulation.
  - 4) Phase conductors having colored tracers shall have background color other than white or green.
  - 5) Solid color coatings and tracers shall have a strongly adherent paint or dye not injurious to the insulation and which will not be obliterated by pulling into a conduit or raceway.
  - 6) On-site coloring of ends of conductor may be permitted by the Engineer upon receipt of satisfactory evidence that the Contractor is unable to order color coded wire and cable as specified.  
Provide certification from the cable manufacturer that the paint or dye proposed for field application is non-injurious to the insulation.
3. Fixture Wire:
- a. Provide fixture wire conforming to UL 62 and the following additional requirements:
    - 1) Type: SF-2 silicon rubber insulated.
    - 2) Conductor: Stranded copper conductor 16 AWG or larger as indicated.
- B. Process Control & Instrumentation Cables:
- 1. 4 to 20 mA Signal Cables: Provide cable of two conductor, single twisted pair, #16 AWG (unless noted otherwise on the drawings), tinned copper, 600 volt polyethylene insulated, Bedfoil aluminum polyester shield, stranded tinned copper drain wire, chrome vinyl jacket.
  - 2. Type 1 Cable (600V Multi-Twisted, Shielded Pairs with Common Overall Shield):
    - a. Individual Conductors: No. 16 AWG, seven-strand copper. 15-mil thickness PVC insulation, nylon overcoat, rated for 90 degrees C (dry location), with black and white numerically printed and coded pairs.
    - b. Assembly: Individual conductors twisted into pairs, pairs individually covered with an aluminum-polyester shield with a tinned copper drain wire. The conductor bundle covered with an overall aluminum-polyester shield and provided with #18

AWG tinned copper drain wire. The outer jacket shall be 40-mil minimum PVC rated 90 degrees C minimum.

- c. Use only 2-, 4-, 8-, 24-, 36-, and 50-pair cable.

<u>No. of Pairs</u>	<u>Max. Outside Dia. (In.)</u>
2	0.50
4	0.60
8	0.75
16	1.05
24	1.29
36	1.48
50	1.79

- d. Manufacturers: Belden, Anixter, or equal.

- e. All multi-conductor instrumentation cables shall be Type 1 unless noted otherwise. Conductors shall run end to end with no splices.

3. Multi-Shielded Triad Signal Cables: Provide #18 AWG (unless noted otherwise on the drawings), stranded conductor cable of three conductors, single twisted triad, each triad cabled with a Bedfoil shield and #20 AWG stranded tinned copper drain wire. The triad conductor bundle covered with an overall aluminum-polyester shield and provided with #20 AWG tinned copper drain wire. The outer jacket shall be 40-mil minimum PVC rated 90 degrees C minimum.
4. Process control and instrumentation cables shall comply with UL Subject 1227 (NEC Articles 318, 340, and 501) Class I, 600V 90°C.

#### C. Motor Connection Kits

Provide low voltage motor connection kits consisting of heat-shrinkable, polymeric insulating material, flame-retarded per IEEE 383, to cover the connection area and a high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Motor connections shall be suitable for continuous operation at conductor temperatures of 90°C.

## 2.2 SOURCE QUALITY CONTROL

All wires and cables shall be factory tested to ensure that it has been manufactured in accordance with the applicable standards.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Low Voltage Power Cables and Wires:

1. Provide wiring systems complete as indicated. Provide ample slack wire for motor loops, service connections, and extensions.
2. Do not bend cables during installation, either permanently or temporary, to radii less than 12 times the outer diameters, except where conditions make the specified radius impracticable and shorter radii are permitted by NFPA 70 and NEMA WC 7, Appendix N.
3. Bundle cable and conductors neatly and securely with nylon straps located in branch circuit panelboards, cabinets, control boards, switchboards, and motor control centers. Use nylon bundling straps. Bundle power cables separate from control cables.
4. Install motor feeders, service connections, and extensions in accordance with the referenced codes. Install motor feeder in liquid-tight-flexible conduit of 18 inches minimum length at motor conduit box.
5. Wire Pulling: Comply with the requirements of Section 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL and the following:
  - a. Install wire and cable in conduit as indicated. Do not pull wiring into conduit until conduits and outlets have been thoroughly cleaned and swabbed. Do not use block and tackle or other mechanical means for pulling conductors smaller than No. 2 AWG in raceways.
  - b. Provide suitable installation equipment to prevent cutting and abrasion of conduits and wire during the pulling of feeders. Use lubricant and installation procedure as recommended by the cable manufacturer.
  - c. Pulling tension shall not exceed manufacturer's recommendations. For conduits runs with three or four bends, and cable size larger than 2 AWG, provide the Engineer with cable pulling calculations prior to making the pull.
  - d. Provide masking or other means to prevent obliteration of cable identifications when solid coating or colored tracers are used.
  - e. Pull cables installed in a single conduit together.

### 3.2 IDENTIFICATION

- A. Low Voltage Power Cables and Wires:
  1. Comply with the requirements of Section 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS.

2. Provide nonmetallic fiberboard or plastic identification tags or pressure-sensitive labels designed for fastening to cables, feeders and power circuits in pullboxes and manholes, and at all terminations of cable wire.
3. Stamp or print tags or labels to correspond with markings as indicated, or mark so that feeder or cable may be readily identified. ID tags for lighting and convenience outlets circuits not needed.
4. If suspended type identification tags are provided, attach the tags to slip-free plastic cable lacing units or to nylon bundling straps.

### **3.3 FIELD QUALITY CONTROL**

#### **A. General:**

1. Insulation resistance and continuity tests shall be made by the Contractor in the presence of the City Representative after cable has been pulled in ducts and conduits, prior to connecting the new cables to existing cables or to equipment.
2. Defects in the cable installation revealed by the testers specified shall be corrected by replacement or repairs satisfactory to the City Representative, after which the Contractor shall repeat the tests until he obtains test results satisfactory to the City Representative.

**END OF SECTION**

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**SECTION 26 05 26****GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 – GENERAL****1.1 DESCRIPTION**

This Section specifies the requirements for furnishing, installing, connecting, and testing system and equipment grounding and bonding as indicated.

**1.2 REFERENCE STANDARDS**

- A. ASTM International (ASTM):
  - 1. ASTM B 3: Soft or Annealed Copper Wire.
  - 2. ASTM B 187: Copper Bus Bar, Rod, and Shapes.
- B. National Fire Protection Association (NFPA) 70: National Electrical Code (NEC).
- C. Underwriters Laboratories, Inc. (UL) 467: Grounding and Bonding Equipment.

**1.3 SUBMITTALS**

- A. Submit the following to the City Representative as specified in Section 01 33 00.
- B. Shop Drawings: Show locations of ground rods, grounding connections, locations of embedded and buried grounding conductors, and locations of stub outs and pigtails for future connections to the grounding system by others. Also indicate locations of test points to measure grounding resistance.
- C. Product Data: Manufacturers' data for specified, manufactured materials.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Provide marking on wire and cable in accordance with applicable standards. Each item shall have the UL label.
- B. Ship each material securely wrapped, packaged, and labeled for safe handling in shipment and to avoid damage.
- C. Store equipment and materials in secure and dry storage facility.

**PART 2 – PRODUCTS****2.1 GENERAL**

Conform to UL 467 and the additional requirements specified below.

**2.2 GROUNDING RODS**

Medium carbon steel core, copper clad by the molten weld cast process, UL-listed. Size grounding rods at 3/4-inch in diameter by 10 feet long unless as otherwise indicated on the Drawings.

### **2.3 BARE GROUNDING CONDUCTORS**

ASTM B 3, Class B stranded, annealed copper, unless otherwise indicated on the Drawings. Conductor sizes as indicated on the Drawings.

### **2.4 SINGLE CONDUCTOR INSULATED WIRE**

As specified in Section 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

### **2.5 JUMPERS**

Tin-plated copper, braided, flexible jumpers.

### **2.6 TERMINAL LUGS**

NEMA Standard 2 holes, heavy duty, high copper alloy compression type terminal lugs, with terminal lugs having twin clamping elements to secure joint against vibration and flexing. Size terminal lugs as indicated on the Drawings.

### **2.7 GROUND CONNECTORS**

- A. Cable to Box Ground Connectors: Provide high copper alloy ground connector for grounding pull boxes, enclosures, or cabinets purpose. Sizes as indicated on the Drawings.
- B. Cable to Grounding Rod Ground Connectors:
  - 1. Above Ground: High copper alloy ground connectors for joining grounding cables to grounding rods for above ground connections. Size as indicated on the Drawings.
  - 2. Buried and Embedded: Ground connectors of exothermic weld type for buried and embedded ground connections. Size as indicated on the Drawings.

## **PART 3 – EXECUTION**

### **3.1 GENERAL**

Install the grounding system in accordance with Article 250 of the National Electrical Code or as indicated on the Drawings.

### **3.2 GROUNDING RODS**

Install grounding rods as indicated on the Drawings. Bury grounding rods vertically with the top of the rods at a minimum of 18 inches below grade. Interconnect grounding rods with grounding cables.

### **3.3 JUMPERS**

Install jumpers where required between adjacent cabinets of equipment enclosures.

### **3.4 TERMINAL LUGS**

Use terminal lugs to connect grounding conductors to motor frames and equipment enclosures.

### 3.5 GROUND CONNECTIONS

- A. Above Ground Connections: Install compression type terminal lugs in accordance with applicable requirements specified in Section 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL.
- B. Buried and Embedded Ground Connections: Provide exothermic welding such as Cadweld or equivalent only. Prior to backfilling, clean and coat welded connections with a bitumastic epoxy coating. Make welds in accordance with the manufacturer's requirements. Compression-type mechanical connectors are not acceptable.
- C. Grounding Conductors: Continuous grounding conductors without splices, or splice by exothermic weld only.

### 3.6 EQUIPMENT GROUNDING SYSTEM

- A. All electrical equipment (enclosure, motors, etc.) shall be grounded. Ground buses and ground pads provided on electrical equipment shall be grounded using removable connections.
- B. Conductor for equipment grounding shall be bare stranded copper. Conductors shall have green type THWN insulation when encased in conduit. Otherwise, bare stranded copper wires shall be used.
- C. All structural steel shall be grounded using welded connections. Vessels, tanks, pumps and other removable equipment shall be grounded using removable connections.
- D. Resistance of the Grounding System: Less than 5 ohms.
- E. Enclosures: Ground enclosures of all distribution panels, controller cabinets, small transformers, control/relay panels, in addition to the grounding conductor run with the supply cable/conductors. Connect one end of the grounding conductor run with the supply cable to the equipment, the other end to the ground bus of the power supply.

### 3.7 FIELD QUALITY CONTROL

- A. Test the grounding system by the fall-of-potential method in the presence of the Engineer.
- B. Demonstrate that the total ground resistance is below 5 ohms in accordance with NEC, unless otherwise noted.
- C. If resistance requirements are not met, bury additional ground rods or use electrolytic ground electrodes, as necessary to meet resistance requirements.
- D. Test grounded equipment enclosures, raceways, conduits, exposed expansion joints, trench ducts, receptacles, light standards for continuity to the ground system.

**END OF SECTION**

**SECTION 26 05 33.26****PVC COATED GALVANIZED RIGID STEEL  
(PGRS) CONDUIT AND SYSTEM COMPONENTS****PART 1 - GENERAL****1.01 DESCRIPTION**

- A. This Section specifies the requirements for furnishing, installation and assembly of for PVC coated galvanized rigid steel (PGRS) conduit system, including PVC coated conduit, conduit bodies, fittings, couplings, etc. as described herein.
- B. The Contract Drawings show diagrammatic installation and not offset, fittings and accessories that may be required.
- C. The atmosphere in which PGRS conduit and accessories is installed is corrosive, hence the requirement for PVC coating as applied by the manufacturer of the PGRS conduit and system components.
- D. The Contractor is informed that PGRS conduit and system components is required for this Contract, please see Item 1.02 MANUFACTURER'S SERVICES below.
- E. Manufacturer's Services training is to be provided to installer of PGRS conduit and system components for a four (4) hour mandatory period, thirty (30) days prior to installation.
- F. Installer of the PGRS conduit and system components must provide a certificate supplied by the PGRS manufacturer's representative that he or she has received the Manufacturer's Services training during the last eighteen (18) months and is qualified to install the system.
- G. Qualified installer of the PGRS conduit and system components must handle and assemble the components as instructed by the manufacturer's representative, unless this specification is more restrictive, in which case this specification shall supersede the manufacturer's recommendations.
- H. At the 50% completion of the PGRS conduit and system components installation, the qualified PGRS conduit and component system installer shall submit a request for approval inspection by the Engineer of the PGRS conduit and system components. Only after successfully passed the approval inspection may this qualified PGRS conduit and system components installer proceed with his or her work. Failure to pass the approval inspection will require the qualified installer to remove and replace the work found unacceptable by the City Representative, at which point he or she may then proceed.
- I. Before installing any wires, the qualified installer of the PGRS conduit and system components must obtain a Certificate of Approval from the manufacturer's representative that certified him or her as qualified, that the installation of the PGRS conduit and system components meets the requirements of the manufacturer. The City Representative will also inspect the final installation for punch list items.
- J. Should the Contractor fail to provide factory representative training to the installer of the PGRS conduit and system components prior to the installation of the PGRS conduit and

system components, all work shall be removed and installed properly after the proper personnel have been provided to install the PGRS conduit and system components. The Contractor must comply with the Specification in its entirety.

## **1.02 MANUFACTURER'S SERVICES**

- A. The manufacturer's representative offers a free on-site training course consisting of videotape showing proper installation procedure of PGRS conduit and system components. This will be followed by a questionnaire of the information presented in the installation video. Any tool shown for use by the video installation instruction, such as specially modified wrenches, that potentially damages PVC coating shall not be used in this project. The time required for this training is estimated to be four (4) hours.
- B. After the on-site training video and questionnaire, the manufacturer's representative shall then register the installer of PGRS conduit and system components in his data base and provide certification for installation.
- C. The manufacturer's representative shall provide a Certificate of Approval for the work installed by the certified installer at completion only if the work is satisfactory to the manufacturer's representative.

## **1.03 RELATED WORK**

- A. Section 26 05 00: COMMON WORK RESULTS FOR ELECTRICAL
- B. Section 26 05 26: GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## **1.04 SUBMITTALS**

- A. Submit in accordance with Section 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL.

## **1.05 REFERENCE STANDARDS**

- A. National Electrical Manufacturers Association (NEMA):
  - 1. NEMA RN1: Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- B. National Fire Protection Association (NFPA):
  - 1. NFPA 70: National Electrical Code (NEC).
- C. Underwriters Laboratories, Inc. (UL):
  - 1. UL 6: Safety Standard for Rigid Metal Conduit
  - 2. UL 360: Liquid-Tight Flexible Steel Electrical Conduit
  - 3. UL 514B: Safety Standard for Fittings for Conduit and Outlet Boxes
  - 4. UL 886: Safety Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
- D. American National Standards Institute (ANSI):

1. ANSI C80.1: American National Standard for Rigid Steel Conduit-Zinc Coated
- E. Electrical Testing Laboratories (ETL):
1. ETL Verification Mark to PVC 001.
- F. San Francisco Electrical Code (SFEC)

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. Furnish PVC coated galvanized rigid steel (PGRS) conduit of size as indicated. If not indicated, the smallest trade size shall be 3/4-inch. The PGRS conduit system shall include necessary PVC coated fittings, boxes and covers to form a completed system.
- B. PGRS conduit and system components shall be UL listed. The PVC coating must have been investigated by UL as providing the primary corrosion protection for the galvanized rigid steel conduit.
- C. The PGRS conduit must be certified and authorized to apply the ETL Verification Mark "ETL Verified to PVC-001." ETL Verified to: Intertek ETL SEMKO High Temperature H20 PVC Coating Adhesion Test Procedure. Continued compliance to this specification is monitored through production testing, quarterly inspections by Intertek ETL SEMKO at production facility and random sample testing.

### **2.02 CONDUIT AND FITTINGS**

- A. The PVC coated conduit shall be hot dip galvanized inside and out. The PVC coated conduit factory cut threads shall be protected with hot galvanized threads and a clear urethane coating. Thread protectors shall be used on the exposed threads of the PVC coated conduit.
- The PVC coating shall be gray in color, 40 mils in thickness continuous over the entire length of the conduit except at the threads, and be free of blisters, bubbles or pinholes.
- B. Ferrous fittings for general service and corrosive locations must be UL listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to PVC coating must be UL listed. The PVC coating shall be gray in color, 40 mils in thickness, and be free of blisters, bubbles or pinholes.
- C. Form 8 conduit bodies, 3/4-inch through 2-inch trade size, shall have a tongue in groove, V-Seal gasket to effectively seal against corrosive elements and be supplied with plastic encapsulated stainless-steel cover screws. The design shall be equipped with a positive placement feature to ease and assure proper installation.
- D. A PVC sealing sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female opening, except unions. The inside sealing sleeve diameter shall be matched to the outside diameter of the conduit.
- E. The PVC coating on the outside of the conduit couplings shall be 40 mils in thickness and have a series of raised longitudinal ribs to protect the coating from tool damage during installation.

- F. The exterior coating bond shall be confirmed using the methods described in Section 3.8 of NEMA RN1. After these tests, the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3-1 "Properties of PVC Coatings" of NEMA RN1.
- G. A red, green or gray urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2-mil thickness. Conduit or fittings having pinholes or areas with thin or no coating shall be unacceptable.
- H. All male threads on elbows and nipples, and female threads on fittings or conduit couplings shall be protected by application of a red, green or gray urethane coating.
- I. Right angle beam clamps and U-bolts shall be specially formed and sized to snugly fit the outside diameter of the PVC coated conduit.
- J. Acceptable Manufacturers: Robroy Industries, Perma-Cote and KorKap.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. The PGRS conduit and system components have been selected for use in at atmosphere considered corrosive for this project. The corrosive atmosphere is considered more damaging than merely the presence of moisture. Accordingly, conduit and corresponding fittings for same must have PVC protection as described under Part 2 Products. Conduit and fittings that are merely galvanized for this purpose are insufficient.
- B. Should the PGRS conduit and system components installer not have completed the course offered by the manufacturer's system representative and proceed to work, his workmanship will be held to the same high standards as if he had successfully completed the course and followed the recommendations of the manufacturer concerning product storage, handling and assembly.
- C. When half the PGRS conduit and system components is installed and prior to pulling, landing and testing conductors, the installer shall request an approval inspection from the Engineer per paragraph 1.01.H. The installer must not apply PVC touchup compound prior to this approval inspection, or he will fail the inspection.

#### **3.02 INSTALLATION**

- A. Clamping
  - 1. If a power drive unit that spins the PGRS conduit is used, the chuck must be equipped with inserts designed specifically for PVC coated conduit.
  - 2. When using a pipe vise, the jaw assembly must be replaced with vise adaptors, recommended by the PGRS conduit manufacturer, that spread the clamping force over a larger area and helps to prevent spinning of the PGRS conduit during cutting and threading operations. The manufacturers recommendation shall be mandatory for this project.
  - 3. If a chain vise is used with conduits 2 inches or larger, use special half shell clamps recommended by the manufacture to protect a large surface area of the PGRS conduit. The shell clamps have aluminum nickel bronze construction. The manufacturers recommendation shall be mandatory for this project. Do not

use a chain vise for smaller trade size conduit.

B. Cutting

1. Use a roller cutter to cut PGRS conduit since it produces a square cut end and removes about 1/4 inch of the PVC outer coating that helps in conduit threading. This requirement is more restrictive than that of the manufacturer. Use a reamer to remove any rough edges from the conduit interior caused by the cutting process.

C. Threading

1. Standard threading tools may be used. Larger power threaders with open die heads are acceptable, except that the grip inserts must be used to clamp the PGRS conduit.
2. Follow manufacturer recommendations concerning tight fitting die heads as well as manual threading.
3. Before threading, make cuts along the longitudinal axis of the conduit as recommended by the manufacturer to allow the PVC coating to be removed in small places instead of long strips that can otherwise foul the head and cause the conduit to collapse during threading.
4. Use good quality thread cutting oil to flush away PVC coating and metal chips. After cutting use a degreasing spray, to ensure that the manufacturer supplied grounding and bonding compound for PGRS conduit will adhere to the bare steel.

D. Installation

1. When using a hand bender, to accommodate the PVC coating of the PGRS conduit, use the next larger shoe size. Use equipment specially designed and recommended by the manufacturer of the PGRS conduit for making bends.
2. When bending PGRS conduit with powered equipment, use rubbing alcohol to clean the inside of the shoe and the area of the conduit to be bent.
3. Do not use a lubricant on the shoe or conduit, as this will permit the conduit to slip above the centerline of the shoe, causing the elbow to flatten.
4. Apply grounding and bonding compound supplied by the PGRS manufacturer for this purpose to all field cut threads and internal reams of the PGRS conduit. When assembling into an access fitting or coupling onto the newly coated threads a colored band will form at the end of the sleeve, indicating proper installation procedure. The grounding and bonding compound fills the annular space between the outer PVC coating of the PGRS conduit and the inner sleeve of the fitting or coupling, effectively sealing out what will in future become a corrosive atmosphere from the metal of the PGRS conduit. Do not apply a grounding compound to the threads of the PGRS conduit that would be used for galvanized rigid steel conduit prior to assembly.
5. This requirement supersedes the recommendation of the manufacturer for assembling factory cut and protected threads. Prior to assembly of these threads to fittings or couplings, provide grounding and bonding compound supplied by the PGRS manufacturer for this purpose, as in field cut threads and assemble



similarly. The advantage this offers is further protection to the factory cut threads from the future corrosive atmosphere, by sealing the annular space between PGRS conduit and PVC sleeve of the fitting or coupling. In addition, all connections whether field cut or not, can be readily verified as having proper assembly and proper grounding of the PGRS conduit is achieved as well.

6. Under no circumstances are pipe wrenches permitted for assembly. Use of pipe wrenches will automatically be cause for rejection of workmanship of the PGRS conduit and system component installation. Conduit installed with this method shall be immediately removed and discarded.
7. A Z-wrench offered by the manufacturer of the PGRS conduit are acceptable for assembly since it has extra wide jaws that spread the clamping force allowing a grip that does mar the PVC coating. Z-wrench tools intended for installation must be submitted for approval prior to actual use.
8. Where high density of conduits is required such as at pipe racks, strap wrenches may be used, after having been approved through the submittal process.
9. Manufacturer offered "Spin-It" can be used to tighten conduit faster than with conventional tools. The "Spin-It" never touches the coating, saving labor and time eliminating touch up to the PVC coating caused by damage from approved wrenches.
10. PVC touch up compound is not to be applied to hide poor workmanship. After the City Representative has approved the installation at 50% assembly of the PGRS conduit and system component assembly, the PVC touch up compound may be applied to superficial damage of the PVC coating caused by using approved tools by a qualified installer.
11. Spare PGRS conduits are to be terminated into PVC coated box or conduit, as exposed field cut threads or even factory cut threads with 2-mils polyurethane insulation do not offer enough protection against the corrosive atmosphere.
12. Should the City Representative's inspection find damage to the PVC coating is not just superficial, that perhaps the ETL Verification or UL listing has been compromised, the contractor may not use the PVC touch up compound, but must replace the conduit at no cost to the City. The responsibility for any time delay caused by this replacement work will be that of the electrical subcontractor.
13. The City Representative and manufacturer's representative that certified the installer of the PGRS conduit and system components prior to assembly will perform final inspection, both must give approval for the installation.

#### END OF SECTION



**SECTION 26 05 43****UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. Work included in this Section: Furnish and install underground electrical conduits, pull/splice boxes, and accessories. All conduit systems shall be complete and operable.
- B. Related work specified in other sections:
  - 1. Section 31 23 00: EXCAVATION & FILL
  - 2. Section 26 04 00: GENERAL REQUIREMENTS FOR ELECTRICAL
  - 3. Section 26 05 00: COMMON WORK RESULTS FOR ELECTRICAL

**1.2 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Unless specifically exempted in the detailed specifications for any specific product, the manufacturer shall have similar products in successful installation under similar installation conditions for at least 5 years and shall, if requested, submit a list of representative installations.
- B. Requirements of Regulatory Agencies: All work shall be in full compliance with all current requirements of regulatory agencies including OSHA and the State Division of Industrial Safety as well as being in conformance with the San Francisco Electrical Code and other national fire codes of NFPA.

**1.3 SUBMITTALS**

- A. Shop Drawings: Shop drawings shall be submitted for all conduit materials and conduit accessories.
- B. Record Drawings. During the progress of the work, the Contractor shall prepare a set of Record Drawings which shall be delivered to the City at the completion of the work. The Record Drawings shall be prepared using a set of the Contract Drawings. The Record Drawings shall include the following information:
  - 1. All changes in new construction from that shown on the Contract Drawings.
  - 2. The exact location, size, and material of each existing underground utility, including any existing underground utilities not shown on the Contract Drawings.

**1.4 REFERENCE STANDARDS**

- A. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- B. ANSI C80.1 – Rigid Steel Conduit, PVC Coated.

- C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies, PVC Coated.
- D. ANSI/NFPA 70 - National Electrical Code.
- E. NECA "Standard of Installation."
- F. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

### **1.5 DESIGN REQUIREMENTS**

- A. Conduit Size: ANSI/NFPA 70 or as noted on the Drawings (whichever is larger).

### **1.6 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Accept conduit on site. Inspect for damage.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC/HDPE conduit from sunlight.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS FOR UNDERGROUND CONDUIT**

- A. Underground conduit outside of building walls shall be PVC Schedule 80 conduit unless otherwise noted on Drawings.
  - 1. Conduit: NEMA TC 2 & TC6.
  - 2. Fittings and Conduit Bodies: NEMA TC 3.
- B. Underground conduit under buildings, in or under slabs on grade, and risers shall be rigid galvanized steel conduit with PVC coating.
  - 1. Conduit: NEMA RN 1; rigid steel conduit with external PVC coating, 80 mil thick.
  - 2. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit.
- C. Underground conduit installed by guided boring shall be continuously extruded high density polyethylene (HDPE).
  - 1. Conduit: ASTM D2683 of sufficient wall thickness to withstand the pulling operations within the borehole.
  - 2. Joints: Electrofusion or butt fusion welded in strict accordance with the conduit manufacturer's recommendations.

- D. Conduit Spacers:
  - 1. Conduit Spacers: Conduit Spacers suitable for duct bank installations. UL listed, IPEX – Monobloc, Thomas and Bett, or approved equal.

## 2.2 PULL/SPLICE (UTILITY) BOXES & LIDS

- A. Boxes: Utility boxes shall be fabricated of precast high density reinforced concrete. All details and dimensions shall be per Standard Plan 87,201. A 12" W X 3 1/2" D (min.) concrete collar shall be constructed around pull box in unpaved areas or in asphalt paved areas. Top of pull box and concrete collar shall be 1" above grade in unpaved areas. A 6" W x 12"H concrete retaining wall shall be constructed around traffic rated pull boxes. Utility boxes shall be Oldcastle Products or approved equal.
- B. Lids: Traffic rated box lids shall be galvanized steel checker plate with thread bolt down for vandal resistance and shall have the appropriate wording as shown on the Contract Drawings cast into the lid. Reinforced concrete lids shall be bolt down type Oldcastle Products or approved equal.
- C. AT&T Splice Boxes shall be Christy Model No. PTS 3048 rated H-20 for heavy traffic with Steel Cover. Pull boxes for Telephone cable shall be denoted by "Telephone" on the pull box cover.

## 2.3 PULL CORDS

- A. Pull cord shall be 3/16 polypropylene pull-line with a minimum breaking strength of 800 pounds.

## 2.4 WARNING TAPE

- A. General. Warning tape shall be non-detectable underground utility marking tape conforming to ASTM D2103. It shall consist of a minimum 4.0 mil overall thickness, inert 100% virgin low density polyethylene plastic film formulated for extended use underground. The materials shall be acid and alkali resistant. Width of warning tape shall be 6 inches. Warning tape shall be ShieldTec as manufactured by THOR Enterprises, Inc., the equivalent product manufactured by Line Guard Inc., or approved equal.
- B. Color Coding: The tape shall conform to the American Public Works Association color code as follows:
  - 1. Secondary Power Conduit: Warning tape color shall be safety red.
  - 2. Control Conduit: None required.
- C. Message Inscription: The warning tape shall include an inscription in black letters to identify the type of utility conduit on or over which it is installed. The inscription shall be impregnated with color-fast, lead-free, organic pigments suitable for direct burial and prolonged exposure to the elements normally encountered in moderately corrosive type soils. The height of the message letters shall be 1.5 inches minimum, and the message inscription shall be repeated at approximately 2-foot intervals. The message inscription for the different types of pipelines shall be as follows:
  - 1. Secondary Power Conduit: The message on the tape shall be "CAUTION – SECONDARY ELECTRICAL CONDUIT BELOW"

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Location: Conduit shall be installed true to line and grade as shown on the Contract Drawings. Buried conduit shall be installed at a continuously sloping grade between points of given elevation without low or high points. Location of the conduit may be modified by the City Representative to clear obstructions. Depth of cover over the conduit to finish grade shall be as shown on the Contract Drawings, but in no case less than minimum ANSI/NFPA 70 requirements.
- B. Handling: Conduit shall be handled carefully to prevent damage. Conduit shall be kept clean and shall be plugged at the end of each day's work or when conduit is not being laid to prevent the entry of water or foreign material.
- C. Trench Conditions: Each conduit section shall have a full, even bearing for its entire length on the floor of the trench. All conduit shall be laid in the dry; the Contractor shall dewater the trench as required. Conduit ends shall be clean when joints are made.
- D. Rock Conditions: If rock is encountered during excavation, the trench shall be excavated 6 inches below conduit grade and 6 inches of sandy material shall be placed in the trench bottom. The sandy material shall be free of sharp-edged materials of any kind. Occasional rounded rocks less than 1/4-inch diameter are acceptable.
- E. Clearances with Other Underground Utilities: Conduit shall be installed with the following minimum clearances with other underground utilities:
  - 1. Water pipelines. Minimum horizontal clearance shall be 3 feet. Minimum vertical clearance shall be 6 inches.
  - 2. Sanitary sewers and storm drains. Minimum horizontal clearance shall be 3 feet. Minimum vertical clearance shall be 6 inches.
  - 2. Other Utilities. Minimum horizontal clearance shall be 3 feet. Minimum vertical clearance shall be 6 inches.
- F. Conduit Spacers: All multiple runs of conduits shall have conduit spacers. Conduit spacers to align conduits and avoid staggering or crushing of conduits. Install high impact, plastic spacers a maximum of eight feet on center, when more than two rigid, non-metallic conduits are to be installed in a common trench.

### 3.2 CONDUIT INSTALLATION

- A. Conduit shall have watertight joints:
  - 1. Grout around conduit tie-ins entering pull/splice boxes, vaults, or building floors and walls. Where conduit enters buildings, seal openings with approved duct seal to prevent circulation of air or moisture. Obtain approval from the City Representative before backfilling.
- B. Installation Requirements:
  - 1. Install conduit in accordance with NECA "Standard of Installation."
  - 2. Install conduit in accordance with the manufacturer's recommendations.
  - 3. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2-inch (50 mm) size.
- C. Installation Methods:

1. Cut conduit square using saw or pipe-cutter; de-burr cut ends.
2. Bring conduit to shoulder of fittings; fasten securely.
3. Join PVC conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
4. Use suitable caps or plugs to protect installed conduit against entrance of dirt and moisture.

### **3.3 RISER CONDUIT**

- A. Risers to overhead: Provide rigid galvanized steel conduit with 90-degree sweep bend. Size as shown on the Contract Drawings.
- B. Firmly secure conduit to Power Utility pole with galvanized steel stand-off brackets. Connection to Power Utility facilities will be by the Power Utility Owner.

### **3.4 PULL CORD**

- A. Pull cords shall be installed in unused conduit. The pull cord shall be securely attached to conduit plugs or caps.
- B. Pull wires are not permitted.

### **3.5 WARNING TAPE**

- A. Each underground electrical power conduit, or parallel pair of electrical power conduit, shall be installed with a continuous strip of warning tape located directly above the conduit at a distance 12 inches below finish grade or as otherwise shown on the Contract Drawings. In addition, each electrical power conduit, or parallel pair of conduits, shall be installed with a continuous strip of warning tape placed over the top of the conduit(s).

### **3.6 CLEANING**

- A. Conduit shall be thoroughly cleaned to remove all dirt, rocks, debris or other obstructions introduced into the conduit during the construction operations. Cleaning shall be by pulling a satisfactory swab through each conduit run. The Contractor shall remove swabbings from all pull/splice boxes.
- B. The Contractor shall prove, in a manner acceptable to the City Representative, that the conduit system is free of obstructions.

**END OF SECTION**

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**SECTION 26 05 53****IDENTIFICATION FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Identification of electrical materials, equipment, and installations

**1.02 RELATED SECTIONS**

- A. Interface and coordinate the work of this Section with other Sections of Division 26.

**1.03 SUBMITTALS**

- A. Submit each item in this Article according to the Conditions of the Contract and Division 1, Section 01 33 00.
- B. Product Data for each type of product specified.
- C. Schedule of identification nomenclature to be used for identification signs and labels.
- D. Samples for each color, lettering style, and other graphic representation required for identification materials, samples of labels and signs.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

**1.04 QUALITY ASSURANCE**

- A. Comply with NEC.
- B. Comply with ANSI C2, ANSI A13.1.
- C. General Industry Safety Orders and CAL/OSHA Standards, California Administrative Code, Title 8.
- D. Warning tapes for underground use, color in accordance with AWPA uniform color code.
- E. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

**1.05 SEQUENCING AND SCHEDULING**

- A. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

- B. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

## **PART 2 - PRODUCTS**

### **2.01 CLASSIFICATION**

- A. Cable, conduit and equipment marking and labeling shall be color coded and sized in accordance with ANSI A13.1 and UL No. 969.
- B. Provide safety, and physical hazard markings in accordance with CAL/OSHA, and as specified.
- C. Provide miscellaneous and City-required signage, wiring diagrams, and inspection, calibration or maintenance records for permanent attachment to designated equipment or device in heavy gage, clear vinyl frames or envelopes suitable for indoor and outdoor application, as required.

### **2.02 MANUFACTURERS**

- A. Manufacturers - Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpha Wire Company.
  - 2. American Labelmark Co.; Labelmaster Subsidiary.
  - 3. Brady USA, Inc.; Industrial Products Div.
  - 4. Calpico, Inc.
  - 5. Carlton Industries, Inc.
  - 6. Champion American, Inc.
  - 7. Cole-Flex Corp.
  - 8. D&G Sign and Label.
  - 9. EMED Co., Inc.
  - 10. George-Ingraham Corp. (The).
  - 11. Grimco, Inc.
  - 12. Ideal Industries, Inc.
  - 13. Kingsley, a division of ITW.

14. LEM Products, Inc.
15. Markal Corp.
16. National Band & Tag Co.
17. Panduit Corp.
18. Radar Engineers.
19. Ready Made Sign Co., Cornerstone Direct Corp. Div.
20. Seton Name Plate Co.
21. Standard Signs, Inc.

### **2.03 RACEWAY AND CABLE LABELS**

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, consult the City Representative and obtain the City Representative's approval to provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Electrical conduit markers: Stainless steel marker plates/tags and strapping with embossed or laser market for each raceway size with black letters.
  1. Conform to ANSI A13.1, Table 3.
  2. Legend: Indicates voltage and service.
  3. Panduit, PAN-STEEL or equal.
- C. Wire and cable identification tags: PVC tubing (MIL-1-6310, UL 224) with labels deeply embedded, on tubing using hot stamp process by Kingsley or Brady; or approved equal.
- D. Housekeeping markings: Black and white striped or checkered tape in accordance with OSHA; minimum 2 inches wide.
- E. Physical hazard markings: Black and yellow striped or checkered tape in accordance with OSHA 1910.144; minimum 2 inches wide.
- F. Physical hazard signs: Permanent "DANGER," "CAUTION," and "WARNING" signs in accordance with ANSI A13.1; size, lettering and color codes as required.
- G. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is laminated with a clear, weather and chemical-resistant coating.
- H. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

- I. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- J. Underground Line Warning Tape: Polyethylene plastic for buried utility lines. Use metal-core detection tape except for steel or iron pipelines. Color and legend as follows:
  - 1. Red - Caution - Buried Electric Line Below
  - 2. Orange - Caution - Buried Telephone Line Below
  - 3. Red - Caution - Buried Water Line Below
  - 4. Orange - Caution - Buried Drainage Line Below
  - 5. Yellow - Caution - Buried Chemical Line Below
  - 6. Size: Not less than 6 inches wide by 4 mils thick

#### **2.04 ENGRAVED NAMEPLATES AND SIGNS**

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, consult the City Representative and obtain the City Representative's approval to provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Equipment nameplates: Engraved 20 gage metal/baked enamel or phenolic plastic, drilled for screw mounting with round head screws. Provide for all mechanical, electrical and control equipment and devices.
  - 1. Engraved Legend: White letters on black background.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396-inch, galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.
- E. In corrosive environment use engraved stainless.
- F. Color code for signage in accordance with ANSI A13.1 and Cal/OSHA 1910.
  - 1. Danger: White letters on red field with black background.
  - 2. Informational: White letters on blue field. Black letters on white field.
  - 3. Safety: White letters on green field.
  - 4. Caution: Yellow letters on black field.

- G. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.
- H. Provide posts or frames and mounting hardware as necessary.

## **2.05 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength: 50 lb minimum.
  - 3. Temperature Range: Minus 40 to 185 deg F (Minus 4 to 85 deg C).
  - 4. Color: As indicated where used for color coding.
- B. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install identification devices according to manufacturer's written instructions.
- B. Install labels at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Use consistent designations throughout the Project.
- D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- E. Identify feeders over 600 V with "DANGER--HIGH VOLTAGE--\_\_ KV" in black letters 2 inches high, stenciled with paint at 10-foot intervals over a continuous, painted orange background. Identify the following:
  - 1. Entire floor area directly above conduits running beneath and within 12 inches of ground floor that is in contact with earth or is framed above unexcavated space.
  - 2. Wall surfaces directly external to conduits concealed within wall.
  - 3. All accessible surfaces of concrete envelope around conduits exposed in the building.
  - 4. Entire surface of exposed conduits.
- F. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
  2. Prime Surfaces: For galvanized metal, use single-component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty, acrylic-resin block filler. For concrete surfaces, use clear, alkali-resistant, alkyd binder-type sealer.
  3. Apply one intermediate and one finish coat of silicone alkyd enamel.
  4. Apply primer and finish materials according to manufacturer's instructions.
- G. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of the systems listed below for identification. See Section 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL.
1. Bands: Pre-tensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side by side.
  2. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25 feet in congested areas and at every junction box and pull-box.
  3. Color shall be as follows:
    - a. Mechanical and Electrical Supervisory System: Green and blue
    - b. Control Wiring: Green and red
- H. Install Caution Signs for Enclosures Over 600 V: Use pressure-sensitive, self-adhesive label indicating system voltage in yellow, preprinted on black field. Install on exterior of door or cover.
- I. Install Circuit Identification Labels on Boxes: Label externally as follows:
1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
  2. Concealed Boxes: Plasticized card-stock tags.
  3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- J. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope do not exceed an overall width of 16 inches, use a single line marker.
- K. Color-Code Conductors: Refer to Section 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1. Factory-apply color the entire length of the conductors, except the following field-applied, color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
  - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to prevent possible unwinding. Use 1-inch wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
  - b. Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.
  
- L. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and electrical rooms.
  1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
  2. Fasten tags with nylon cable ties; fasten bands using integral ears.
  
- M. Apply identification to conductors as follows and in coordination with Section 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES -3.2.
  1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
  2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
  3. Multiple Control and Communications Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color coding, or cable marking tape.
  
- N. Apply warning, caution, and instruction signs and stencils as follows:
  1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
  
- O. Install identification as follows:
  1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment. This includes communication and signal systems unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2 inch high label; where 2 lines of text are required, use lettering 2 inches high. Use white

lettering on black field. Apply labels for each unit of the following categories of equipment.

- a. Panelboards, electrical cabinets and enclosures.
  - b. Access doors and panels for concealed electrical items.
  - c. Electrical switchgear and switchboards.
  - d. Transformers.
  - e. Electrical substations.
  - f. Emergency system boxes and enclosures.
  - g. Motor-control centers.
  - h. Disconnect switches.
  - i. Enclosed circuit breakers.
  - j. Motor starters.
  - k. Push-button stations.
  - l. Power transfer equipment.
  - m. Contactors.
  - n. Remote-controlled switches, dimmer modules, and control devices.
  - o. Battery inverter units.
  - p. Battery racks.
  - q. Power-generating units.
  - r. Monitoring and control equipment.
  - s. Uninterruptible power supply equipment.
  - t. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
  - u. I&C field devices
2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control center, and similar items for power distribution and control components above, except panelboards and signal components where labeling is specified elsewhere. For panelboards, provide



framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

3. Installation

- a. Verify identity of each item before installing identification products.
  - b. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
  - c. Apply identification devices to surface that require finish after completing finish work.
  - d. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
  - e. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
  - f. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- P. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70, including but not limited to the following.
- a. Service equipment.
  - b. Industrial control panels.
  - c. Motor control centers.
  - d. Elevator control panels.
  - e. Industrial machinery.
- Q. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
- a. Minimum Size: 3.5 by 5 inches (89 mm by 127 mm).
  - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
  - c. Service Equipment: Include the following information in accordance with NFPA 70.

**END OF SECTION**

**SECTION 26 08 00****COMMISSIONING OF ELECTRICAL SYSTEMS****PART 1 – GENERAL****1.1 SUMMARY**

- A. Work included:
1. The Contractor shall furnish necessary personnel, materials, and equipment to perform all tests, inspections, assistance to manufacturer's or Owner's Representatives, etc.
  2. Testing will consist of two different testing procedures: Pre-operational and Functional testing.
  3. All electrical equipment shall be inspected in the presence of the City Representative. City Representative will be notified at least one week in advance of test date.
  4. All testing shall be performed by an independent testing firm. Testing company shall provide certificates of calibration for all test equipment used.

**1.2 REPORTS**

- A. All tests shall be suitably recorded, and the documents submitted to City Representative immediately after the tests have been performed.
- B. Test reporting shall comply with the following:
1. Four certified copies of the test data shall be given to City Representative.
  2. The report for each test shall include the date of performance and name of the person in charge of the test, all in legible writing.

**PART 2 – EXECUTION****2.1 DISTRIBUTION PANELS, PANELBOARDS AND DISCONNECT DEVICES**

- A. Verify that the following procedures are performed at the site before the panel is energized:
1. All switches, circuit breakers and other operating mechanisms are manually exercised.
  2. All breakers (100 amps or larger) are tested by a NETA certified testing contractor before acceptance.
  3. All debris, scrap wire, boxes, spare parts, etc., are removed from the panel interior.
  4. Nameplate, breaker designation and directories per contract drawings.
- B. Verify that all distribution panels, panelboards, and disconnects are mounted and secured (using 3/8" bolts and vibration isolators) to concrete pads per manufacturer's recommendations.
- C. Verify that the neutral connection is terminated on an isolated neutral bar.
- D. Verify that all power and grounding cable termination are made using two-hole bolted circumferential crimp-type connectors.
- E. Verify that all circuit breakers have bolted bus connections. Plug-in circuit breakers are not allowed.

**2.2 CABLES - LOW VOLTAGE - 600V MAXIMUM**

- A. Visual and Mechanical Inspection:
1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
  2. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench. In the absence of manufacturer's data use NETA ATS Table 10.1.
  3. Check cable color coding and tagging with San Francisco Electrical Code Standards.

4. Verify that all power and grounding cable connections are made using two-hole bolted circumferential-crimp type connectors.
- B. Electrical Tests:
1. Verify that all cables are examined for physical damage and tested using a 1000 VDC insulation tester. Branch circuits should be tested for one minute. Feeder circuits should be tested for 15 minutes with readings at one-minute intervals.
  2. A 1000-volt motor driven megger shall be used on all 480- volt conductors and a 500-volt hand driven megger shall be used on all lower voltage service conductors.
  3. Perform continuity test to insure proper cable connection.
- C. Test Values:
1. Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.

### **2.3 CIRCUIT BREAKERS - LOW-VOLTAGE**

- A. Visual and Mechanical Inspection:
1. Check circuit breaker for proper mounting and compare nameplate data to drawings and specifications.
  2. Operate circuit breaker to ensure smooth operation.
  3. Inspect case for cracks or other defects.
  4. Check cell fit and element alignment and proper operation of racking interlocks.
  5. Check tightness of connections using calibrated torque wrench. Refer to manufacturer's instructions or NETA ATS Table 10.1 for proper torque levels.
  6. Check arc chutes for damage.

## B. Electrical Tests:

1. Perform a contact-resistance test.
2. Perform an insulation-resistance test at 1000 volts dc from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase.
3. Determine long-time minimum pickup current by primary current injection where practical.
4. Perform long-time delay time-current characteristics tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time.
5. Determine long-time pickup and delay by primary current injection
6. Determine short-time pickup and delay by primary current injection, if applicable.
7. Determine ground-fault pickup and time delay by primary current injection, if applicable.
8. Determine instantaneous pickup current by injection using run-up or pulse method.
9. Make adjustments for final settings in accordance with breaker setting sheet.
10. Activate auxiliary protective devices, such as ground-fault or under voltage relays, to ensure operation of shunt trip devices. Check the operation of electrically-operated breakers in their cubicle.
11. Check charging mechanism.

## C. TEST VALUES:

1. Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.
2. Insulation resistance shall not be less than 100 megohms.
3. Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.

4. All trip times shall fall within NETA ATS Table 7.6.1.1. Circuit breakers exceeding specified trip time at three hundred percent (300%) of pickup shall be tagged defective.
5. Instantaneous pickup values shall be within values shown on NETA ATS Table 7.6.1.2.

## 2.4 GROUNDING SYSTEMS

### A. VISUAL AND MECHANICAL INSPECTION

1. Inspect ground system for compliance with drawings and specifications.
2. Verify that all power and grounding cable termination are made using two-hole bolted circumferential crimp type connectors.

### B. Electrical Tests (Small Systems):

1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be as defined in Section 12 of the above guide and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.

### C. Equipment Grounds

1. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

### D. Test Values

1. The main ground electrode system impedance-to-ground should be no greater than five (5) ohms for commercial or industrial systems and one (1) ohm or less for generating stations, transmission stations, and large industrial systems. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

## 2.5 SYSTEM FUNCTIONAL TESTING

- A. Only qualified persons shall work on or test electrical equipment or systems.

- B. Test, Work, and Inspections: All electrical equipment and systems shall be treated as energized until tested or otherwise proven de-energized.
- C. Energized Equipment or Systems: work or testing shall not be performed on exposed energized parts of equipment.
- D. The complete, fully installed lighting system will be tested of a minimum of two (2) hours of operation.

**END OF SECTION**



**SECTION 26 24 17****SUMP TERMINATION PANEL****PART 1 - GENERAL****1.1 Scope**

- A. The contractor shall furnish and install a sump termination panel next to wet well as shown on the drawings and as required for a complete and fully operating system that shall provide separation of hazardous and non-hazardous area.

**1.2 References**

- A. NFPA 70 –National Electrical Code, National Fire Protection Association, Latest Edition.
- B. U.L. 508A – Industrial Control Panels, Underwriters Laboratories, Inc., Latest Edition.
- C. NFPA 820 – Standard for Fire Protection in Wastewater Treatment

**1.3 1.04 SUBMITTALS**

- A. Submit in accordance with Section 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL.

**PART 2 - PRODUCTS****2.1 General**

- A. Provide NEMA 3RX rated pump termination enclosure where shown on the drawings. Termination enclosure shall be constructed of 316L stainless steel. The panel shall have a minimum of two sections and no more than three sections. Each section shall include a three-point vandal resistant, pad lockable door. Doors shall also be held open to a 90 degree with a mechanical rod.
- B. One section will include a ventilated space suitable for a Class1, Division 2 hazardous area. The second, and if applicable the third, section shall be an unrated area and shall include pump cable termination blocks (power and control). Blocks shall be rated for a minimum of 150 percent of pump FLA and rated for the type of conductors used
- C. The barrier between the non-rated and rated hazardous area shall comprise of a mechanical barrier for equipment cables to pass from a Class 1, Division 2 area to an unrated area. The barrier shall be a Roxtec Flange style sealing plate capable of creating a barrier with multiple cables of varying size. All compression points

shall include blank plugs for installation when cables are removed. Conduits entering the enclosure from the Class1, Division 1 area shall include a Roxtec compression fitting suitable for creating a mechanical barrier for cables to pass from a Class 1, Division 1 area to a Class 1, Division 2 hazardous area.

## **2.2 Construction**

- A. Exterior 14 Gage 316 Stainless Steel and interior 14 Gage Cold rolled steel electrically welded and reinforced where required. Exterior will be unpainted unless indicated on construction drawings.
- B. Construction will be NEMA3RX.
- C. All nuts, bolts, screws and hinges will be stainless steel.
- D. Nuts, bolts, screws and hinges will not be visible from outside of enclosure.
- E. Plastic nameplates will be provided as required.
- F. Control wiring will be marked at both ends by permanent wire markers.
- G. A plastic covered wiring diagram will be attached to inside of the front door.
- H. Enclosure will be factory wired and conform to required NEMA standards.
- I. Instructions for installing and maintaining barrier integrity will be attached to inside of door.

## **2.3 Acceptable Manufacturers**

- A. Sump termination panel shall be the Tesconnex as manufactured by Tesco Controls, Inc., Sacramento, CA.
- B. Other Approved equal.

## **PART 3 - EXECUTION**

### **3.1 Installation**

- A. The contractor shall install the sump termination panel in accordance with the manufacturer's instructions and as shown on the drawings.
- B. Factory trained representative will confirm proper installation prior to startup.
- C. Seal conduits per NEC requirements.

- D. Ultrasonic Level transducer manufacturer's cables to be terminated at the control panel and shall not be spliced at the termination cabinet.

### **3.2 Storage**

- A. All equipment shall be stored in a weather protected location.

**END OF SECTION**

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**SECTION 26 27 00****LOW-VOLTAGE DISTRIBUTION EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.
- B. Applicable provisions of Section 26 04 00 – General requirements for Electrical shall become part of this section as if repeated herein.
- C. Related work specified in other Sections:
  - 1. Section 26 04 00: General Requirements for Electrical
  - 2. Section 26 05 00: Common Work Results for Electrical

**1.2 SUMMARY**

- A. This Section includes service and distribution switchboards rated 600 V and less; electrical service and utility service entrance; panelboard, and meter/main pedestal.
- B. Conforming to the Utility Owner's requirements.
- C. Meter base shall be furnished by Contractor with prior approval of the Power Utility Owner.

**1.3 REFERENCE STANDARDS**

- A. ANSI/NFPA 70 – National Electrical Code
- B. ANSI/IEEE C12.1 – Code for Electricity Metering
- C. ANSI C39.1 – Electrical Analog Indicating Instruments
- D. NEMA AB 1 – Molded Case Circuit Breakers and Molded Case Switches
- E. American National Standards Institute (ANSI) Publication:  
Z55.1-1967 Gray Finishes for Industrial Apparatus and Equipment

(R1973)

- F. National Electrical Manufacturers Association (NEMA) Publications:
  - 1. PB 1-1977 Panelboards  
(R1983)
  - 2. 250-1979 Enclosures for Electrical Equipment (1000 Volt Maximum)
- G. Federal Specifications (FS):
  - 1. W-P-115A(3) Panel, Power Distribution
  - 2. W-C-375 Series Circuit Breakers, Molded Case, Branch Circuits and Service, Series Trip
- H. Underwriters Laboratories (UL) Standards:
  - 1. 50-1980 Electrical Cabinets and Boxes  
(R1987)
  - 2. 869-1984 Electrical Service Equipment  
(R1986)

#### **1.4 DEFINITIONS**

- A. EMI – Electromagnetic Interference
- B. GFCI – Ground-fault Circuit Interrupter
- C. RFI – Radio-frequency interference
- D. RMS – Root Mean Square
- E. SPDT – Single Pole, Double Throw
- F. SPD – Surge Protection Device

#### **1.5 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and meter/main pedestal details. For each main switchboard and panelboard listed below, submit manufacturer's name and data as required:

1. Power Distribution Panel, Load Center and Panelboard type.
2. Main bus and terminal connection sizes.
3. Location of line connections.
4. Cabinet dimensions.
5. Gutter space.
6. Gauge of boxes and fronts.
7. Finish data.
8. Voltage rating.
9. Breaker types, trip ratings, interrupting ratings and coordination settings of all protective devices.
10. Circuit Directory.

For each power distribution panel and related equipment:

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Bus configuration, current, and voltage ratings.
    - c. Short-circuit current rating of switchboards and overcurrent protective devices.
    - d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
    - e. Utility company's metering provisions with indication of approval by utility company.
    - f. Mimic-bus diagram.
    - g. UL listing for series rating of installed devices.
    - h. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components. For each type of switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- D. Text Reports: Indicate results of factory production tests.

- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Submit seismic loading design provisions.
- G. Utility Approval: Submit written PG&E approval of meter/main pedestal.
- H. Single Submittal: A single complete submittal is required for all products covered by this Section.
- I. Single Manufacturer: All equipment furnished and installed shall all be of the same manufacturer.
- J. The contractor shall be responsible for determining the coordination of the system; therefore, shall provide and apply all the settings for all protective devices including and up to the service transformer.
- K. Power Distribution Panel
  - 1. Manufacturer Seismic Qualification Certification: Submit certification that power distribution panel, overcurrent protective devices, accessories, and components will withstand seismic forces. Include the following:
    - a. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - b. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
    - c. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
    - d. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    - e. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 2. Samples: Representative portion of mimic bus with specified finish, for color selection.
  - 3. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
  - 4. Field Test Reports: Submit written test reports and include the following:
    - a. Test procedures used.



- b. Test results that comply with requirements.
  - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
5. Manufacturer's field service report.
6. Updated directory reflecting field changes after final power distribution panel load connections have been made, for record.
7. Maintenance Data: For distribution panel and components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Contract Closeout," include the following:
  - a. Routine maintenance requirements for power distribution panel and all installed components.
  - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - c. Time-current curves, including selectable ranges for each type of overcurrent protective device.

## 1.6 COORDINATION

- A. Permanent electric power of the phasing, voltage, and characteristics shown will be supplied by the Power Utility Owner. Coordinate the work of this section with the Engineer and the Power Utility Owner. Where work by the Power Utility Owner is required in conjunction with construction, such as installation of cable in common trench with other utilities, the Contractor is responsible for coordinating the work and ensuring that all required work is completed.
- B. Where work is to be performed by the Power Utility Owner that requires payment to the Power Utility Owner, payment will be made by the City. Where the Contractor identifies the need for work by the Power Utility Owner that requires payment and no known contractual arrangement by the City has been made, the Contractor shall immediately notify the Resident Engineer in writing.
- C. Coordinate layout and installation of switchboards and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 Cast-in-Place Concrete.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 2.
- D. Comply with NFPA 70.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards, including clearances between switchboards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

## 1.8 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals per Specification Section 01 78 23.

## 1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years documented experience.

## 1.10 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. testing firm acceptable to the City as suitable for purpose specified and shown.

## 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site per manufacturer's recommendations.

- B. Accept meter/main pedestal on site. Inspect for damage.
- C. Store indoors in a clean, dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, construction debris, physical damage, and traffic.
- D. If stored in areas subjected to weather, cover panels to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside panels; install electric heating (250-W per section) to prevent condensation.
- E. Handle meter/main pedestal in accordance with manufacturer's written instructions.
- F. Handle power distribution panels according to NEMA PB 2.1.

### 1.12 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- 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 seven days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
  - 2. Indicate method of providing temporary utilities.
  - 3. Proceed with utility interruptions only after receiving Architect's written authorizations.
- C. Environmental Limitations: Rate equipment for continuous operation under the following, unless otherwise indicated:
  - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2000 m).
- D. Service Conditions: NEMA PB2, usual service conditions, as follows:
  - 1. Altitude not exceeding 6600 feet (2000 m).
  - 2. Ambient temperatures within limits specified.

### 1.13 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

**1.14 MAINTENANCE MATERIALS**

- A. Provide two of each key.

**1.15 EXTRA MATERIALS**

- A. Spares: For the following:
1. Potential transformer fuses.
  2. Control-power fuses.
  3. Fuses and fusible devices for fused circuit breakers.
  4. Fuses for fused switches.
  5. Fuses for fused power-circuit devices.
- B. Spare Indicating Lights: Six of each type installed.

**1.16 WARRANTY**

- A. Provide two year warranty under provisions of Section 01 78 36.

**PART 2 - PRODUCTS****2.1 PANELBOARDS**

- A. General: As per specifications. Complete with protective devices and enclosures, buses, ground and neutral bars as required, front covers with door and built-in lock. Protective devices shall be removable without disturbing adjacent units. Flush mounted panelboards shall have adjustable fronts with indicating trim clamps.

Subpanel neutrals shall be insulated from their enclosures and grounds. Panelboards used as service entrance shall be UL listed as suitable for service entrance equipment.

- B. Distribution Panelboards:
1. Description: NEMA PB 1, circuit breaker type.
  2. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
  3. Minimum integrated short circuit rating: 42,000 amperes rms symmetrical for all panelboards or as indicated.

4. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.
5. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
6. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
7. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 42,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
8. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
9. Enclosure: NEMA PB 1, Type 4X Stainless Steel for outdoor corrosive atmosphere and Type 1 for indoor locations, cabinet box unless otherwise noted.
10. Cabinet Front: Surface type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

C. Branch Circuit Panelboards:

1. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard. Lighting panelboards shall have front doors with key latch, common keying and a typed directory card and holder. Panelboard circuits shall be arranged with odd numbers on the left and even numbers on the right. Panelboards shall have a main circuit breaker or main lug only as indicated on the schedule. Panelboard shall be door in door type.
2. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard including insulated ground bus where scheduled.
3. Minimum Integrated Short Circuit Rating: 22,000 amperes rms symmetrical for all panelboards or as indicated.

4. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers. Circuit Breakers: Circuit breakers shall be molded case type with ratings as required. All terminals shall be rated for 75°C, and shall be sized based on wire ampacities corresponding to those shown in the NEC, table 310-16 under the 75°C column. No series rated breakers shall be acceptable.
5. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 22,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
6. Enclosure: NEMA PB 1, Type 4X stainless steel for outdoor and Type 1 for indoor locations.
7. Cabinet Front: Surface or flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

D. Load Centers

1. Description: Circuit breaker load center, with bus ratings as indicated. Load Center: Combination Service Entrance Devices for 120/240V, Single Phase, Three Wires, shall have meter socket that meet EUSERC standard. The main breaker shall be rated at 22K AIC. Manufacturer: Square D Homeline Load Center or approved equal.
2. Minimum Integrated Short Circuit Rating: 22,000 amperes rms symmetrical.
3. Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers where indicated. Do not use tandem circuit breakers.
4. Enclosure: NEMA Type 4X stainless steel for outdoor and Type 1 for indoor locations.
5. Box: Flush or Surface type with door, pull ring and lock on door. Finish in manufacturer's standard gray enamel.

- E. Manufacturer: Panelboards shall be surface or flush mounted as noted on the plans by Square D NQOD or approved equal.
- F. Bussing shall be solid copper.
- G. NEMA 1 enclosures.

## 2.2 SERVICE CONDUCTORS

- A. Service conductors from the Power Utility Owner existing pull box or service pole to the meter service panel shall be furnished and installed by the Power Utility Owner.
- B. All terminations, connections, and taps shall be suitable for the intended purpose.

## 2.3 SERVICE PANEL

- A. Service Meter Pedestal:
  - 1. Built to UL 508A standards for industrial control panels and labeled for service entrance equipment.
  - 2. Complies with EUSERC requirements.
  - 3. Rated for appropriate amperage.
  - 4. Service enclosure shall be fabricated from 14 gauge #316 stainless steel
  - 5. Interior of service enclosure shall be fabricated from 14 gauge cold rolled steel & powder coated white.
  - 6. Service enclosure shall be Raw Stainless Steel.
  - 7. Service enclosure shall have continuous welded seams.
  - 8. Service enclosure shall have full length dead front with stainless steel hinge.
  - 9. Service enclosure shall have pull section with removable step.
  - 10. Service enclosure shall have fully framed side hinged outer door with swaged close tolerance sides for flush fit with top drip lip & closed cell neoprene flange compressed gaskets.
  - 11. Service enclosure shall have hinged dead front with ¼ turn latch & knurled knobs.
  - 12. Dead front door shall be hinged on the same side as exterior door & open a minimum of 100 degrees.
  - 13. Removable backpan shall be mounted on 4 welded ¼” studs.
  - 14. All circuit breakers shall be mounted in a vertical position, handle up for “On” handle down for “Off”.
  - 15. Circuit breakers shall be of cable-in cable-out type.
  - 16. Service enclosure shall consist of absolutely no “Bolt-On” or “Plug-In” circuit breakers.
  - 17. Service enclosure shall be completely prewired in the factory.

18. Wiring will be to NEMA IIB standards showing external connections & external equipment.
19. All bussing shall be UL approved copper THHN cable bussing, fully rated.
20. The function of all circuit breakers, switches & other components as required shall be identified by laminated engraved plastic nameplates with minimum ¼" letters fastened with minimum of two #4-40 stainless steel machine screws.
21. Wiring schematics will be Computer Aided Drafting & include all external equipment & connections per NEMA IIB.
22. As Built factory drawings shall be laminated and affixed to the inside of the outer door.
23. Manufacturers will be required to furnish independent laboratory certification of metal preparation & finish & to confirm that the overall product meets these specifications. If this agency wishes to witness this testing, all costs to be paid by contractor.
24. Service enclosure shall be Tescoflex 27-100 or approved equal.
25. Vandal-resistant doors with hasp, stress rated to 2,000 lbs.

B. Manufacturers:

1. Tesco Controls
2. Eaton
3. Schneider Electric

C. Rated as shown on the Contract Drawings for the various locations shown.

## 2.4 MAIN SERVICE DISCONNECT

- A. UL listed as "Service Entrance Equipment", externally operable with open or closed position plainly marked, and capable of interrupting the maximum symmetrical short circuit current available. Provide pressure connectors for attaching service conductors. See Section 26 05 00 Common Work Results for Electrical for panelboards, switches, and individually enclosed circuit breakers. This equipment must have a minimum short circuit rating of 42,000 amps asymmetrical., unless otherwise noted.

## 2.5 METER SOCKET

- A. Type approved by Power Utility Owner, weatherproof. Provide temporary blank cover.
- B. Ring-type meter socket.
- C. UL-414 certified, "Standard for Meter Sockets".
- D. Meter socket requirement (Number of Jaws) per service provider requirement.



## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Main distribution panel and meter/main pedestal shall be installed in location as indicated on the Drawings and in accordance with the manufacturer's instructions. Tighten accessible bus connections and mechanical fasteners after placing meter/main pedestal.
  
- B. EQUIPMENT INSTALLED BY POWER UTILITY OWNER
  - 1. Meters.
  - 2. Incoming service cables to service pedestal.
  
- C. EQUIPMENT INSTALLED BY CONTRACTOR
  - 1. Main Service Disconnect.
  - 2. Service Entrance Panel: Locate as unobtrusively as practical on wall of building or as shown on the Drawings. Bond and ground metal of panel to service ground.
  - 3. Wireway: Service and feeder conductors may not be in same cross section of the wireway.
  - 4. Meter Socket.

### **3.2 PANELBOARDS**

- A. Installation:
  - 1. Install panelboards, including anchors, fasteners and supports, in accordance with NEMA PB 1.1 and the NECA "Standard of Installation." Install products in accordance with manufacturer's instructions.
  - 2. Panelboards shall be flushed, or surface mounted as shown on the Contract Drawings. Panelboard shall be flushed in gypsum wall. Coordinate with Architect and Engineer.
  - 3. Install panelboards with top not more than 78 inches above the floor. Install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
  - 4. Provide filler plates for unused spaces in panelboards.

5. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
  6. Provide engraved plastic nameplates under the provisions of this Section of the Specifications.
  7. Properly ground and bond panelboard enclosure.
  8. Do not drill or cut structural members.
  9. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
  10. Install surface-mounted cabinets and panelboards with minimum of four anchors.
  11. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.
  12. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- B. Field Quality Control
1. Inspect and test in accordance with NETA ATS, except Section 4.
  2. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches and Section 7.5 for circuit breakers.
- C. Adjusting:
1. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

### 3.3 CIRCUIT BREAKERS

- A. Enclosed Circuit Breakers:
1. Install enclosed circuit breakers where shown on the Contract Drawings, in accordance with manufacturer's instructions, including anchors, fasteners and supports.
  2. Install with top of enclosure between 54 inches and 78 inches off ground or floor.

3. Install enclosed circuit breakers plumb.
  4. Provide engraved plastic nameplates in accordance with this Section of the Specifications.
- B. Quality Control:
1. Inspect and test each circuit breaker to NEMA AB 1.
  2. Inspect each circuit breaker visually.
  3. Perform several mechanical ON-OFF operations on each circuit breaker.
  4. Verify circuit continuity on each pole in closed position.
  5. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.
  6. Include description of testing and results in test report.
- C. Adjusting:
1. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.
  2. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

### **3.4 MOUNTING HEIGHTS**

- A. The lighting panelboard shall be mounted with the top of the box 6'-6" above the floor. Panelboard shall be plumb within 1/8-inch. The highest breaker operating handle shall not be higher than 72 inches above the floor. Surface mounted panelboards shall be offset from the backwall by UNISTRUTS.
- B. Highest mounting height of any breakers shall not be higher than 72 inches above the finish floor.

### **3.5 MANUFACTURER'S TESTS.**

Furnish certified manufacturer's test reports for all equipment specified.

### **3.6 FIELD QUALITY CONTROL AND TESTS**

- A. Perform inspection and test procedure as described in NETA publication Acceptance Testing Specifications, 1995.
- B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- C. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each, at test voltage of 1000 volts; minimum acceptable value for insulation resistance is 2 megaohms. Submit test results to Resident Engineer.
- D. Check tightness of accessible bolted bus joints using calibrated torque wrench.
- E. Submit Certified Field Test Reports.

### **3.7 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

### **3.8 EXAMINATION**

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.

### **3.9 INSTALLATION**

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Support switchboards and accessories according to NEMA PB 2.1.
- C. Comply with mounting and anchoring requirements per California Seismic Controls for Electrical Works.
- D. Temporary Lifting Provisions : Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- E. Operating Instructions: Frame and mount the printed basic operating instructions for distribution panel, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of distribution panel.

### **3.10 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 00 Common Work Results for Electrical.
- B. Panelboard Nameplates: Label each panelboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

### **3.11 CONNECTIONS**

- A. Install equipment grounding connections for switchboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.12 FIELD QUALITY CONTROL**

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each power distribution panel bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.
- C. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

### **3.13 ADJUSTING**

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. Set field-adjustable switches and circuit-breaker trip ranges.

**3.14 CLEANING**

- A. Touch up scratched or marred surfaces to match original finish.
- B. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

**END OF SECTION**

**SECTION 26 36 00**  
**MANUAL TRANSFER SWITCHES**

**PART 1 - GENERAL**

**1.01 SCOPE**

- A. The Contractor shall furnish and install the low-voltage manual transfer switch as specified herein and as shown in the contract drawings.

**1.02 CODES AND STANDARDS**

The manual transfer switches and controls shall conform to the requirements of:

- A. UL 1008 - Standard for Transfer Switch Equipment
- B. CSA certified to CSA 22.2 No. 178 – 1978 Manual Transfer Switches
- C. IEC 60947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Manual Transfer Switching Equipment
- D. NFPA 70 - National Electrical Code
- E. NFPA 99 - Essential Electrical Systems for Health Care Facilities
- F. NFPA 110 - Emergency and Standby Power Systems
- G. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- H. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Manual Transfer Switches
- I. International Standards Organization 9001:2008
- J. UL 508 Industrial Control Equipment

**1.03 RELATED SECTIONS**

- A. Division 26 All Electrical Sections.
- B. Division 40 All Instrumentation and Control System Specification Sections.

**1.04 REFERENCES**

- A. The switches and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards:
1. NEMA KS-1
  2. UL 98

**1.05 SUBMITTALS – FOR REVIEW/APPROVAL**

- A. The following information shall be submitted to the City Representative for review and approval:
1. Dimensioned outline drawing
  2. Conduit entry/exit locations
  3. Switch ratings including:
    - a. Short-circuit rating
    - b. Voltage
    - c. Continuous current
  4. Cable terminal sizes
  5. Product data sheets

**1.06 SUBMITTALS – FOR CONSTRUCTION**

- A. The following information shall be submitted for record purposes:
1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process

**1.07 QUALIFICATIONS**

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

**1.08 REGULATORY REQUIREMENTS**

- A. The safety switches shall bear a UL label.

**1.09 DELIVERY, STORAGE AND HANDLING**

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

**1.02 ACCEPTABLE MANUFACTURERS**

Manual transfer switches shall be ESL Power System model 3020 or approved equal. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid. Alternate bids must list any deviations from this specification.

**PART 2 - PRODUCTS****2.01 MANUAL TRANSFER SWITCHES**



- A. Manual transfer switch shall consist of (2) two mechanically-interlocked molded case circuit breakers; kirk-locks are not acceptable, cam-style male connectors, power distribution block and grounding terminals, all housed within a padlockable enclosure.
- B. Manual transfer switch enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated galvaneal steel. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via a) drawn flange cable entry openings in the bottom of enclosure for wall mount units, or b) hinged lower door for pad mount units. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened.
- C. Number of input mechanical lugs shall not exceed the number as shown on the drawings and must be rated for the specified amperage. Mechanical lugs shall be provided for each phase and for ground, and shall also be provided for neutral if required.
- D. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.
- E. Molded case circuit breakers shall be UL Listed and the short circuit interrupt rating shall be a minimum of 35kAIC at 480VAC. Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall be fed from utility power; the other molded case circuit breaker shall be fed from the cam-style male connectors to supply power from a portable generator. Both molded case circuit breakers shall include UL Listed door-mounted operating mechanisms (with provisions for a locking device), preventing the opening of the main access door unless both breakers are in the "OFF" position. Both molded case circuit breakers shall be mounted behind a dead front panel. The load-side of the molded case circuit breakers shall not be energized unless the main access door is closed and one of the molded case circuit breakers is in the "ON" position. The (2) molded case circuit breakers shall be safety interlocked by mechanical means to ensure that only one breaker can be closed at any given time.
- F. Manual transfer switch shall be suitable for use as service equipment in the USA as defined by the NEC.
- G. Manual transfer switch shall include permanently affixed operation instructions.

## **2.02 NAMEPLATES**

- A. Nameplate shall be front cover mounted, containing a permanent record of switch type, ampere rating, and maximum voltage rating.

## **PART 3 - EXECUTION**

### **3.01 FACTORY TESTING**

- A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

### **3.02 INSTALLATION**

- A. Install MTS accessory items according to NEMA PB 1.1.

- B. Mounting Heights: Bottom of trim 42 inches above finished floor, unless otherwise indicated.
- C. Conduit Connections: Make in accordance with Section 26 05 00, Common Work Results for Electrical.
- D. Cable Connections: Made in accordance with Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables.

### **3.03 IDENTIFICATION**

- A. Identify field-installed wiring and components and provide warning signs.

### **3.04 GROUNDING**

- A. Grounding: Ground MTS in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.
- B. Provide ground continuity to main electrical ground bus as indicated in Section 26 05 26, Grounding and Bonding for Electrical Systems.
- C. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.05 FIELD QUALITY CONTROL**

- A. General Requirements: Perform the following tests in the presence of the City Representative, and submit certified test reports to the City Representative for review. Furnish equipment and instruments required to perform the tests.
- B. Testing: After installing MTS electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
  - 2. Test circuits for connections in accordance with the wiring diagram.
  - 3. Test that insulation resistance to ground of non-grounded conductors is a minimum of ten megohms.
  - 4. Test main MTS for continuity to the grounding system.
  - 5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

**END OF SECTION**

**SECTION 26 50 00****LIGHTING****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.
- B. Applicable provisions of Section 26 04 00 – General Requirements for Electrical shall become part of this section as if repeated herein.
- C. Related work specified in other sections:
  - 1. Section 31 23 00: Excavation and Fill.
  - 2. Section 26 04 00: General Requirements for Electrical.
  - 3. Section 26 05 00: Common Work Results for Electrical.
  - 4. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables.
  - 5. Section 26 05 33.26: PGRS Conduit and System Components
  - 6. Section 26 05 43: Underground Ducts and Raceways for Electrical Systems.

**1.2 SECTION INCLUDES**

- A. Lighting Fixtures
  - 1. Interior and exterior luminaires and accessories.
  - 2. Lighting fixtures mounted on exterior building surfaces.
  - 3. Exit signs / Emergency lighting units.
  - 4. Lamps.
  - 5. Luminaire accessories.
  - 6. Luminaire supports.

**1.3 REFERENCE STANDARDS**

- A. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.
- C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).

- D. ANSI/NFPA 70 - National Electrical Code.
- E. ANSI/NFPA 101 - Life Safety Code.
- F. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- G. The City and County of San Francisco Electrical Code.
- H. Fixtures installation shall meet California Earthquake requirements.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
  - 1. Dimensions, of fixtures, ratings, and performance data.
  - 2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
  - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
  - 4. Exit Sign, Emergency lighting unit, battery and charger.
  - 5. LED Driver.
  - 6. Types of lamps.
  - 7. Single stem mounted fixture with 45-degree swivel canopy.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
  - 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
  - 2. Indicate dimensions and components for each luminaire which is not a standard Product of the manufacturer.
- C. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.
- D. Samples for Verification: For lighting fixtures designated for sample submission in the Interior Lighting Fixture Schedule.
  - 1. Lamps: Specified units installed.
  - 2. Accessories: Cord and plug.
- E. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.

- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- G. Maintenance Data:
  - 1. For lighting fixtures to include in maintenance manuals specified in Division 01.
  - 2. For each luminaire.
- H. Manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- I. Closeout submittals: Furnish three of each type and wattage lamp installed.

### **1.5 SUBMITTALS AFTER AWARD OF CONTRACT**

- A. Submittals after award of Contract shall be made in accordance with Section 01 33 00 – Submittal Procedures and Section 26 04 00 General Requirements for Electrical.
- B. In addition, the following specific information shall be provided:
  - 1. Substitution and Samples: Submit a sample for each substituted luminaire and coefficient of utilization table, if requested by the City. Substitutions will be accepted only if judged by the City equal or better in performance characteristics, construction quality, ease of maintenance, and aesthetic appearance.

### **1.6 QUALITY ASSURANCE**

- A. Refer to Section 26 04 00: General Requirements for Electrical.
- B. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- C. Comply with NFPA 70.
- D. FM Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM.

- E. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

## 1.7 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.
- B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

## 1.8 WARRANTY

- A. Refer to 01 78 36 Warranties.
- B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for last nine years.

## 1.9 SPARE PARTS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: Furnish at least one of each type.
  - 2. Plastic Diffusers and Lenses: Furnish at least one of each type.
  - 3. Battery and Charger Data: For emergency lighting units.
  - 4. Globes and Guards: Furnish at least one of each type.
  - 5. Driver and LED: Furnish at least one of each type.

## PART 2 - PRODUCT

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work included, but are not limited to, the products indicated in the Lighting Fixture Schedule on E series drawings.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule on E series drawings.

## 2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
  - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
  - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
  - 2. Lens Thickness: 0.125-inch (3 mm) minimum unless greater thickness is indicated.
- F. Electromagnetic Interference Filters: Integral to fixture assembly. Suppress conducted electromagnetic interference filters as required by MIL-STD-461.

## 2.3 LUMINAIRES

- A. General: Provide luminaires as shown in Lighting Fixture Schedule meeting State of California Title 24 and specified seismic requirements, with proper hangers, pendants, canopies, lamps, etc., necessary for complete installation. Refer to Division 01 Section "Regulatory Requirements" for seismic loading design provisions.

- B. Provide luminaires having "feed thru" or separate junction boxes. Provide luminaires with wire leads not smaller than 14 AWG and with all electrical components easily accessible and replaceable without removing the luminaire from the ceiling.
- C. Manufacturer: See types listed in Lighting Fixture Schedule on Drawings.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 1. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
  - 2. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
  - 3. UL Compliance: Comply with UL 1598 and listed for wet location.
  - 4. Lamp base complying with ANSI C81.61
  - 5. Bulb shape complying with ANSI C79.1.
  - 6. Lamps dimmable from 100 percent to 0 percent of maximum light output.
  - 7. Internal driver.
  - 8. Lamp Rating: Lamp marked for outdoor use.

## 2.4 DRIVERS

- A. Electronic
- B. Voltage range (120 – 277V) +/- 10%, (347-480V) +/-10% optional
- C. Current .350 Adc (+/- 5%), .525 Adc (+/-5%), .700 Adc (+/-5%)
- D. Frequency 50/60 Hz
- E. Power Factor >90% at full load
- F. THD < 20% at full load
- G. Load Regulation: +/- 1% from no load to full load
- H. Output ripple < 10%
- I. Output should be isolated
- J. Case temperature: rated for -40 through +80 C



- K. Fully encased and potted
- L. Overheat protection, self-limited short circuit protection and overload protected
- M. Primary Fused
- N. 10 KVA surge protection
- O. Life rating not less than 100,000 hours
- P. 0-10V Dimming capabilities
- Q. Meet IP 66 standards
- R. EMC compliance-FCC part 15B, CISPR 15
- S. UL listed
- T. Useful life no less than 100,000 hours

## **2.5 LAMPS**

- A. Noncompact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.
- B. LED lamp shall be per manufacturer.

## **2.6 FIXTURE SUPPORT COMPONENTS**

- A. Comply with Section 26 05 00 Common work Results for Electrical, for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy for 45-degree swivel. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- D. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

## **2.7 FINISHES**

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.
  - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
  - 2. Metallic Finish: Corrosion resistant.

## **PART 3 - EXECUTION**

### **3.1 STORING OF EQUIPMENT AND PROTECTION DURING CONSTRUCTION**

- A. All equipment stored offsite shall be protected in accordance with the manufacturer's recommendations. All equipment shall be covered with heavy gauge polyethylene sheeting or canvas while stored and during construction to protect the equipment from dust and moisture until accepted by the Owner.

### **3.2 INSTALLATION**

- A. Install each luminaire in a manner recommended by the luminaire manufacturer and accepted by the City.
- B. Furnish and install all additional ceiling bracing, hanger supports, and other structural reinforcements to the building required to properly and safely mount luminaires, all acceptable to the City and meeting specified seismic requirements.
- C. The Contractor shall be responsible for handling the luminaires, installing plumb and level, and keeping luminaires clean.
- D. Install all luminaires straight and true with reference to adjacent walls and where mounted on tiled ceilings, locate luminaires symmetrically with the tile pattern as shown on the Drawings. In all cases, locate centerlines of luminaires either on centerline of tile or on joint between adjacent tile runs, as best suits luminaire spacing shown.
- E. Provide surface-mounted luminaires, not accepted for installation on combustible low-density cellulose fiberboard, with accepted spacers to mount luminaires 1-1/2 inches from the ceiling surface, unless specified on drawings.
- F. Provide pendant luminaires with single stem, unless twin stems are noted or required, 45-degree swivel type hangers and canopies as accepted by the Engineer. Finish hangers and canopies to match luminaires, unless otherwise noted. Space single-stem hangers on fluorescent luminaires nominally 48 inches apart. Where luminaires are pendant-mounted and a mounting height is indicated in Luminaire Schedule, height is from bottom of luminaire to finished floor. Stem mounted fixtures to meet California Earthquake requirements.

- G. Provide each luminaire outlet box with a galvanized luminaire stud to fit the luminaire selected.
- H. Provide flush and recessed luminaires installed in furred ceilings with junction boxes located at least 1 foot from luminaires. Provide wiring from junction box to luminaire of temperature rating as required by the luminaire in not less than 4 feet, but no more than 6 feet of flexible steel conduit. In concealed location, install junction boxes to be accessible by removing luminaire.
- I. Install all recessed luminaires tight with the finished surface so that no spill light will show between the ceilings and the sealing rings, and furnish plaster frames when required by ceiling construction.
- J. Provide each recessed luminaire with two safety chains or two No. 12 AWG soft-annealed galvanized steel wire of length needed to secure luminaire to building structure independent of ceiling structure. Tensile strength of chain or wires and fastening to structure shall be adequate to support weight of luminaire.
- K. After construction of total project is completed, remove all labels and other markings, wash dirty luminaires inside and out with a nonabrasive mild soap or cleaner. Clean luminaire plastic lenses with antistatic cleaners only. Touch up all painted surfaces of luminaires with high-grade exterior enamel supplied by the manufacturer.
- L. Locate luminaires where shown on the Drawings.
- M. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- N. Support for Fixtures in or on Grid Type Suspended Ceilings: Use grid for support.
  - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
  - 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two  $\frac{3}{4}$  inch (20-mm) metal channels spanning and secured to ceiling tees.
- O. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspended with twin-stem hangers
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on drawings.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: As follows:
  1. Verify normal operation of each fixture after installation.
  2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
  3. Verify normal transfer to battery source and retransfer to normal.
  4. Report results in writing.
- E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- F. Corrosive Fixtures: Replace during warranty period.
- G. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

### **3.4 CLEANING AND ADJUSTING**

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.
- C. Clean electrical parts to remove conductive and deleterious materials.

- D. Remove dirt and debris from enclosure.
- E. Clean photometric control surfaces as recommended by manufacturer.
- F. Clean finishes and touch up damage.

### **3.5 GROUNDING**

- A. All conduits and utilizations equipment shall be permanently and effectively grounded in accordance with the latest rules of the National Electrical Code, the State Safety Orders, and the City and County rules and regulations.

### **3.6 CONNECTIONS**

- A. Ground equipment:
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.7 PROTECTION OF FINISHED WORK**

- A. Relamp luminaries which have failed lamps at Substantial Completion.

### **3.8 FINAL TEST**

- A. The Electrical Contractor shall test in the presence of a representative of the City Architect/Engineer all work done on this project function as intended. All defects or omissions in the work must be satisfactorily corrected before acceptance of the work.

**END OF SECTION**

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SECTION 31 23 00  
EXCAVATION AND FILL

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. This specification section covers the following items of work:
  - 1. Excavation
  - 2. Backfilling and compaction
- B. The work includes excavating, shoring, backfilling, compacting, and grading to construct electrical and communication duct banks, sewers, water lines, to remove facilities as specified, and other work, including work associated with removal and replacement of unsuitable or hazardous materials, incidental work including dewatering, removal of abandoned facilities, protecting existing utilities and excavating exploratory holes.
- C. The Contractor shall design, furnish, and construct trench and excavation shoring to safely support the sides of trenches, excavations and adjacent improvements. The shoring shall be carried to adequate depths and made as secure as necessary for the safe and proper performance of the work.

## 1.02 RELATED SECTIONS

- A. Section 02 41 00 – Demolition

## 1.03 REFERENCES

- A. City and County of San Francisco, Department of Public Works, Standard Specifications (SFDPWSS), latest edition.
- B. City and County of San Francisco, Department of Public Works, Order No. 176,707, "Regulations For Excavating and Restoring Streets in San Francisco."
- C. San Francisco Public Works Code Article 2.4, "Excavation in the Public Right-Of-Way."
- D. California Labor Code Sections 6705 and 6707.
- E. American Society for Testing and Materials (ASTM) Standards
  - 1. C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lbf/ft<sup>3</sup>).
  - 3. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft lbf/ft<sup>3</sup>).
  - 4. D5195 – Standard Test Method for Density of Soil and Rock in Place at Depths Below Surface by Nuclear Methods.

- F. California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA) shall be strictly observed.

1. Title 8 – Industrial Relations, Chapter 4 – Division of Industrial Safety

#### 1.04 SITE CONDITION

- A. In the event that unusual site conditions are encountered, discontinue work in affected area and notify City Representative immediately.
- B. Existing Foundations: The Drawings may not show existing abandoned foundations and/or pile foundations for existing structures. Notify the City's Representative if such foundations are encountered; the City's Representative will provide instructions for their removal or abandonment.

#### 1.05 GROUNDWATER

- A. The Contractor shall be responsible for the continuous control of ground water at all times during the course of construction, including Saturdays, Sundays and holidays.
- B. Dewatering plans shall be designed, stamped and signed by a licensed Civil Engineer registered in the State of California. By approving the plans, the City accepts no responsibility for the adequacy thereof or for damages to public or private property that may result. All such responsibility shall rest with the Contractor. The plans shall include detailed working drawing and pertinent descriptions of the proposed ground water control system including a schedule of installation and details of the system operation plan, contingency plans for interruption or failure of the proposed ground water control system and disposal plans. Provisions shall also include removal of storm water and any other water that may enter into the excavation.

#### 1.06 SUBMITTALS

- A. Submit plans and calculations for the shoring system for review and approval prior to trench excavation. If such plans vary from the shoring standard established by the Construction Safety Orders, the plans shall be prepared by a Civil Engineer registered in the State of California. Approval shall not relieve the Contractor of responsibility to provide a satisfactory and safe shoring system.
- B. Prior to commencing excavation or construction, submit dewatering plans compatible with the shoring system to the Engineer for review and approval.
- C. Thirty days prior to excavation, submit a detailed plan indicating potential corrective measures in the event that the Action Trigger Level of 3/16" ground movement is reached. Engineer approval is required prior to beginning corrective measures.
- D. Thirty days prior to excavation, submit a detailed plan indicating potential corrective and restorative measures in the event that the Maximum Allowable Movement of 1/4" ground movement is reached. Engineer approval is required prior to beginning corrective measures.

### PART 2– PRODUCT

#### 2.01 MATERIAL

- A. Select Fill Material: Soil selectively obtained from site excavation and subject to approval of the City Representative and conforming to the following:



1. Predominantly granular, not showing excessive shrinkage or swelling when subjected to changes in water content.
  2. Soil Backfill: All soil backfill materials shall be free of organic and deleterious materials and stock piling shall comply with the provisions of Section 700.06 of the SFDPW Standard Specifications.
  3. Sand: Imported sand type backfill shall be free from rock, concrete, organic material and other objectionable material. Backfill material shall have 100 percent passing the 3/8-inch sieve size, 93 percent to 100 percent passing the No. 4 sieve size and 0 percent to 10 percent passing the No. 200 sieve size. Samples shall be submitted to and approved by the Department of Public Works Material Testing Laboratory prior to placement. Unacceptable material shall be immediately removed from the site of work. The acceptance of import fill also depends on the results of the environmental analytical testing, and compliance with Section 01 57 23, Environmental Management of Excavated Materials.
  4. Bedding and Cover Material: Where not otherwise specified in these Specifications, bedding and cover material shall conform to SSDWSF, Section 703 Trench Backfill of City Standard Specifications.
  5. Bedding material for new main sewers shall be well-graded crushed rock with 100 percent passing the 1-inch sieve, min. 90 percent passing the 3/4-inch sieve and maximum 5 percent passing the No. 4 sieve. The fines passing No. 200 shall be non-plastic. Bedding material shall be minimum 5 inches below the pipe and shall extend min. 9 inches on both sides of the pipe up to spring line, unless otherwise noted.
  6. Stabilization Material: Washed, evenly graded mixture of crushed stone or crushed gravel with 100 percent passing a 1-inch sieve, 90 to 100 percent passing a 3/4-inch sieve and not more than 5 percent passing the No. 4 sieve. Recycled Materials shall not be allowed.
  7. Recycled Material and crushed concrete shall not be used as bedding material.
- B. Controlled Low Strength Material (CLSM).  $f'_{c,min} = 100$  psi,  $f'_{c,max} = 1,200$  psi.

## 2.02 TRENCH SUPPORT SYSTEM

- A. Steel sheet piling, if employed, shall be of rolled steel shapes of the continuous interlocking type forming a continuous wall when individual sheets are installed side by side. They shall be installed in a manner that their interlocking is kept continuous without separation at the joints. Sheet pilings, if used, shall not be installed by hard driving. Propose and submit for approval a suitable installation method, which will minimize the noise and vibrations. Other equivalent methods that will effectively prevent water leakage through the joint such as insitu-soil cement mixing will be acceptable. The interlocking sheet piling and all accessories shall conform to the requirements of ASTM A328.
- B. Lagging members, if employed, shall be installed in accordance with approved design and in a manner which will prevent loss of ground. Where, in the judgment of the Engineer, the loss of ground cannot be prevented by wedging the lagging tight against the original ground, e.g., at the sandy non-cohesive soils, prevent the loss of ground by an approved method. This shall not be a cause for changed condition or for claims for extra by the Contractor.

- C. All timber, lumber, and structural steel employed for the trench supporting system, whether new or used, shall be sound and free from defects that might impair their strength. Where sheet piles or soldier piles are to be removed, they may be removed after backfilling is completed. Voids left by such removal shall be immediately backfilled with an acceptable bode type structural mix ready on site, at no extra cost to the project. The Contractor shall meet the requirements to control settlements and shall plan its operations accordingly.
- D. All timber lagging left in place shall be pressure treated with wood preservative in accordance with the applicable requirements of Section 415.05 of the DPW Standard Specifications.
- E. Except for bracing struts, allowable basic stresses for rolled steel sections, including sheet piling, may be increased by 20 percent for all temporary shoring structures. Allowable basic stresses for all temporary shoring structures shall be in accordance with the latest AISC Code. Allowable stresses for struts shall not exceed those allowed by the AISC code for permanent structures. All welds shall be designed according to AISC code without any increase in the allowable stresses for temporary structures. Lagging and all timber structures shall be designed using allowable stresses determined by National Design Specifications In Wood Construction, latest edition. The duration of the load shall not be taken as less than 3 months.
- F. Trench shields will not be allowed to be used for shoring.

### 2.03 WARNING AND IDENTIFICATION TAPE

- A. Buried warning and identification tape shall be metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 6 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

#### Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials, Auxiliary Water Supply System
Orange:	Telephone and Other Communications
Blue:	Water System
Green:	Sewer Systems/Storm Drain Systems
Purple:	Reclaimed Water
White:	Steam Systems
Gray:	Compressed Air

- B. Detectable Warning Tape for Non-Metallic Piping. Detectable warning tape shall be polyethylene plastic tape conforming to the width, color and printing requirements specified above, but additionally containing integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Minimum thickness of tape shall be 0.10 mm. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Encase metallic element of the tape in a protective jacket or provide other means of corrosion protection.

### PART 3– EXECUTION

### 3.01 EXAMINATION

- A. The Contractor is responsible to identify required lines and levels.
- B. The Contractor is responsible to verify fill material to be reused, is acceptable

### 3.02 PREPARATION

- A. Identify required lines, levels, contours and datum shown in the Contract Drawings.
- B. Take measure to prevent surface water from entering excavation.
- C. Take measures to prevent soil from caving during excavation.
- D. Do not undermine adjacent existing foundation for building to remain during Contractor's excavation.
- E. Maintain and protect existing utilities remaining, which pass through work area.
- F. Protect benchmarks, existing structures, sidewalks, and curbs from excavation equipment and vehicular traffic.
- G. Notify the City Representative prior to commencing and upon completion of excavations. Provide 48 hours notification to coordinate schedule and availability. It is the contractor's responsibility to notify the City to request inspection.

### 3.03 EXCAVATION

- A. Provide all engineering including design, details and calculations, installation and construction of shoring, sheeting and bracing necessary to support the sides of the excavation to prevent movement, which may damage adjacent pavements, utilities or structures, damage, or delay the Work, or endanger life and health as required by Cal/OSHA and other applicable governmental regulations and agencies. All trench work shall also be performed with the applicable provisions of California Labor Code Sections 6705 and 6707.
- B. The provisions specified herein shall complement, and not substitute for nor diminish, the obligations of the Contractor for providing a safe work area and for protecting the Work, structures and other improvement.
- C. Regardless of the shoring system used, prevent ground loss along the project alignment. Cantilever types of shoring walls are not acceptable. No sloping/benching type shoring system is allowed. Steel shims or filler plates shall be installed to obtain a tight fit and bearing.
- D. The Contractor shall be solely responsible for damage to adjacent properties caused by its construction operations.
- E. Accurately cut foundation excavations to dimensions and elevations shown on Contract Drawings to tolerances of ACI 301.
- F. Where sides are unstable or excavations are not accurately cut, excavate to permit placement and removal of formwork.
- G. Where foundations sides are intended to be formed, excavate to permit placement and removal of formwork.

- H. Shore and brace excavations as required to prevent caving and danger to persons and structures. Comply with applicable safety regulations.
- I. Prepare bottoms of footing excavations to produce conditions acceptable to City Representative.
  - 1. Hand trim bottoms and sides of excavation and leave bottom free of loose material.
  - 2. Trim bottom of excavations square and true.
  - 3. Remove and/or recompact soft, disrobed or uneven areas.
  - 4. Fill over-depth excavations with concrete.
- J. Maintain footing conditions approved by the City Representative until concrete work is complete. It is the Contractor's responsibility to maintain footing subgrade conditions. Contractor's means and methods may include over-excavation by a few inches and placing CLSM to protect footing subgrade at no cost to the City.
- K. Keep excavations free of water at all times until foundation structural concrete is cast.
- L. Stockpile or remove excavated material from site.

### 3.04 BACKFILLING

- A. Preparation for Backfilling:
  - 1. Verify that foundation is adequately braced to support forces imposed by backfilling.
  - 2. No backfilling shall occur behind retaining walls until concrete has cured to achieve the minimum 7-day compressive strength as specified in the drawings.
  - 3. Verify areas to be backfilled are free of debris, formwork, and water.
- B. Placing and compacting Backfill:
  - 1. Place and compact select fill material in accordance with the Geotechnical Report.
  - 2. Compaction by flooding, ponding, or jetting will not be permitted.
  - 3. Employ methods which will not disturb or damage waterproofing and protective cover and perimeter drainage.
  - 4. Use pneumatic hand held tempers in areas that are not accessible to wheeled equipment.
  - 5. Backfill behind retaining walls shall only be placed using hand held pneumatic equipment. No wheeled equipment is allowed.

### 3.05 FIELD QUALITY CONTROL

- A. City Representative will observe footing excavations prior to placement of reinforcement; and again, immediately prior to casting of concrete. Do not place form, reinforcement,

concrete or fill material until excavation has been inspected and approved by Geotechnical Engineer.

- B. The DPW Geotechnical Engineer or appointed technician (by the Geotechnical Engineer) will inspect and test placement of backfill.
- C. Notify the City Representative 48 hours prior to any filling or backfilling operations to allow proper scheduling of tests and operations.

END OF SECTION



## SECTION 31 23 19

## DEWATERING

## PART 1 – GENERAL

## 1.1 SUMMARY

- A. This Section includes all work related to dewatering and groundwater control. All work in this Section shall be considered as Incidental Work, to the completion of the Work in which it pertains. The cost of this work shall be Incidental Work and shall be accounted for, in accordance with the General Conditions.
- B. This Section specifies the general requirements for furnishing all labor, materials, equipment and operations necessary if dewatering is involved, and the handling and treating of groundwater prior to discharge.
- C. It is anticipated that the depth of groundwater will be encountered during this project at depth ranging 4 to 10 feet below the existing ground surface. The Contractor is alerted to the fact that groundwater levels within the project area may exhibit variation due to seasonal and tidal influence.
- D. According to the project's geotechnical report: *Geotechnical Investigation, Pier 94 Backland Improvements, San Francisco, CA, July 2012, T&R/R/RYCG* it is anticipated that the depth of groundwater will be encountered during this project at depth ranging 4 to 7 feet below the existing ground surface.
- A. Any groundwater intrusion into the excavated area shall be pumped and disposed of site by the Contractor and per requirements of City applicable codes and regulations. In the event that groundwater is encountered, excavation must stop in the affected area and the conditions and submittals of this Section must be met prior to resuming work within the affected area.
- B. This Section includes the following topics:
  - 1. Submittals
  - 2. General Requirements
  - 3. Sewer Discharge Requirements
  - 4. Discharge to the SFPUC Water Pollution Control Plant (WPCP)
  - 5. Dewatering System
  - 6. Site Dewatering
  - 7. Contractor's Dewatering Plan
  - 8. Analyses of Groundwater Discharge
  - 9. Notification of Intent to Dewater at Each Point of Discharge
- C. Related Documents and Sections:
  - 1. Section 01 41 00 – Regulatory Requirements

2. Section 01 57 19 - Environmental Mitigation Measures

- D. Payment: With the exception of the chemical/environmental testing of the groundwater (if needed), all work in this Section shall be incidental to mobilization (Bid Item No. 1, Mobilization and Demobilization), unless noted otherwise. If needed chemical/environmental testing of the groundwater will be paid through to the Allowance for Soil Pre-Excavation Soil Profiling and Unforeseen Environmental Conditions (Bid Item No. 47)
- E. Liquidated Damages: In addition to any regulatory fines, should the Contractor fail to implement the dewatering criteria as per this Section, or promptly take all required remedial actions to the City's satisfaction herein, the City Representative reserves the right to issue environmental non-compliance notices, have the necessary work performed by others, assess fines of one thousand dollars (\$1000.00) per non-compliance occurrence or per event, or to deduct or withhold all monies required therefore as permitted under the Contract Documents.

1.2 APPLICABLE CODES AND STANDARDS

- A. National Pollution Discharge Elimination System (NPDES) permit
- B. Regional Water Quality Control Board (RWQCB) regulations
- C. San Francisco Public Utilities Commission (SFPUC) permit and regulations

1.3 SUBMITTALS

- A. Pursuant to the provisions of Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following at least ten (10) working days before any earth materials disturbing activity in the project area is affected by groundwater.
  - 1. Dewatering Plan in accordance with Articles 1.7, 1.8, and 1.9 herein.
  - 2. Monthly Updates of dewatering activities and analytical results of the discharged water in accordance with Article 1.6 herein
  - 3. Copies of the sewer discharge permit from the San Francisco Public Utilities Commission (SFPUC), Wastewater Enterprise Collection Systems Division (SFPUC-WECS)
  - 4. Groundwater analytical results as per Part 1.10 of this Section.
  - 5. Notifications for sewer discharge for each discharge point as per Part 1.11 of this Section.

1.4 GENERAL REQUIREMENTS

- A. Sewer Batch Wastewater Discharge Permit
  - 1. The Contractor shall obtain the sewer discharge permit from the San Francisco Public Utilities Commission (SFPUC), Wastewater Enterprise Collection Systems Division (SFPUC-WECS). The sewer discharge permit shall meet the Regional



Water Quality Control Board (RWQCB) and the Port of San Francisco requirements. The Contractor shall obtain the sewer discharge permit by submitting a dewatering control plan along with the permit application. <https://sfwater.org/modules/showdocument.aspx?documentid=2327>

2. The Contractor is wholly responsible for obtaining the sewer discharge permit in a timely manner. The City will not honor any claims from the Contractor, arising from delays in obtaining the sewer discharge permit.
3. The Contractor shall submit monthly updates of dewatering activities and conduct the water quality sampling and submit analytical results of the discharged water, in accordance with the requirements of the sewer discharge permit.

**B. Groundwater Controls**

1. The Contractor shall design, furnish install and maintain, and operate dewatering systems and controls as required to control water levels and hydrostatic pressures at least 3 feet below the bottom of excavation during excavation and other construction operations.
2. Methods of groundwater discharge, conveying, and transmission to onsite and offsite locations shall meet the approval of the City regulations and other governmental authorities having jurisdiction. The Contractor shall provide all temporary holding tanks required for sedimentation of soil particles and treatment of other contaminants.
3. The Contractor shall conduct chemical testing of groundwater pumped into temporary holding tanks. The Contractor shall submit results of tests to City Representative for evaluation. The Contractor shall not discharge any water until the test results have been reviewed and approved by the City Representative.
4. The Contractor is responsible for the continuous control of groundwater at all times during the course of the construction, including Saturdays, Sundays, holidays work stoppages, during periods of labor strikes and during periods of work stoppages.
5. Unless otherwise specified in this Specification, the Contractor shall schedule and conduct its work in a way that will not cause interference and temporary disruptions to the existing utilities and services. Existing utilities and services include but are not limited to sewers, water mains, gas lines, electrical lines, telephone lines, telecommunication lines and the normal flow of traffic.

**C. Prohibition of flows and unauthorized discharges to the San Francisco Bay**

1. The City clearly and unequivocally prohibits the Contractor from discharging any flows to the San Francisco Bay, without authority from the San Francisco Bay Regional Water Quality Control Board (RWQCB) and the Port of San Francisco. Neither the City nor the Contractor has authorized permission or has received a permit from the RWQCB to discharge into the Bay.
2. The Contractor shall be responsible for providing all necessary means to handle, carry through, or divert all flows properly, all flows including storm flows and unforeseen sub-drains. The Contractor shall be responsible in preventing backup or bypassing unauthorized discharge to the Bay and preventing flooding damage to property.

3. The RWQCB has the power, derived from the Porter-Cologne Water Quality Control Act, to impose up to twenty-five Thousand Dollars (\$25,000) per day (or portion thereof) fine for bypassing of sewerage flows and unauthorized discharges to the San Francisco Bay.
  4. In addition, provisions of the Clean Water Act, Section 3.09 "Federal Enforcement" state that any civil and criminal violations of the Act may result in a fine of up to a maximum of One Hundred Thousand Dollars (\$100,000) per day, plus imprisonment for anyone who knowingly violates the regulations. The Contractor shall be responsible for any violation of Regional Board requirements caused by his or her operations. The City will pass on all such penalties to the Contractor.
  5. If an overflow and an authorized discharge to the bay occurs because of the Contractor's operations or neglect, and any fine is levied against the City, the fine will be considered direct damages caused by the Contractor. The City will recover such monetary sums from the Contractor's progressive payments and final payment.
  6. The Contractor shall comply with all applicable provisions of the Phase II Stormwater Regulations of the Clean Water Act (CWA). The Contractor's Dewatering Plan shall be implemented in conjunction with the Port of San Francisco Stormwater Pollution Prevention guidelines.
- D. Handling and Disposing of Sanitary Sewage, Groundwater and Infiltrated Flows
1. The Contractor shall make allowances for seasonal and daily fluctuations in the sewer flow when dewatering or controlling ground water control within the project limits.
  2. Flow information may be obtained from the DPW/BOE Hydraulic Section at 1680 Mission Street, 2<sup>nd</sup> Floor, San Francisco, (415) 554-8325.
  3. The Contractor shall not impede or obstruct any wet weather flow anywhere in the sewer system. The Contractor shall not begin disruption of a sewer without the City Representative's approval.
- E. Work Within Existing Sewers
1. The Contractor shall comply with California Code of Regulations, General Industry Safety Orders, Article 108, and Title 8, Sections 5156 through 5159 when entering and working in existing sewers.
  2. It is the responsibility of the Contractor to provide all equipment or assistance to make the confined space safe for entry by the City Representative or his/her representative per the California Code of Regulations, Title 8; General Industry Safety Orders entitled "Confined Spaces".
- F. Construction of Flow Diversion
1. The Contractor may construct open or close conduits, wholly within the excavation for flow diversions at places where sewers cross the excavation. Existing sewer flows shall be maintained at all times.

## 1.5 SEWER DISCHARGE REQUIREMENTS

- A. Discharges to the sewerage system shall meet the requirements of the following:
  - 1. Article 4.1 San Francisco Public Works Code; Industrial Waste Ordinance, No. 116-97
  - 2. DPW Order No. 158170 for wastewater discharges into the City's sewerage system.
  - 3. Requirements for Batch Wastewater Discharges - the San Francisco Public Utilities Commission, Wastewater Enterprise Collection Systems Division (SFPUC-WECSO).
  - 4. The Construction Dewatering Site Discharge Limits of the Southeast Water Pollution Control Plant (SEWPCP)
- B. The Contractor is permitted to discharge uncontaminated wastewater into the City's sewerage system after obtaining approvals as follows:
  - 1. Submit, obtain approval and abide by the Dewatering Plan. The City Representative will forward the Dewatering Plan, to the San Francisco Public Utilities Commission (PUC). The City Representative will only approve the Plans after the regulatory agencies approve the Plans. The Contractor shall be responsible for correcting any deficiencies to the Plan.
  - 2. Obtaining the sewer discharge permit. Contact SFPUC/CSD at (415) 695-7369.
- C. The Contractor is advised that the Public Utilities Commission has authority to order immediate cessation of discharge(s) to the sewerage system. The Contractor is solely responsible for all costs associated with cessation discharges, and any and all costs for delay in operations.
- D. Should the existing groundwater be uncontaminated, and subsequently become contaminated due to the Contractor's operations, all costs related to satisfactory cleanup and disposal shall be the responsibility of the Contractor. Such costs shall include re-design, re-construction, pretreatment and, sewer service permit and usage fees cost necessary to satisfy the above requirements.

#### 1.6 DISCHARGE TO THE WATER POLLUTION CONTROL PLANT (SEWPCP)

- A. The Contractor shall adhere to the Construction Dewatering Site Discharge Limits of the Water Pollution Control Plant (WPCP), which includes, but is not limited to:
  - 1. Limit the maximum discharge flow from the project to less than 285,000 GPD (200 GPM over a continuous 24-hr period). For intermittent dewatering (e.g. daytime only), the dewatering flow rate shall not exceed 300 GPM.
  - 2. Collect and analyze discharge flows from each site for chloride concentration. To be performed by the Contractor in presence of the City Representative.
  - 3. The ability to terminate discharge to the SEWPCP collection system, upon request, and provide storage and/or bypass alternatives.
- B. Monthly Updates: Provide monthly updates to the Water Pollution Control Division (WPCD), regarding the status of all construction dewatering in the collection system. This shall include:

1. Previous and planned dewatering schedule
  2. Start and stop of each discharge
  3. Measured flow rates in gallons per minute (GPM) and volumes in gallons per day (GPD)
  4. Field measurements of chloride concentrations
  5. Method(s) of dewatering
- C. For variances of the limits prescribed above, coordination through the WPCD, information, notification, and reporting contact WPCD.

#### 1.7 SITE DEWATERING

- A. Unless otherwise directed by the City Representative, the Contractor shall discharge all dewatered groundwater to the sewer system through settling tank(s), with sediment traps and oil/water separators. The Contractor may select its own dewatering system. The Contractor shall furnish, install and operate sufficient equipment to allow all dewatering flows to reside in the settling tanks for a minimum of one hour. The system shall include all required pumps, hoses, fittings and accessories as necessary to contain and handle the dewatering flows.
- B. The Contractor shall employ a professional Civil Engineer, Geotechnical Engineer, Certified Engineering Geologist or Certified Hydro geologist registered in the state of California to design and operate the dewatering system to:
1. Prevent direct discharge into the City's Sewer System
  2. Prevent loss of ground as water is removed
  3. Avoid inducing settlement or damage existing facilities, completed work, or adjacent property
  4. Relieve artesian pressures and resultant uplift of excavation bottom.
  5. Ensure dry conditions at the final lines and grades of the bottom of the excavation
  6. Control all odors emanating from the dewatering system
  7. After treatment through the dewatering system, discharge the flow(s) directly into the catch basin or sewerage. Discharges shall neither flood the streets and/or other surfaces, nor affect adjacent residences and businesses. Dewatering operations shall neither cause a dust nuisance, nor a health menace, nor create muck deposits.
- C. The Contractor shall provide and maintain at all times during construction, ample means and adequate devices with which to promptly dewater and properly dispose of all water 1 meter (3 feet) below the deepest excavation until backfill has been completed. The Contractor shall continuously control water during construction, including weekends and holidays and during periods of work stoppages, regardless of source, and until backfilled to final grade. The Contractor shall also provide adequate backup systems to maintain control of water.

- D. The Contractor shall design, furnish, install, test, operation, meter the flow, monitor and maintain the dewatering system including all discharge piping and connections at point of discharge. The Contractor shall be responsible to design a system that shall ensure that the excavation and removal of underground obstructions occurs in a dry environment. Hydrostatic pressure shall be properly relieved to prevent excessive seepage of water into the excavation, which may create instability to the sides and bottom of the excavation.
- E. Uptake lines to the settling tank(s) shall be screened and set in the excavation to minimize uptake of sediment and/or other contaminants. Outflow from the settling tank(s) shall be by gravity only, no pumping. The outflow capacity shall be sufficient to accommodate the rate of inflow while meeting applicable discharge standards. The Contractor shall provide a sufficient number of properly configured settling tanks to prevent any delay to his/her operation.
- F. The Contractor shall have sufficient redundancy in the treatment system and standby units to safeguard against breakthrough of the primary units and to keep the excavation free of water in event of component failure. Standby pumping equipment shall be maintained on the jobsite.
- G. The Contractor shall furnish multiple systems to handle flows at each discharge location he or she proposes to discharge. The groundwater shall be discharged at locations approved by the City Representative.
- H. Dewatering shall commence after dewatering plan has been reviewed and approved by the City Representative, when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise.
- I. The Contractor shall provide 100% emergency power backup with automatic startup and switchover in the event of electric power failure.
- J. The Contractor shall include worksite traffic controls at the dewatering locations that enter into vehicular or pedestrian pathway
- K. The Contractor shall restore all facilities to conditions prior to construction and to the satisfaction of the City Representative. Demobilization of the dewatering system includes the following:
1. Cleaning the settling tank(s) to a level acceptable to the tank vendor
  2. Removal and containerizing all tank(s) sediment
  3. Sediment sample collection as necessary for proper sediment disposal
  4. Load, transport and disposal of sediment and floatable waste,
  5. Return of the tank as per the vendor's requirements.
  6. Remove all temporary lines and related connections upon completion of the work

#### 1.8 CONTRACTOR'S DEWATERING PLAN

- A. As a condition of the commencing site work under this Contract, the Contractor shall submit to the City Representative, a written plan for dewatering, including obtaining all required permits. Review and approval of the Contractor's dewatering plan by City

Representative shall not relieve the Contractor of the responsibility for the adequacy of the dewatering system to achieve the specified result.

- B. Thirty (30) days prior to commencing excavation or prior to the planned start of work affecting the flow in any major sewer, the Contractor shall submit to the City Representative six (6) copies of a detailed Dewatering Plan for approval. The Contractor shall also send a copy of the Dewatering Plan to the San Francisco Public Utilities Commission (SFPUC), Wastewater Enterprise Collection Systems Division (SFPUC-WECS) and the Port of San Francisco. The Contractor shall provide evidence to the City Representative that the above agencies have approved the dewatering plan. The dewatering plan shall fulfill the sewer discharge requirements of the San Francisco Bay Regional Water Quality Control Board (RWQCB) and the Port of San Francisco.
- C. The dewatering plan shall include:
1. Drawings of the proposed groundwater control system showing locations, dimensions and relationships of elements of each system
  2. Description of the proposed groundwater control system but not limited to, equipment, standby equipment and power supply
  3. Method of handling, treating, dewatering and disposing of sanitary, groundwater and tidewater flow
  4. Design calculations demonstrating adequacy of proposed dewatering system and components
  5. Schedule of installation
  6. Statement of the Contractor's awareness and intent to comply with the City's sewer discharge requirements as per the Industrial Waste Ordinance Article 4.1 Section 127-Reporting and Sampling Requirements the certification statement shall be as follows:  
  
*I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.*
  7. Procedures for notification, testing for chlorides and reporting requirements with the Construction Dewatering Site Discharge Limits of the Southeast Water Pollution Control Plant (SEWPCP)
  8. Flow rates and sewer discharge volumes
  9. Proposed points of discharge to the sewer
  10. Details of the system operation plan and its portability
  11. Contingency plans for interruption or failure of the proposed groundwater control system
  12. Disposal plan for the settled wastes, and floatable and oily wastes

13. The sewer discharge permit
- D. The dewatering plan shall be designed, stamped and signed by a licensed Civil Engineer registered with the State of California. By approving the plan, the City does not accept responsibility for the adequacy thereof nor any damages to public or private property that may result. All such responsibility shall rest with the Contractor and its engineer or consultant.
  - E. If the dewatering system is modified during installation or operation, the Contractor shall revise or amend, and resubmit the dewatering plan to the City Representative for review and approval. Review and approval of the Contractor's amended dewatering plan by City Representative shall not relieve the Contractor of the responsibility for the adequacy of the dewatering system to achieve the specified result.

#### 1.9 ANALYSES OF GROUNDWATER DISCHARGE

- A. In the presence of the City Representative, the Contractor shall collect groundwater samples at each point of discharge for chemical analyses and send and shall pay for the analyses of the samples at a State of California accredited laboratory. The analytical parameters for each sample, and frequency of collection shall be as per:
  1. The sewer discharge permit from the San Francisco Public Utilities Commission (SFPUC), Wastewater Enterprise Collection Systems Division (SFPUC-WECS).
  2. Industrial Waste Ordinance No. 116.97 (Chapter X (Public Works Code), Part II, San Francisco Municipal Code, Article 4.1)
  3. DPW Order No. 158,170 for wastewater discharges into the City's sewerage system.
  4. The requirements for Batch Wastewater Discharges of the San Francisco Public Utilities Commission (SFPUC), Wastewater Enterprise Collection Systems Division (SFPUC-WECS).
- B. The Construction Dewatering Site Discharge Limits of the Southeast Water Pollution Control Plant (SEWPCP). Schedule the time required to sample, and to obtain the analytical results. The standard turnaround time to obtain the analytical results shall be ten (10) working days. Provide the analytical data to the City Representative, within two working days of receipt of results.

#### 1.10 NOTIFICATION OF INTENT TO DEWATER AT EACH POINT OF DISCHARGE

- A. Provide written notification of its intent to dewater within at least three (3) full working days prior to beginning the discharge for each discharge point. Present notification of intent to dewater at regularly scheduled progress meetings. This notification is a requirement of the SFPUC and will be forwarded to City Representative. Notification shall include:
  1. The location (station location)
  2. Time of day
  3. Estimated duration rate (GPM)

4. Estimated volume (GPD) of dewatering
- B. During dewatering episodes, daily complete, and submit a basic form, which documents the specifics regarding the dewatering activity: location, time, duration and volume.
- C. In the event that the settling tank configuration requires the addition of an oil/water separator, make the change within two (2) full working days from the time of notification by the City Representative.
- D. Treat water collected by dewatering operations prior to discharge as required by regulatory agencies.
- E. Discharge water as required by the discharge permit and in a manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed work or adjacent properties.

## PART 2 – PRODUCTS

### 2.1 FILL MATERIALS

- A. The Contractor shall provide all materials and equipment, including but not limited to:
  1. Pipe, fittings, valves, pumps, tools, meters, fuel and all other appurtenances in suitable and adequate quantities as required to perform the groundwater control work.

## PART 3 – EXECUTION

### 3.1 HYDROSTATIC PRESSURE RELIEF

- A. Where deep excavations are made, the Contractor shall maintain a safe hydrostatic pressure level directly below the excavated areas. Where by mud or similarly impermeable material is found below final excavation subgrade, the Contractor must design a pressure relief system to lower the water pressures in the strata below the bay mud to safe levels to prevent blowout or instability of the base of the excavation.
- B. The Contractor shall also be responsible for preventing all hydrostatic pressure build-up under newly placed slabs and walls until the concrete has attained its 28-day compressive strength.
- C. Reducing the hydrostatic pressure will no longer be necessary when:
  1. Backfilling of the excavated areas has been completed above groundwater elevation.
  2. The construction has been completed sufficiently that the Contractor can demonstrate to the City Representative that the reactions from the completed portion of the structure can safely and adequately resist all potential uplift pressures.
- D. The Contractor shall accept full responsibility for any damage, which may result from not maintaining adequate hydrostatic relief as specified during construction.
- E. If at any time the hydrostatic pressure exceeds safe limits, the Contractor shall take immediate steps to reduce the hydrostatic pressure to safe limits. Any damage, which



may result either to the Contractor or City as a direct result of excessive hydrostatic pressure, shall be corrected by, and at the expense of the Contractor.

END OF SECTION

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## SECTION 31 23 33

## TRENCHING AND BACKFILLING

## PART 1 – GENERAL

## 1.1 DESCRIPTION

- A. The Work specified in this Section includes pavement cutting, trench excavation, shoring of excavations during construction, limits of the trench support work, backfilling and compaction.

## 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Other Contract Documents, including Drawings, relevant Sections of the Standard Specifications and Special Provisions apply to the Work specified herein.
- B. Section 01 55 26 – Traffic Control
- C. Section 33 33 00 – Sanitary Sewerage Utilities

## 1.3 REFERENCES

- A. DPW Standard Specifications (SSDPWSF), revised November, 2000.
- B. ANSI/ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ANSI/ASTM D1557 – Test Methods for Moisture–Density Relations of Soils and Soil–Aggregate Mixtures Using 10 lb (4.54 kg) Rammer and 18 inch (457 mm) Drop.
- D. ANSI/ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Method (Shallow Depth)
- E. Sections 6705 and 6707 of the California Labor Code.
- F. DPW Order No. 187,005, “Regulations for Excavating and Restoring Streets in San Francisco”.
- G. Article 2.4 of the Public Works Code, “Excavation in the Public Right–Of–Way”.

## 1.4 SUBMITTALS

- A. Plans and calculations for the shoring system shall be submitted for review and approval by the City prior to trench excavation. If such plans vary from the shoring standard established by the Construction Safety Orders, the plans shall be prepared by a licensed Civil Engineer registered in the State of California. Approval will not relieve the Contractor of the responsibility to provide a satisfactory and safe shoring system.
- B. Prior to commencing excavation or construction, the Contractor shall submit dewatering plans compatible with the shoring system to the City Representative for review and approval.

- C. Details and calculations for full horizontal and vertical structural support for all exposed and/or undermined sections of water facilities, which are to be signed and stamped by a California licensed Civil or Structural Engineer.

1.5 POST EXCAVATION REPAIR AND MAINTENANCE OBLIGATION OF CONTRACTOR (WARRANTY PERIOD)

- A. The Contractor is responsible to maintain, repair or reconstruct the site of the excavation so as to maintain a condition acceptable to the City for a period of three (3) years following the date of the acceptance of the Work.

1.6 EXCAVATION / SHORING SUPPORT

- A. The Contractor shall provide all engineering, including design, details and calculations, installation and construction of shoring, sheeting and bracing necessary to support the sides of the excavation to prevent movement, which may damage adjacent pavements, utilities or structures, damage or delay the Work, or endanger life and health as required by Cal-OSHA and other applicable governmental regulations and agencies. All trench work will also be performed with the applicable provisions of California Labor Code Sections 6705 and 6707.
- B. The provisions specified herein will complement and not substitute for, nor diminish, the obligations of the Contractor for providing a safe work area and for protecting the Work, structures and other improvement.
- C. Regardless of the shoring system used, the Contractor shall prevent ground loss along the project alignment. Cantilever type of shoring walls is not acceptable. No sloping/benching type shoring system is allowed. Steel shims or filler plates will be installed to obtain a tight fit and bearing.
- D. The Contractor is solely responsible for any damage to adjacent properties caused by its construction operations.

1.7 WATER FACILITY SUPPORT AND WORK AROUND

- A. If the project work exposes water facilities, the Contractor is required to:
  - a. Backfill and compact in compliance with SFDPW Street Excavation Code as required by CDD Engineering; and
  - b. Coordinate through the City Representative to perform soil compaction testing for backfill material placed within five (5) feet, horizontal or vertically, from the outside edge of a water facility, with all test results furnished to CDD Engineering.
- B. For excavations that expose more than four (4) feet of water facilities, either in the horizontal or vertical direction, the Contractor is required to backfill with Control Density Fill (CDF) material.

1.8 HANDLING OF GROUND WATER

- A. The Contractor is responsible for the continuous control of ground water at all times during the course of construction, including Saturdays, Sundays and holidays.
- B. If required, dewatering plans shall be designed, stamped and signed by a licensed Civil Engineer registered in the State of California. By approving the plans, the City accepts no responsibility for the adequacy thereof nor for any damages to public or private property that may result. All such responsibility shall rest with the Contractor. The plans

shall include detailed working drawings and pertinent descriptions of the proposed ground water control system, including a schedule of installation and details of the system operation plan, contingency plans for interruption or failure of the proposed ground water control system and disposal plans. Provisions shall also include removal of storm water or any other water that may enter into the excavations.

## PART 2 – PRODUCTS

### 2.1 FILL MATERIALS

- A. All fill materials shall be free of organic and deleterious materials, and stock piling shall be in accordance with the requirements of Section 700.06 of the DPW Standard Specifications.
- B. Imported sand type or equivalent backfill shall be free from rock, concrete, organic material and other objectionable material. Backfill material will have 100% passing the 3/8" sieve size, 93% to 100% passing the No. 4 sieve size and 0% to 10% passing the No. 200 sieve size. Samples approximately 50 pounds weight shall be submitted to and approved by the San Francisco Public Works' Material Testing Laboratory, located at 2027 Newcomb Avenue, 94124 (Telephone 415-641-4028), prior to placement. Unacceptable material shall be immediately removed from the site.
- C. CDF material shall be free of organic materials and other deleterious substances. The CDF material shall have produced 28 days unconfined compressive strength from 50 pounds per square inch (psi) to a maximum of 125 psi and shall contain aggregate no larger than 3/8" top size with the 3/8" aggregate comprised of less than 30% of the total aggregate content.

### 2.2 MATERIALS FOR TRENCH SUPPORT SYSTEM

- A. Steel sheet piling, if employed, shall be of rolled steel shapes of the continuous interlocking type forming a continuous wall when individual sheets are installed side by side. Steel sheet piling shall be installed in a manner that interlocking is kept continuous without separation at the joints. Sheet pilings, if used, shall not be installed by hard driving. The Contractor shall propose and submit for approval, a suitable installation method, which will minimize noise and vibrations. Other equivalent methods that will effectively prevent water leakage through the joint such as insitu-soil cement mixing will be acceptable. The interlocking sheet piling and all accessories shall conform to the requirements of ASTM A328.
- B. Lagging members, if employed, shall be installed in accordance with approved design and in a manner, which shall prevent loss of ground. Where, in the judgment of the City, the loss of ground cannot be prevented by wedging the lagging tight against the original ground, e.g., at the sandy non-cohesive soils, the Contractor shall prevent the loss of ground by an approved method. This shall not be a cause for changed condition or for claims for extra cost by the Contractor.
- C. All timber, lumber and structural steel employed for the trench supporting system, whether new or used, shall be sound and free from defects that might impair their strength. Where sheet piles or soldier piles are to be removed, they may be removed after backfilling is completed. Voids left by such removal shall be immediately backfilled with an acceptable bode type structural mix ready on site, at no extra cost to this Contract. The Contractor shall meet the requirements to control settlements and plan its operations accordingly.

- D. All timber lagging left in place shall be pressure treated with wood preservative in accordance with the requirements of Section 415.05 of the DPW Standard Specifications.
- E. Except for bracing struts, allowable basic stresses for rolled steel sections, including sheet piling, may be increased by twenty percent (20%) for all temporary shoring structures. Allowable basic stresses for all temporary shoring structures shall be in accordance with the latest AISC Code. Allowable stresses for struts shall not exceed those allowed by the AISC Code for permanent structures. All welds shall be designed according to AISC Code without any increase in the allowable stresses for temporary structures. Lagging and all timber structures shall be designed using allowable stresses determined by the National Design Specifications In Wood Construction, latest Edition. The duration of the load shall not be taken as less than three (3) months.
- F. Trench shields shall not be used for shoring.

### PART 3 – EXECUTION

#### 3.1 EXAMINATION

- A. The Contractor shall verify fill material to be reused is acceptable.

#### 3.2 PREPARATION

- A. The Contractor shall identify required lines, levels, contours and datum shown on the Drawings.
- B. The Contractor shall maintain and protect existing utilities remaining, which pass through the site.
- C. The Contractor shall protect bench marks, existing structures, sidewalks and curbs from excavation equipment and vehicular traffic.

#### 3.3 PAVEMENT CUTTING AND STREET EXCAVATION

- A. Pursuant to Section 373 of the San Francisco Public Works Code, the Contractor may use concrete saw cutting or vibratory pavement breaker or equal.
- B. No machine or device that breaks pavement by blows struck by a falling or driven hammer or weight will be allowed. Hoe-ram and trenching machines shall not be used for concrete street at the edge of pavement restoration. Such prohibition, however, shall not be construed as barring the use of hand tools or manually operated air tools such as jack hammers.
- C. The use of the rock wheel cutter for street excavation is prohibited unless permitted by special order of the Director of Public Works for specific locations. If permitted, rock wheel cutter shall only be used to remove the pavement (concrete base and asphalt concrete wearing surface), and only after potholing has been done to determine the pavement thickness. Rock wheel cutters shall not be used on concrete streets, shall not be used as a trenching device, and shall not be used within 10 feet of a signalized intersection.

- D. All areas of pavement to be cut shall be in neat and straight lines, and overcutting of lateral trenches will not be allowed. Dust control shall be provided by using non-potable water with the rock cutting wheel. Protection from flying rocks, debris, etc., shall be provided.
- E. Excavation and backfill shall be in accordance with the requirements of Part 7 of the DPW Standard Specifications.
- F. The pavement shall be restored in accordance with the requirements of Part 2 of the DPW Standard Specifications.
- G. All City noise requirements shall be observed at all times.

### 3.4 TRENCH EXCAVATION

- A. The Contractor shall excavate every type of material encountered within the limits of the Work to the lines, grades and elevations indicated on the Drawings and specified herein, except materials indicated on the Drawings or directed by the City to remain.
- B. Unauthorized Excavation:
  - 1. Unauthorized excavation will be excavation below indicated subgrade elevations or beyond indicated dimensions without specific instruction from the City.
  - 2. Under footings, foundations or retaining walls:
    - a. The Contractor shall fill unauthorized excavation by lowering the indicated bottom elevation of the footing or base to the excavation bottom, without altering the required top elevation.
    - b. Lean concrete fill may be used to bring bottom elevations to proper position, subject to the City's approval.
  - 3. Elsewhere, the Contractor shall backfill and compact unauthorized excavation as specified for authorized excavations, unless otherwise directed by the City.
- C. Excavation of unsound subgrade material shall be in accordance with the requirements of Section 700.10 of the DPW Standard Specifications.

### 3.5 TRENCH SUPPORT WORK

- A. The shoring of excavation during construction shall be in accordance with the requirements of Section 700.04 of the DPW Standard Specifications, and shall include adequate sheeting shoring and bracing etc. or equivalent method, for the protection of life and limb, and conforming to applicable safety orders of Cal-OSHA and the State of California Division of Industrial Safety.
- B. Sections 6705 and 6707 of the California Labor Code shall apply to any excavation 5 feet or more in depth, constructed under this Contract.
- C. Sheet piling, lagging and bracing may be removed during backfilling, and shall be in accordance with the requirements of Section 700 of the DPW Standard Specifications.
- D. The width of the trench shall be in accordance with the requirements of Section 700 of the DPW Standard Specifications.

### 3.6 BEDDING

- A. The Contractor shall support the new pipes during placement and compaction of crushed rock bedding fill. Crushed rock shall comply with the requirement of Section 703.05 and 712 of the DPW Standard Specifications and as shown on SW-drawings.

- B. The placement of crushed rock bedding fill shall not alter the pipe alignment. Crushed rock bedding fill shall be placed to ensure continuous contact with the pipes. Care shall be taken to completely fill all spaces under the haunches.

### 3.7 BACKFILLING AND COMPACTION

- A. The Contractor shall backfill excavations as promptly as progress of Work permits, and shall be in accordance with the requirements of Sections 703, 712 and all other applicable Sections of the DPW Standard Specifications.
- B. The Contractor shall place crushed rock beneath and backfill material around structures. The Contractor shall not begin backfill operations until concrete has achieved a minimum compressive strength of 3,000 psi.
- C. Placement of CDF Bedding Material:
1. The length of the CDF bedding material will be the width of the sewer trench less the minimum space necessary for formwork. The width of CDF bedding material shall be the outer diameter of the water main pipe plus one (1) foot on each side. The depth of CDF bedding material shall be three (3) feet below the bottom of the water main pipe and no higher than the water main pipe's spring-line. There shall be a minimum one (1) foot vertical separation between the top of the sewer main and the bottom of the CDF material.
  2. CDF bedding material placement will be at the discretion of the CDD Inspector. The CDF bedding material will be formed on all vertical sides. Placing CDF against sewer trench shoring to be removed or exposed soil will not be allowed. Any volume of CDF spillage due to improper form work will not be considered for payment and shall be removed prior to backfilling the trench.
  3. The Contractor shall place the CDF prior to backfilling the sewer trench. Placing temporary backfill, and re-excavating the area at a later time to place CDF before final trench excavation is not allowed. If the water facility becomes damaged due to improper placement of CDF bedding prior to backfilling the sewer trench, then the Contractor will be held liable.
- D. Compaction of fill and backfill materials shall be in accordance with the requirements of Section 707 and all other applicable Sections of the DPW Standard Specifications.
- E.. The Contractor shall compact all materials by mechanical means in lifts not to exceed 8 inches unless permitted otherwise in writing by the City. Flooding or jetting will not be permitted. If compaction tests indicate that compaction or moisture content is not as specified, material placement shall be terminated and corrective action shall be taken by the Contractor prior to continued placement.
- F. The Contractor shall compact all fill materials to the following relative dry densities per ASTM D1557, D6938 or other reference standards acceptable to the City:
- |    |  |         |
|----|--|---------|
| 1. | Asphaltic Concrete Pavement Subgrade Areas | 95%     |
| 2. | Landscape Planting Areas                   | 85%     |
| 3. | Structural Fill                            | 95%     |
| 4. | Trench Backfill                            | 90-95%* |

\*90% compaction from bottom of trench to within 4 ft of finish grade and 95% compaction for the remainder of the trench.



- G. During compaction, the Contractor shall protect new and any existing pipes, and structural walls from damage due to the operations of the compaction equipment. The Contractor shall not operate earth-moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material. The Contractor shall compact backfill adjacent to concrete walls with hand-operated tampers or similar equipment that will not damage the structure.
- H. The Contractor shall place detectable warning tape at a distance of 12 inches above the top of the sewer pipe.

### 3.8 REMOVAL OF WATER

- A. The Contractor shall provide and operate equipment adequate to keep all excavations and trenches free of water. The Contractor shall avoid settlement or damage to adjacent properties. When dewatering the excavations, the Contractor shall dewater from outside the structural limits and from a point below the bottom of the excavation when possible. Dewatering, contingency and disposal plans will be submitted for approval by the City.

### 3.9 FIELD QUALITY CONTROL

- A. The Contractor shall secure the Testing Agency's inspection and testing, and the City Representative's approval of testing results and visual inspection and approval for subgrades and fill layers before proceeding with construction thereon.
- B. Fill and backfill materials shall be compacted to densities in accordance with the requirements of Sections 703, 706, 707 and 709 of the DPW Standard Specifications.
- C. If, based on reports from a testing laboratory, subgrade or fills, which have been placed are below specified requirements, the Contractor shall provide additional compacting and retest at no cost to the City.

### 3.10 MAINTENANCE

- A. The Contractor shall protect newly graded areas from traffic and erosion, and keep the areas free from trash and weeds. The Contractor shall repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, the Contractor shall scarify the surface, reshape and compact to the required density prior to further construction.

END OF SECTION



## SECTION 31 23 34

## PAVEMENT CUTTING AND EXCAVATION

## PART 1 – GENERAL

## 1.01 DESCRIPTION

- A. Work Included: The work specified in this Section includes pavement cutting, pavement excavation, backfilling and compaction.

## 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Other contract documents, including Contract Drawings, Relevant Sections of the Standard Specifications and Special Provisions apply to the work specified herein.
- B. Division 1, General Requirements.

## 1.03 REFERENCES

- A. Standard Specifications of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SSDPWSF), Revised November 2000.
- B. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 kg) Rammer and 18 inch (457 mm) Drop.
- D. ANSI/ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Method (Shallow Depth)
- E. SFDPW Order No. 187,005, 'Regulations For Excavating and Restoring Streets in San Francisco'.
- F. Article 2.4 of the Public Works Code, "Excavation In The Public Right-Of-Way".

## 1.04 SUBMITTALS

- A. Imported Backfill: Samples approximate 50 pounds weight shall be submitted to the Contractor's Testing Agency and the testing results shall be submitted to and approved by the Engineer and the Department of Public Works' Material Testing Laboratory, located at 2099 Kearny Street, San Francisco (Tel: 415-274-0278), prior to placement.

## PART 2 – PRODUCTS

## 2.01 FILL MATERIALS

- A. All fill materials shall be free of organic and deleterious materials and stock piling shall comply with the provisions of Section 700.06 of the SFDPW Standard Specifications.
- B. Imported sand type or equivalent backfill shall be free from rock, concrete, organic material and other objectionable material. Backfill material shall conform to the following grading:

Sieve Size

Percentage Passing

3/8-inch	100
No. 4	93-100
No. 200	0-10

- C. Unacceptable material shall be immediately removed from the site of work.

### PART 3 – EXECUTION

#### 3.01 EXAMINATION

- A. Verify that fill material to be reused is acceptable.

#### 3.02 PREPARATION

- A. Identify required base repair limit lines, levels, contours and datum shown in the contract drawings. Actual limits of base repair work may vary as directed by the Engineer in the field.
- B. Protect survey bench marks or monuments, existing structures, utility poles, sidewalks and curbs from excavation equipment and vehicular traffic.

#### 3.03 PAVEMENT CUTTING AND STREET EXCAVATION

- A. Pursuant to Section 373 of the San Francisco Public Works Code, Contractor may use concrete saw cutting or vibratory pavement breaker or equal.
- B. The Contractor shall not use any machine or device that breaks pavement by blows struck by a falling or driven hammer or weight. Hoe-ram and trenching machines shall not be used for concrete street at edge of pavement restoration. Such prohibition, however, shall not be construed as barring the use of hand tools or manually operated air tools such as jackhammers.
- C. Rock Cutter: The use of the rock wheel cutter for street excavation is prohibited unless permitted by special order of the Director of Public Works for specific locations. If permitted, rock wheel cutter shall only be used to remove the pavement (concrete base and asphalt wearing surface), and only after potholing has been done to determine the pavement thickness. Rock wheel cutters shall not be used on concrete streets; shall not be used as a trenching device and shall not be used within 10 (ten) feet of a signalized intersection.
- D. All areas of pavement to be cut shall be in neat and straight lines and overcutting of lateral trenches shall not be allowed. Dust control shall be provided by using non-potable water with the rockcutting wheel. Protection from flying rocks, debris, etc. shall be provided.
- E. The excavation and backfill shall be in accordance with the applicable requirements as set forth in Part 7 of the SFDPW Standard Specifications.
- F. The pavement shall be restored in accordance with the applicable requirements as set forth in Part 2 of the SFDPW Standard Specifications and in these specifications.
- G. All city noise requirements shall be observed at all times.
- H. Water used for cutting machines shall be removed by vacuum pump or equivalent means immediately following the cutting machine. Cut residues shall not be removed and not

allowed to form slurry. The slurry collected in the vacuum pump's tank shall not be discharged to City sewers.

### 3.04 BACKFILLING AND COMPACTION

- A. Backfilling excavations as promptly as progress of work permits and in accordance with all relevant requirements of Sections 703, 712 and all other applicable sections of the SFDPW Standard Specifications.
- B. Compaction of fill and backfill materials shall be in accordance with the requirement of Section 707 and all other applicable sections of the SFDPW Standard Specifications.
- C. Compact all materials by mechanical means in lifts not to exceed 8" unless permitted otherwise in writing by the City Representative. Flooding or jetting will not be permitted. If compaction tests indicate that compaction or moisture content is not as specified, material placement shall be terminated and corrective action shall be taken by the Contractor prior to continued placement.
- D. Compact all fill materials to the following relative dry densities per ASTM D1557, D6938 or other reference standard acceptable to the City Representative:
 

1.	Asphaltic Concrete Pavement Subgrade Areas	95%
2.	Landscape Planting Areas	85%
3.	Structural Fill	95%
4.	Trench Backfill	90-95%*

\*90% compaction from bottom of trench to within 4 ft of finish grade and 95% compaction for the remainder of the trench.

### 3.05 FIELD QUALITY CONTROL

- A. Secure the Testing Agency's inspection and testing, and the City Representative's approval for subgrades and fill layers before proceeding with construction thereon
- B. Fill and backfill materials shall be compacted to densities specified in the applicable provisions of Sections 703, 706, 707 and 709 of the SFDPW Standard Specifications.
- C. If, based on reports from a Testing Laboratory, Subgrade or fills which have been placed are below specified requirements, provide additional compacting and retest at no cost to the City.

### 3.06 MAINTENANCE

- A. Protection of newly graded areas:
  - 1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
  - 2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

END OF SECTION



## SECTION 31 23 36

## EXCAVATION AND BACKFILL FOR WATER WORK

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. Work under this section includes:
1. Trench Excavation and Backfill
    - a. Saw cut, excavate, remove and dispose pavement.
    - b. Excavate trench to dimensions specified in the Contract Drawings .
    - c. Excavate bell holes or joint holes.
    - d. Support and protect the adjoining property and structures.
    - e. Support and work around existing utilities.
    - f. Remove abandoned utilities in conflict with the installation of the new main.
    - g. Handle all drainage or ground water.
    - h. Furnish, place and compact sand backfill.
    - i. Remove surplus material.
    - j. Furnish and install temporary pavement.
    - k. Testing and inspection.
  2. Shoring trenches and connection pits.
- B. Additional Excavation and Backfill
1. Perform additional excavation outside of the prescribed trench area as required by the City Representative, and furnish and place backfill material. Work performed without approval of the City Representative shall be at the sole risk and expense of the Contractor.
  2. Additional excavation and backfill shall also include:
    - a. Excavating test holes.
    - b. Change of trench alignment.
    - c. Preparation of pipe bedding.
    - d. Increase trench depth to change pipe profile or for preparation of pipe bedding.
    - e. Removal of subsurface obstacles.
    - f. Removal of concrete pavement, concrete pavement slabs and concrete parking strips.

- g. Removal of sidewalk, curbs and gutters.
  - h. Expose existing mains and services for connections.
  - i. T-trench and 3-foot rule per SFPW Order No. 187005.
3. Utility Verification. Excavate test holes (potholes) to locate existing pipelines, electrical ducts, concrete encasement and other utilities prior to trenching and general excavation.
4. The extra cost of excavation and pavement restoration outside the trench, up to one foot from the edge of the excavated trench due to the T-trench, shall be paid for under the Bid Item for Additional Excavation and Backfill and Pavement Restoration, respectively. At locations where the 3-foot rule Code is triggered, the cost for the extra excavation and restoration shall be paid for under the Bid Items for Additional Excavation and Backfill and Pavement Restoration.

#### 1.02 RELATED SECTIONS

- A. SFPW Standard Specifications
- B. Section 00 73 20 – Existing Utility Facilities
- C. Section 00 73 21 – Utility Crossings Specifications
- D. Section 01 55 26 – Traffic Control
- E. Section 02 81 10 – Environmental Management of Excavated Materials
- F. Section 31 23 37 – Controlled Density Fill Barrier
- G. Section 32 10 00 – Pavement Restoration for Water Work
- H. Section 33 11 00 – Water Utility Distribution Piping
- I. SFPUC CDD Standard Plans (<https://sfpuc.org/documents/cdd-standard-plans>)

#### 1.03 CITED REFERENCES

- A. ASTM D-1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))
- B. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- C. California Labor Code Section 6707 - Excavation five (5) feet or more in depth.
- D. California Occupational Safety and Health Administration (CAL/OSHA), State of California Code of Regulations, Title 8 – Industrial Relations, Chapter 4 – Division of Industrial Safety
- E. United States Department of Labor, Occupational Safety and Health Administration, Section V, Chapter 2 Excavations: Hazard Recognition in Trenching and Shoring.



#### 1.04 SUBMITTALS

- A. The Contractor shall submit samples of backfill material specified in Part 2 to the Inspection and Testing Agency hired, employed or approved by the City Representative. The size of samples shall be as required by the Inspection and Testing Agency.
- B. The Contractor shall submit pothole plan, log and report showing the results of each test hole. Report and log shall show sizes of exposed utilities as well as horizontal and vertical location of utilities.
- C. The Contractor shall submit a shoring plan signed by a Registered Civil or Structural Engineer and submitted to the City Representative for approval at least fifteen (15) working days before the Contractor schedules to begin excavating. Regardless of the depth, Contractor shall submit a shoring plan that shows typical shoring for connection holes and trenches where SFWD will perform work. The City Representative's acceptance of the shoring plans does not relieve the Contractor of his/her responsibility of providing a safe shoring system. The Contractor shall be solely liable for any claims or injuries resulting from his/her shoring system. The Contractor shall not start excavation prior to the City acknowledging receipt of the shoring plan by the City Representative.
- D. The design engineer for the excavation support systems and dewatering work shall perform structural observation and provide a letter stating that the shoring work is in accordance with his/her design.

#### 1.05 QUALITY CONTROL

- A. Testing and Inspection
  - 1. The Contractor shall retain a Testing and Inspection Agency to provide the soil testing and inspection.
  - 2. Notify the City 48 hours prior to any filling or backfilling operation.
  - 3. Schedule required tests and inspection. Provide test results to the City Representative.
  - 4. The Testing and Inspection Agency shall:
    - a. Sample and test fill materials and confirm compliance with the requirements of this section.
    - b. Approve methods of compaction.
    - c. Observe and provide emergency engineering control of excavation, preparation and compaction of subgrade, placement and compaction of fill and backfill material.
    - d. The Contractor shall not place formwork, reinforcing, concrete, or fill material until the Testing Agency provides written confirmation that the excavation and subgrade preparation conform with the requirements of this section.
    - e. Provide the Contractor and City Representative with written confirmation that the placement of fill conforms to the requirements of this section. Acceptance of excavated surfaces and compacted fill shall be based on inspections and tests performed by the Testing Agency. The Testing Agency shall inform the Contractor immediately of any unsatisfactory

observed conditions. No further work shall proceed until the unsatisfactory work is corrected. It shall be the Contractor's sole responsibility to achieve the specified degree of compaction.

- f. If tests indicate work not meeting the specified requirements, remove and replace the work for retesting at no cost to the City.
- B. Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.
- C. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the City Representative.
- D. The design engineer for excavation support systems shall be a licensed Civil or Structural Engineer in the State of California, and shall have experience in providing successful engineering services for excavation support systems and dewatering work similar in extent of that required for this project.
- E. Structural Observations: The design engineer for the excavation support systems and dewatering work shall perform structural observation and provide a letter stating that the shoring work is in accordance with his/her design.

## PART 2 – PRODUCTS

### 2.01 BACKFILL MATERIALS

- A. Import Backfill
  1. All import backfill shall be furnished and placed in accordance with Section 703 of the Standard Specifications Department of Public Works, except as specified herein.
  2. All import backfill material shall consist of dune sand or well-washed beach sand free from rock, concrete, organic material and other objectionable material. Recycled or crushed concrete will not be accepted as backfill. Documents shall be submitted to show that the total chloride content is no more than 100 ppm. Imported backfill material shall have 100% passing the 3/8" sieve size, 93% to 100% passing the No. 4 sieve size and 0% to 10% passing the No. 200 sieve size. Samples shall be submitted to, and approved by, the Inspection and Testing Agency hired, employed or approved by the City Representative prior to placement. Unacceptable material shall be immediately removed from the site of work.
- B. Controlled Density Fill Barriers
  1. See Specification 31 23 37 – Controlled Density Fill Barrier.

### 2.02 BURIED WARNING AND IDENTIFICATION TAPE

- A. Manufacturer: THOR Enterprises, Inc.; Line Guard Inc.; or approved equal.
- B. General: Warning tape shall be non-detectable underground utility marking tape conforming to ASTM D2103. It shall consist of a minimum 4.0-mil overall thickness, inert 100 percent virgin low-density polyethylene plastic film formulated for extended use

underground. The materials shall be acid and alkali resistant. Width of warning tape shall be 6 inches.

- C. Color Coding; Blue for potable water and purple for recycled water.
- D. Message Inscription: The warning tape shall include an inscription in black letters. The inscription shall be impregnated with color-fast, lead-free, organic pigments suitable for direct burial and prolonged exposure to the elements normally encountered in moderately corrosive type soils. The height of the message letters shall be 1.5 inches minimum, and the message inscription shall be repeated at approximately 2-foot intervals. The message inscription shall be "CAUTION – WATER LINE BELOW".

### PART 3 – EXECUTION

#### 3.01 SUBSURFACE INVESTIGATION

- A. It is the responsibility of the Contractor to investigate and familiarize with the site conditions, including subsurface soil, prior to bidding. Investigation includes but is not limited to the examination of the US Geological Survey (USGS) Map at the project area.

#### 3.02 LAYING OUT OF WORK

- A. Contractor shall employ a competent surveyor to properly lay out all grades and stakes preparatory to starting excavation and grading. It shall be the Contractor's sole responsibility to accurately locate all levels, set all stakes and protect stakes against damage by equipment during progress of work.

#### 3.03 BENCH MARK AND MONUMENTS

- A. Before any work is started the surveyor shall check all existing monuments, benchmarks, and property corners.
- B. Any monument moved or displaced during grading operations shall be put back at Contractor's expense. The establishment of grade stakes and the maintenance of such grade stakes shall be the responsibility of the Contractor.

#### 3.04 WATER MAIN ALIGNMENT

- A. The location and general arrangement of existing and proposed underground utilities, underground structures, pipelines with fittings, valves and appurtenances as shown on the contract drawings are diagrammatic. The contractor shall conduct exploratory excavations to locate existing utilities for potential horizontal and potential vertical conflicts with excavation methods meeting California Government Code 4216. It is the responsibility of the Contractor to dig test holes based on contract drawings as well as USA markings on the street as approved by the City Representative to determine a suitable alignment of the water main. The suitable water main alignment based on information from test holes may be different from the proposed alignment as shown on the drawings. Changes in the alignment of any portion may result in different construction methods or different conditions, such as requiring hand digging for portions of the work, will not be subject to claim for any extra payment if the length of trench excavated is not increased. At minimum, three test holes shall be excavated per 500 linear feet of pipe along city blocks and two test holes shall be excavated in each intersection.

### 3.05 DEWATERING

- A. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the structures and/or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water to accumulate in the excavation or levels to return to natural groundwater elevations.
- B. The Contractor shall furnish all materials and equipment and perform all work required to install and maintain the drainage systems he proposes for handling groundwater and surface water encountered during construction of structures and water main pipelines.
- C. All permits for disposal of dewatering drainage shall be acquired and all fees paid by the Contractor. The Contractor shall submit his/her water disposal plans for approval by the City Representative.

### 3.06 SHORING

- A. The term "shoring" as used in connection with the excavation items of this contract, shall include all structures used to support temporarily the earth adjacent to any excavation.
  - 1. The Contractor shall furnish, put in place and maintain, all shoring necessary to support the sides of any excavation and to prevent any movement, which might, in any way, injure the proposed structures or endanger any person.
  - 2. Provision of protection from caving ground does not relieve the Contractor from the requirement of maintaining safety in all operations performed by him/her or his/her subcontractor.
  - 3. The manner of shoring or bracing excavations shall be in accordance with the approved shoring plans and with the rules, orders and regulations of the State of California Code of Regulations, Title 8, Chapter 4 and United States Department of Labor, Occupational Safety and Health Administration, Section V, Chapter 2
  - 4. Wherever, in the opinion of the City Representative, sufficient or proper shoring has not been provided, the Contractor shall, on demand, furnish additional shoring but neither compliance with such demand nor failure of the City Representative to make such demand shall relieve or release the Contractor from his responsibility for the sufficiency of the shoring.
  - 5. The Contractor shall be responsible for any injury occurring to persons or property or to the work due directly or indirectly to improper or insufficient shoring or to the replacement or removal of shoring.
  - 6. Unless otherwise permitted or directed, shoring may be removed from the excavation before backfilling, to the greatest extent practicable and consistent with safety.
  - 7. For main connections to be done by SFWD crews, complete and solid shoring is required for the excavation hole regardless of the depth.
- B. Shoring for main and service connections in locations where the SFWD-CDD crews will install main or service connections, regardless of depth, the Contractor shall install solid

sheeting-type shoring system, approved by a Civil or Structural Engineer licensed in the State of California, that is capable of protecting all excavations from excessive water that may be present and give ample access to the crews to perform the installation as directed by the City Representative.

### 3.07 PAVEMENT EXCAVATION

- A. The removal of pavement, sidewalk, parking strip and other roadway structures shall be performed in accordance with Section 701 'Pavement Excavation' of the "Standard Specifications D.P.W.", and in accordance with SFPW Order No. 187,005 'Regulations for Excavating and Restoring Streets in San Francisco', approved on November 2010 and all modifications, unless otherwise specified herein. When work involves water main replacement in streets having concrete pavement or concrete parking strips, the entire slab or parking strip affected shall be saw cut, excavated entirely to construction joints and concrete removed to dump site, and furnish backfill material required to prepare bedding for new concrete pavement slab or new concrete parking strip. Saw cuts in concrete pavement and parking strip shall be of sufficient size to provide neat, regular and vertical edges, but shall not be less than 3/4-inch in depth. The use of a saw may be omitted on approval of the City Representative in streets where the existing pavement is due to be reconstructed or is in visibly poor condition.

### 3.08 TRENCH EXCAVATION

- A. All trench excavation shall be performed in accordance with Section 702 'Trench Excavation' of the "Standard Specifications D.P.W." and SFPW Order No. 187,005, 'Regulations for Excavating and Restoring Streets in San Francisco', Approved on November 2010 and all modifications, unless otherwise specified herein.
- B. In accordance with rules and regulations adopted by SFPW., the trench length of all street openings shall not exceed the length of one block in any three-block section without special permission from SFMTA. The amount of excavated trench in excess of pipe laid therein shall not exceed 200 linear feet at the end of each working day.
- C. The depth of a trench as specified in the proposal is below the gutter grade. The gutter grade shall be defined as the existing gutter grade or six inches below the official grade (grade at top of curb as established by the San Francisco Board of Supervisors) whichever is lower. The section of trench above the gutter grade shall be included in the cost of the excavation per linear foot of trench and no additional payment will be allowed for that section of trench cut from the present ground surface to the gutter grade. Where the existing pavement elevation is below the gutter grade, the depth of the trench shall be measured from the existing pavement grade.
- D. The trench shall be excavated so that the barrel of the pipe will have an even bearing along its entire length, and with sufficient clearance provided for any necessary operations in connection with the laying of the pipe. Bell holes shall be excavated for each pipe bell or joint.
- E. Where ordered by the City Representative, the Contractor shall excavate the trench to a depth of at least 4-inches below the prescribed trench depths.
- F. Notify City Representative immediately if, during the course of excavation, the contractor encounters any sanitary or health hazards, including but not limited to sewer overflows, sewer leaks, contaminated soils, soils with suspected underground tank leaks, etc.

### 3.09 INSTALLATION OF WARNING TAPE

- A. The pipe, fittings, and pipe encasement shall be installed with a continuous strip of warning tape located 12 inches directly above the pipe but not less than 12 inches below the finished grade. The Contractor shall ensure that the warning tape is not removed or damaged during the backfilling of the trench.
- B. Warning tape ends shall overlap each other a minimum of 12 inches and be fastened together with an approved water resistant adhesive tape.

### 3.10 PROTECTION OF EXISTING STRUCTURES

- A. The trench shall be excavated in a manner to avoid existing structures, property, and other obstructions encountered during the progress of the work. The Contractor shall support, protect, maintain, and provide for the safe operation and use of all such structures and property so encountered. Should the Contractor damage any structure or property during the progress of the work, he shall immediately notify the proper owners or authorities and shall arrange for the immediate repair of the same at his expense.
- B. The Contractor shall maintain access to adjacent areas/property at all time. This shall be considered as incidental work.
- C. When side sewers are encountered that interfere with the laying of the pipelines, the City Representative shall direct the Contractor to remove and replace or relocate such side sewers as required during the progress of the work. Removed side sewers shall be reconstructed in accordance with the "Standard Specifications, D.P.W." Where the City Representative determines that the removal and replacement or relocation of side sewers is infeasible, the Contractor may be directed to adjust the grade of the pipeline to avoid such side sewers. Additional excavation required to avoid such side sewers shall be paid for under the Bid Item for Additional Excavation and Backfill.
- D. Where proposed water main crosses under streetcar, cable car or railroad tracks, the tracks must be properly supported in a manner required by the owner and approved by the City Representative. The Contractor shall submit detailed drawings and specifications delineating the method of support approved by the owners.
- E. Supporting, working around and protecting of all utility facilities owned and operated by the City and County of San Francisco are considered as incidental work per provisions of the Section 00 73 20 - Existing Utility Facilities and Section 00 73 21 - Utility Crossings Specifications.

### 3.11 ADDITIONAL EXCAVATION

- A. Test Holes (Potholes)
  - 1. The contractor shall excavate test holes to locate existing utilities for potential horizontal and vertical conflicts (Refer to Section 01 71 33 Protection of Adjacent Construction) as directed by the City Representative. Excavation methods shall meet California Government Code 4216.
- B. Change of Trench Alignment
  - 1. Where change of alignment of the main becomes necessary after the pavement has been broken or removed and no trench excavated, the volume of pavement

required to be removed in order to repave shall be paid for under the Bid Item for Additional Excavation and Backfill.

C. Increase Trench Depth

1. Where ordered by the City Representative, the Contractor shall excavate the trench to a depth of at least 4 inches below the prescribed trench depths. Refer to Section 3.16 for backfilling of the trench.
2. Where ordered by the City Representative, the Contractor shall excavate the trench to a prescribed depth to adjust the pipe profile to avoid obstructions or to maintain sufficient horizontal and/or vertical clearances.

D. Removal of Subsurface Obstacles

1. While excavating for contract work, the Contractor may encounter subsurface obstacles such as: man-made structures not apparent prior to the bid date and/or field conditions differing substantially from those normally encountered and recognized as inherent to the work; or existing pavement in excess of 14-inches in depth; or abandoned pavement sections below the existing pavement; concrete piers; concrete conduits; wooden ties etc., beneath the pavement. The Contractor shall remove such subsurface obstacles to the extent necessary to complete the work, when such excavation is directed and approved by the City Representative.
2. Removal of any other subsurface structures and materials will be paid for under other appropriate bid items, if such bid items exist, or will be considered as incidental work.

E. Removal of Concrete Pavement and Concrete Parking Strips

1. When work involves water main replacement in streets having concrete pavement or concrete parking strips, the entire slab or parking strip affected shall be saw cut, excavated entirely to construction joints and concrete removed to dump site, and furnish backfill material required to prepare bedding for new concrete pavement slab or new concrete parking strip, to comply with SFPW Order No. 187,005, 'Regulations for Excavating and Restoring Streets in San Francisco' Approved on November 2010 and all modifications.

F. Sidewalk

1. When removing and installing meter boxes in accordance with the Bid Item for Removal and Installation of Meter Box, Contractor shall saw cut, excavate and remove the concrete sidewalk within prescribed flag lines and/or as directed by the City Representative, and furnish backfill material required to prepare sub-base for new concrete sidewalk and meter boxes.

G. Expose Existing Mains and Service for Connections

1. The Contractor shall excavate and expose existing mains and services as directed by the City Representative for measurements, water main and service connections and disconnection work by the Water Department.
2. At the minimum, the connection hole shall have 24 inches of clearance from the edge of the pipe to the edge of the shoring and 12 inches of clearance from the

bottom of the pipe to the bottom of the connection hole. If the water main or service connection involves offsetting pipe, the hole shall be a minimum of 7 feet in addition to the length of the offset. Depending upon the condition of the existing pipes, SFWD may request to expand the hole at the time of measurement.

3. The Contractor shall cover the excavations with steel plates. The Contractor shall remove and replace steel plates and provide traffic control to accommodate the work by the Water Department. This shall be considered as incidental work.

H. T-Trench

1. The pavement excavation for a T-Trench involves additional excavation on both sides of the normal trench. The volume of pavement removed in order to form the T-Trench shall be paid for under Additional Excavation and Backfill. Refer to SFPW Order No. 187,005 for Pavement Base Restoration Requirements.

3.12 MAINTENANCE AND PROTECTION OF SUBSURFACE UTILITIES, OTHER STRUCTURES AND AREAS

- A. Known locations of underground utilities and structures are indicated on the Drawings. Contractor shall determine exact locations of underground utilities and structures sufficiently in advance of excavation to allow adjustment of alignment and elevation.
- B. Excavation and other work under or adjacent to underground pipes, and conduits or other structures thereto, shall be conducted and maintained in such a manner so as not to disrupt or interfere with the safe operations and use of such structures. The Contractor shall prosecute the work in such a manner as not to damage any private or public property.
- C. Should any such structures or property be damaged in the course of the Contractor's operations, the Contractor shall immediately notify the City Representative as well as proper authorities or owners, and shall arrange for the immediate repair of same in accordance with the applicable provisions of these Specifications, at Contractor's expense.

3.13 UNDERGROUND OBSTRUCTIONS

- A. Any data shown on the Drawings, or imparted to the Contractor by the City Representative, relative to location, dimensions, type or character of pipes, conduits, and/or other structures along or across the line of the pipe, are based on information obtained from field surveys and the owners of such structures. The City assumes no responsibility for the accuracy or completeness of such data, which are offered solely for the convenience of the Contractor and should be checked by him/her to his/her satisfaction. The Contractor shall assume full responsibility and shall make no claim against the City on account of any damage to any pipes, conduits and/or other structures or for any inconvenience or added cost of performing the work which may be attributed in any degree to inaccuracy of information furnished relative to the location of such structures, or for failure thereto.
- B. Removal of Abandoned Utilities
  1. The Contractor shall identify, remove and dispose of retired, deactivated, or abandoned facilities where required for installation of new pipe main in accordance with the owner's requirements.



2. Regarding deactivated gas mains: Any main that is in conflict and requires removal must first be inspected by PG&E field crews to confirm no product or pressure. Mains cannot be cut into or removed without PG&E first confirming they are abandoned, and without PG&E approval. Contact PG&E 4-6 weeks ahead of schedule to coordinate locations that will require verifications. PG&E can be contacted at PGEDistribution@pge.com.

### 3.14 DISPOSAL OF MATERIALS

- A. Unsuitable excavated material for backfill, including large sizes of rock, cemented materials, boulders, broken concrete, asphalt and other materials shall be removed and disposed of at the Contractor's expense at a waste disposal or landfill site conforming to all County, State, and Federal regulations.

### 3.15 BACKFILL AND COMPACTION OF TRENCHES

- A. All trench backfill shall be performed in accordance with Section 703 'Trench Backfill' of the "Standard Specifications D.P.W." and SFPW Order No. 187,005, 'Regulations for Excavating and Restoring Streets in San Francisco', Approved on November 2010 and all modifications, unless otherwise specified herein. All compaction shall be performed in accordance with Section 707 "Compaction" of the "Standard Specifications D.P.W." unless otherwise specified herein.
- B. Prior to backfilling, the trench shall be cleared of all wood, debris and loose soil.
- C. Backfill material shall not be dropped directly on the pipe.
- D. Shoring Removal:
  1. Carefully remove shoring and bracing system using methods that will minimize caving.
  2. Metal sheet piling, sheeting, and bracing shall not be left in place.
- E. Low points along the pipe trench shall not be backfilled until all backfill at adjacent higher elevation has been completed. Water collecting at the low points shall be removed by pumping or other approved means.
- F. Backfill of Pipe Bedding
  1. In accordance with the Contract Drawings or directed by the City Representative, the Contractor shall place a uniform layer of import sand over the bottom of the trench to provide continuous support for the pipe prior to installing the pipe. The pipe bedding import sand shall be compacted with approved plate-type vibrating equipment before pipe installation. Bell holes shall be excavated for each pipe bell or joint.
- G. The level of the backfill on either side of the pipe barrel shall be brought up to the same approximate elevation simultaneously.
- H. Backfill shall be made in lifts not exceeding approximately 8 inches in loose thickness, from the pipe bedding up to the concrete base level using hand-operated motor driven vibrating plate type or tamping type equipment to compact trenches for 12-inch diameter and smaller pipe; and hand-operated motor driven vibrating plate type equipment to

compact trenches for pipes larger than 12-inch diameter. Compaction by saturating with water is not permitted.

- I. Each lift of backfill material shall be satisfactorily compacted before placing the next lift thereon.
- J. Each lift shall be tested for a relative compaction of not less than 95%.
- K. For trenches parallel to the center line of the roadway and exceeding 25% of the block face length, shall require a test every 50-feet with a minimum of three compaction tests. For trenches crossing intersections, a minimum of 2 compaction tests are required within the intersection in accordance with SFPW Order No. 187,005, 'Regulations for Excavating and Restoring Streets in San Francisco'.
- L. Tests of relative compaction, including determination of optimum moisture content and maximum density of backfill shall be made in accordance with ASTM D1557 and ASTM D6938. Laboratory maximum dry density will be determined in accordance with ASTM D1557. Field in-place density will be determined in accordance with ASTM D6938 and Field in-place moisture will be determined in accordance with ASTM D6938. As stated herein, the term "relative compaction" means the percentage ratio of the field-compacted dry density to the maximum dry density obtainable by compaction at optimum moisture content.
- M. At the time of compaction, the moisture content of backfill material shall be such that the required relative compaction will be obtained.

END OF SECTION

## SECTION 31 40 00

## SHORING AND UNDERPINNING

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. Under this Section, the Contractor shall install an approved shoring system for all excavations 5 feet or more in depth.
- B. Design bracing, shoring, and underpinning.
- C. Selection of construction sequence.
- D. Temporary bracing of the structure or portions of the structure as required to prevent the structure from becoming unsafe during the construction.
- E. Construction and removal of posts, timbers, lagging, braces, etc. required in connection with bracing, shoring, and underpinning the structure during construction.
- F. Excavation, concrete placement, and backfilling required in connection with underpinning foundations.

## 1.02 RELATED SECTIONS

- A. Section 02 41 00 – Demolition
- B. Section 31 23 00 – Excavation and Fill

## 1.03 REFERENCES

- A. General:
  - a. Shoring and bracing work shall be designed and constructed in accordance with the requirements of agencies having jurisdiction of this work.
  - b. Refer to Division 01 Section “General Requirements” for list of applicable regulatory requirements.
- B. Geotechnical Investigation, Amador Street Sanitary Pump Station Improvements, prepared by T & R / RYCC, Dated 19, September, 2011 and Pier 94 Backland Improvements, San Francisco, California, dated July 5, 2012, prepared by T&R/RYCC.
- C. California Labor Code Sections 6705 and 6707.
- D. American Society for Testing and Materials (ASTM) Standards
  - 1. C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
  - 2. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lbf/ft<sup>3</sup>)

3. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft lbf/ft<sup>3</sup>)
  4. D5195 – Standard Test Method for Density of Soil and Rock in Place at Depths Below Surface by Nuclear Methods
- E. California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA) shall be strictly observed.
1. Title 8 – Industrial Relations, Chapter 4 – Division of Industrial Safety

#### 1.04 DESIGN REQUIREMENTS

- A. General: The stability and integrity of the structure during construction shall be maintained at levels generally acceptable within the construction industry by the use of bracing, shoring, and underpinning. In no case shall the structure be allowed to become unsafe during construction as defined by the local governing jurisdiction. Design stresses in bracing, shoring, and underpinning shall not exceed the allowable stresses in Section 51-1.06A (2) of the Standard Specifications.
- B. Bracing and Shoring of Structures:
1. The bracing and shoring system required to provide temporary support of a structure or portions of a structure during construction shall be designed to support the dead, live, soil, earthquake and wind loads that may be imposed on the structure during construction in accordance with industry standards and generally accepted engineering principles.
  2. The proposed bracing shoring systems shall have foundations designed for allowable soil bearing pressures in accordance with the geotechnical investigation prepared for the Project.
  3. Due to limitations on space, shoring will be permitted to be used as formwork for cast-in-place concrete.
- C. Shoring of Excavations and Underpinning: The proposed shoring and underpinning systems shall be designed for earth pressures and allowable soil bearing values as applicable in accordance with the geotechnical investigation prepared for the Project

#### 1.05 SUBMITTALS

- A. Submit under provisions of Division 01 Section “ General Requirements”
- B. Shop Drawings indicating layout, member sizes, connection details and construction sequence for bracing, shoring and underpinning. No work related to bracing, shoring or underpinning shall take place until the City Representative has reviewed the calculations and Shop Drawings.
- C. Design calculations of bracing, shoring and underpinning showing member stresses and connections due to imposed loads.

#### 1.06 QUALITY ASSURANCE

- A. The Contractor and/or Sub-Contractor performing these operations shall have a minimum of 5 years proven experience in this type of work.
- B. Contractor shall retain and pay for the services of a California licensed Civil or Structural Engineer who has demonstrated experiences in shoring design, to design all aspects of shoring and bracing in accordance with the recommendations in the geotechnical memorandum.
  - 1. Submit drawings and calculations bearing the design engineer's seal and signature, together with specifications, proposed procedures and sequences for the construction, for the City Representative's review and for approval by the San Francisco Department of Building Inspections prior to commencing any work of this Section. Approved plans are required at the job site prior to start of work.
  - 2. Design and construction of all shoring and bracing is exclusively the responsibility of the Contractor. It shall be understood and agreed that the submittal specified herein does not become a part of the Contract Documents and the City representative's review is for the purposed to assure himself/herself of general compliance with the Labor Code and Safety Orders.

## PART 2 – PRODUCTS

### 2.01 SHORING

- A. All timber, lumber, and structural steel used in trench shoring, whether new or used, shall be sound and free from defects that might impair their strength.

## PART 3 – EXECUTION

### 3.01 GENERAL

- A. Protect all structures requiring shoring and bracing from damages as the result from construction under this contract. Any damage shall be restored by the Contractor at no cost to the City.

### 3.02 INSTALLING SHORING

- A. All shoring for excavations shall be installed in accordance with Standards established by the California Division of Industrial Safety and in conformance with all other applicable rules and requirements. Section 6705 and 6707 of the California Labor Code shall apply to any excavation five (5) feet or more in depth, installed under this contract.
- B. Construction of bracing, shoring, and underpinning shall be in accordance with the reviewed Shop Drawings prepared by the Subcontractor's Engineer.
- C. The Subcontractor shall hire the Engineer responsible for the design of bracing, shoring, and underpinning and inspection of the work detailed on the bracing, shoring, and underpinning Shop Drawings, prior to sawcutting or removing portions of the structure.
- D. Excavations for underpinning the foundation shall be inspected by the Geotechnical Engineer prior to placement of the concrete.

- E. The Engineer responsible for the design of bracing, shoring, and underpinning shall write a letter to the City Representative certifying that construction of bracing, shoring, and underpinning was completed in accordance with the bracing, shoring, and underpinning Shop Drawings and meets its approval, prior to placement of concrete, sawcutting, and removal or modification of portions of the structure.

### 3.03 REMOVAL OF BRACING AND SHORING

- A. Bracing and shoring shall not be removed until the new members have acquired sufficient strength to support their weight and the loads superimposed thereon safely. In no case may the bracing or shoring be removed until the time and sequence has been approved by the Engineer responsible for bracing and shoring reviewed by the City representative.
- B. In general, bracing and shoring of concrete shall remain in place for at least ten days, when they may be removed provided the concrete is sufficiently hard and will not be injured.
- C. Shoring may be permitted to be abandoned in place, provided the affects of sloughing of the surrounding soil as the shoring degrades is mitigated.

END OF SECTION

## SECTION 31 62 23.13

## TORQUE DOWN PILES

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. This section specifies covers the following items of work for design and construction of torque down piles for foundation support:
1. Installing torque down piles at required locations per plans. Cutting off pile casings at required elevations. Filling with concrete and providing reinforcing steel and clean up.
  2. Torque Down Pile System: Torque down piles that transfer the loads of the structural elements indicated on the Drawings to the underlying soils. Torque down piles are a deep foundation system placed without the soil removal, without driving, and are installed with minimal noise and vibration. Penetration of the soil to depth is achieved through rotation of the pile with or without downward pressure. These systems resist structure loads primarily through skin friction in combination with bearing at their tip.

## 1.02 RELATED SECTIONS

- A. Section 31 23 00 – Excavation and Fill
- B. Section 03 20 00 – Concrete Reinforcement
- C. Section 03 30 00 – Cast-in-Place Concrete

## 1.03 REFERENCES

- A. Geotechnical Investigation, Amador Street Sanitary Pump Station Improvements, prepared by T & R / RYCC, Dated 19, September, 2011 and Geotechnical Investigation Pier 94 Backland Improvement, San Francisco, California prepared by T&R/R YCG dated 5 July 2012 and Geotechnical memorandum from public works “Amador street Sewer and Pavement Improvement Project-Torque Down Pile for the New Sump Pit, dated June 2, 2020.
- B. American Welding Society (AWS)
1. D1.1 – Structural Welding Code - Steel
  2. D1.4 – Structural Welding Code - Reinforcing Steel

## 1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide piles capable of withstanding design loads within limits indicated and under conditions existing at Project site.
- B. The specified vertical load capacity shall be developed in the surficial fill materials, Bay Mud, and dense sand in accordance with the Geotechnical Investigation, Amador Street Sanitary Pump Station Improvements, prepared by T & R / RYCC, Dated 19, September, 2011 and Geotechnical Investigation Pier 94 Backland Improvement, San Francisco, California by T&R/R YCG dated July 5, 2012.

**1.05 UNIT PRICE**

- A. Measure and payment for all labor, material, and equipment for furnishing and installing piles and all associated work as shown on the S-Series Drawings and as specified in the Specification Sections, including pile testing program will be made at the Contract Unit Price per linear foot in place as indicated in the Schedule of Bid Prices. Quantities may vary by up to  $\pm 25\%$ . The unused portion of this Bid Item shall be credited to the City.

**1.06 SUBMITTALS**

- A. Installer qualifications: Provide list of similar projects completed, including name and resume of the installer in responsible charge, on-site foreman and drill rig operators. Provide contact information for the client for each project listed.
- B. Product Data: For each pile product, accessory, and concrete material proposed. If polymer drilling fluid is proposed, also include in product data.
- C. The Contractor shall submit a step-by-step procedure describing all aspects of the pile installation including materials, personnel, testing and equipment, including but not limited to:
1. Installation methods and equipment to be used: Identify proposed method for the steel pipe installation, placing of concrete in pile; methods for placing, positioning supporting rebar reinforcement or other connection method.
- D. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing installation and material requirements.
1. Pile details
  2. Include structural analysis data signed and sealed by a qualified California registered Civil or Structural Engineer responsible for their preparation. Include calculations for torque down pile per S-10 drawing.
  3. Reinforcement details
  4. Concrete mix designs
- E. Pile Installation Records: The Contractor shall submit a piling layout drawing indicating location and numbering system. At completion of work, the Contractor shall submit installation records showing:
1. Pile number (based on numbering system shown on Drawings)
  2. Date installed
  3. Location including deviation from design
  4. Pre-drill depth, if any
  5. Tip and butt elevation
  6. Torque with depth



7. Advancement rate of pile with depth
  8. Locations of splices, if any
  9. Unusual occurrences encountered during installation
- F. Pile Fabrication Records: The Owner's Testing Agency shall submit inspection records per General requirements. Structural Steel inspection records shall include, but not be limited to the following:
1. Date of fabrication
  2. Pipe lot number
  3. Welding procedure used

#### 1.07 QUALITY ASSURANCE

- A. Design and install in accordance drawing S-10
- B. Installer Qualifications: An entity (subcontractor) that has designed, installed, and tested piles for at least 5 similar projects involving piles of similar capacity to those indicated in the last 5 years.
1. The engineer in responsible charge shall have at least 3 years experience in pile design with the subcontractor.
  2. The on-site foreman and drill rig operators shall have at least 3 years experience in pile design with the subcontractor.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- D. The City Representative is to verify the equipment for adequacy and condition of the installation equipment and inspect and continuously observe each pile installation.
- E. Variation from plan location 3 inches for piles in groups of 3 or more and 1 inch for all others. Deviations for plumb 1 percent of pile length, but 3 inches maximum. Variations from cutoff elevation: plus (higher) 1 inch.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle and store materials at Project site to prevent cracking, distorting, warping, or other physical damage.
- B. After pile lengths are verified and required welding inspections performed, deliver materials to the project site in such quantities and at such times to assure the continuity of pile installation operations and the project schedule. Make allowances in delivery for limited space on site for storage. Protect pipe from damage during transportation, storage, and handling.

#### 1.09 PROJECT CONDITIONS

- A. Data on indicated subsurface conditions are not intended as representations or warranties of the continuity of such conditions. The data is made available for the convenience of the Contractor.

- B. Additional test borings and other exploratory operations may be made by the Contractor, at no additional cost to the City.

#### 1.10 GEOTECHNICAL ENGINEER

- A. A Geotechnical Engineer selected and paid by the OWNER, shall observe all work to be executed under this section. The Geotechnical Engineer shall at all times have access to the work and data and be furnished every reasonable help for checking the progress and coordination of all phases of work. Advice to the CONTRACTOR by the Geotechnical Engineer, either solicited or freely given, shall not diminish the CONTRACTOR's responsibility to install permanent ground anchors according to these specifications.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Concrete: Concrete shall be in accordance with Section 03 30 00
- B. Reinforcing Bars: ASTM A706 or ASTM A615, grade 60.
- C. Steel Casing: ASTM A252 Grades 2, API 5Lx46, Grade B, or equivalent, seamless, longitudinal fusion, spiral-welded or electric-resistant welding. Minimum wall thickness shall be (3/8") 0.375 inches. Pipe shall be 12.75 inches outside diameter. Used pipe, meeting the above requirements, with or without reconditioning, may be used subject to Contractor's inspection and the City Representative's approval.
- D. Portland Cement: ASTM C150, Type II
- E. Fly Ash: ASTM C618, Class F
- F. Silica Fume: ASTM C1240, amorphous silica
- G. Normal-weight Aggregates: ASTM C33
- H. Water: Potable
- I. Pipe tips shall be weldable fabrication. The tip shall have teeth and/or helical fins as necessary for cutting soil
- J. Other Materials: Provide other materials and/or equipment, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the City Representative.

#### 2.02 CONCRETE MIXES

- A. Prepare design mixes with strength adequate for the loads imposed and of a consistency to allow free flow of concrete. Minimum 28-day compressive strength of concrete shall be 4,000 psi. Maximum aggregate size 3/8".

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Field Measurements: Pile location - Staked out by Contractor; protect stakes from movements and damage. Replace moved or damaged stakes with new stakes at no expense to Owner.
- B. Do not install piles until earthwork in area which piles are to occupy has been completed.
- C. Pile Markers: Mark each pile's length with a horizontal line, at 1-foot intervals, and the number of feet from the pile tip at 5-foot intervals.

### 3.02 INSTALLATION TOLERANCE

- A. Pile Installation
  - 1. Pile Spacing: Minimum 3 pile diameters, center to center, unless otherwise shown.
  - 2. Alignment: Maintain pile location and plumb. Take special precautions to ensure against buckling of pile or leading away from plumb or true position. Install substitute piles where piles exceed specified tolerances. Costs in connection with substitute piles are to be borne by Contractor. Include such costs as structural redesign and additional material and labor required for pile caps.
  - 3. Obstructions: Existing obstructions such as footings, pile caps, and buried utilities are to be removed under other applicable sections.
  - 4. Pre-drilling:
    - a. Pre-drilling may be required in the fill (top 15 feet from surface) if obstruction is encountered.
    - b. Auger Size: To produce hole diameter equal to 75% of side dimension of pile for compression and tension piles.
    - c. Hole: Pre-drilling should be performed in a manner that produces a hole of uniform diameter, and so that uniform contact is maintained between the pile and sidewall of hole.
  - 5. Refusal: After achieving a minimum designed, tension tip elevation, the pile may be stopped if it experiences refusal above design compression tip elevation. The Contractor will have the option of performing additional soil investigations or providing Engineer with Geotechnical Engineer's review of pile to verify the minimum tip elevation required. Refusal will be defined as when the pile installation rate becomes less than one foot of penetration in fifteen (15) minutes, or when the torque required to install the pile exceeds 250,000 foot-pounds.
  - 6. Noise: Machinery for installation shall operate at less than 85 dB at full torque, when measured at a distance of 20 feet in unconfined areas.
  - 7. Vibration: Vibration shall not exceed background vibration levels recorded at a distance of 10 feet from the pile location.
  - 8. Piles shall be installed using torque and pull force provided by pile tip.
  - 9. Cutting Off: The piles shall be cut off to a true even plane at elevations shown on the drawings.

**B. Concrete Core**

1. Water infiltration: Surface water shall not be permitted to enter the piling. Water that has infiltrated the piling shall be removed before placing concrete therein. Residual water in the cone of the tip itself need not be removed.
2. Placement: The concrete to be placed in piles shall be permitted to free-fall provided that flow of concrete is directed at the center of the pile using a hopper or pump. Concrete shall be pumped or poured directly into pipe piles at a rate that allows free flow of the concrete to bottom of pile and as the pipe fills. Concrete shall be placed carefully so as to provide a dense, monolithic section for the full length of the pile. Concrete in the top 15 feet of the pile shall be vibrated.
3. Reinforcing: Install reinforcing steel cage in top section of pile as shown on the Contract documents.

**3.03 FIELD QUALITY CONTROL**

- A. Sample concrete by making a set of cylinders per 100 cubic yards of concrete placed or at least once a day.
- B. Location Survey:
  1. General: Prepared by licensed surveyor registered in State of California. Make progress submittals immediately upon completion of the following:
    - a. Location: After installing piles in each pile cap group. Indicate measured location of each pile with respect to column lines.
    - b. Elevation: Indicate measured elevation of each pile based on top datum.

**3.04 UNSATISFACTORY PILES**

- A. General :
  1. Misaligned piles or piles improperly installed or damaged as a result of Contractor's operations to an extent that, in the Structural Engineer's opinion, are incapable of performing the function for which it was designed, will be considered unsatisfactory.
  2. Replace all unsatisfactory piles with required replacement piles installed in accordance with requirements specified herein.

**3.05 CLEAN UP**

- A. Remove all material discarded by piling and grouting operations to approved stockpiling areas and containers.
- B. The Contractor shall at all times keep the immediate work area adjacent to pile operations free of accumulations of excavated material and/or rubbish and trash.
- C. At completion of work, remove all excavated materials, trash, rubbish and all tools, scaffolding, and surplus materials leaving the site with a clean, finished appearance relative to site conditions.

3.06 CHANGES OR SUBSTITUTIONS

- A. Contractor shall not make changes in any material, equipment or method of installation, nor deviate from Drawings or Specifications without written approval of the Engineer.

END OF SECTION



## SECTION 32 01 16.71

## COLD MILLING ASPHALT PAVING

## PART 1 – GENERAL

## 1.1 DESCRIPTION

- A. This Section includes provisions for milling asphalt concrete pavement at the locations and to the dimensions shown on the Drawings, in accordance with the Project Manual and as directed by the City.

## 1.2 REFERENCE STANDARDS

- A. DPW Standard Specifications (SSDPWSF), revised November, 2000.
- B. San Francisco Police Code: Article 29 Regulation of Noise.

## PART 2 – PRODUCTS

## 2.1 EQUIPMENT

- A. Cold planer machine: In accordance with the requirements of Section 214.02 of the DPW Standard Specifications.

## PART 3 – EXECUTION

## 3.1 MILLING EXISTING ASPHALT CONCRETE SURFACES

- A. General: In accordance with the requirements of Section 214.01 of the DPW Standard Specifications.
- B. Conduct of the Work: In accordance with the requirements of Section 214.03 of the DPW Standard Specifications.

## 3.2 PROTECTION

- A. A temporary 1:18 slope of hot asphalt concrete wedge will be constructed along any longitudinal and/or transverse drop off exceeding  $\frac{3}{4}$  inches during the same day that the milling is accomplished.
- B. Asphalt concrete for temporary asphalt concrete wedge will be as approved by the City.

## 3.3 SURFACE PREPARATION

- A. The temporary asphalt concrete wedges will be removed by the Contractor before placing the asphalt concrete wearing surface.
- B. Full compensation for installing and removing the temporary asphalt concrete wedges before the placing of asphalt concrete wearing surface will be considered as Incidental Work to cold milling.

END OF SECTION





## SECTION 32 01 90

LANDSCAPE MAINTENANCE  
LONG-TERM PLANT MAINTENANCE PERIOD

## PART 1- GENERAL

## 1.01 SECTION INCLUDES

1. A. Furnishing and implementing a complete landscape maintenance program. Maintain all planting areas from time of delivery, through the 1095 calendar days Plant Establishment Period and Final Acceptance, in accordance with SSDPWSF, SECTIONS - 1008.04 and 1008.10. The Work includes but is not limited to:
2.
  1. 1.The watering, cultivating, fertilizing, weeding and mulching of all plant material in this contract.
  2. 2.The resetting of trees to be level, at proper grades, and upright positions including resetting and replacing of tree stakes and ties.
  3. 3.Restoration of watering basins as directed by the City Representative. Replacement of mulches/quarry fines due to displacement on a weekly basis.
  4. 4.Contractor is to take all necessary measures to keep plants pest and disease free and in thriving condition.
  5. 5.Restoration of finish grades by replenishing planting areas with soil; replacing eroded soil, or soil made sterile by herbicidal application, with approved and tested import topsoil taking precautions as necessary to prevent windburn damage.
  6. 6.Replacement of dying, dead or diseased plants within two weeks of notification from City Representative.
  7. 7.Replacement of plants damaged or loss due to vandalism and animal damage within two weeks of notification from city representative.
  8. 8.Water trees and all planting by hand via water truck. Frequency of hand watering to be determined by Port staff based on season and environmental conditions.
  9. 9.Litter in tree wells and planting beds to be picked up a minimum of once a week. Planting areas are to remain neat and clean at all times.
  10. 10. Resetting, reinstallation, or adjusting of tree guards and support structures to remain plumb and level within two weeks of notification from City Representative.
  - 11.
- 3.

## 1.02 RELATED WORK

- A. Section 32 90 00 - Planting
- B. Section 32 91 19 – Planting Preparation

## 1.03 REFERENCE STANDARDS

- A. SSDPWSF - Section 1008 - Maintenance and Plant Establishment
- B. Plant Material Standards: "American Standard for Nursery Stock", 1981 Edition, American Association of Nurserymen.

## 1.04 WARRANTY

- A. Refer to Section 32 90 00 Planting.

### 1.05 SCHEDULE

- A. Submit a proposed maintenance work schedule to the City Representative in writing for review at least 10 days prior to commencement of maintenance work. All maintenance work shall be done at times approved by the City Representative so as not to conflict with the operation of the project.

### 1.06 PROTECTION

- A. Protect planting areas and plants against damage during the Plant Establishment Period.
- B. Maintenance also includes temporary fences, barriers, and signs as required for protection.
- C. The Contractor shall treat or replace any plant which becomes damaged or injured, as directed by the City Representative at no additional cost to the City.

### 1.07 FERTILIZATION

- A. Including but not necessarily limited to 16-6-8 fertilizer at the rate of 7 pounds per 1000 square feet, 30 days after installation.

## PART 2 - PRODUCTS

NOT USED

## PART 3- EXECUTION

### 3.01 FIELD QUALITY CONTROL

- A. Perform Site Observations for establishing the 1095-day Maintenance Period and observing completion of the work of this Section through Final Acceptance. A minimum of six separate field visits, occurring chronologically as follows:
  - 1. Observation for Maintenance at Commencement.
  - 2. 30-day Progress Maintenance Observation.
  - 3. 90-day Progress Maintenance Observation
  - 4. 180-day Progress Maintenance Observation
  - 5. 270-day Progress Maintenance Observation
  - 6. 365- day Progress Maintenance Observation
  - 7. 485-day Progress Maintenance Observation
  - 8. 605-day Progress Maintenance Observation
  - 9. 730-day Progress Maintenance Observation
  - 10. 850-day Progress Maintenance Observation
  - 11. 970-day Progress Maintenance Observation
  - 12. 1095-day Observation for Acceptance
- B. Observation for Maintenance Period Commencement: Request observation by City Representative after all plant material is installed and after all irrigation work and other work of this Section is completed. Maintenance Period shall begin upon observation and review by the City Representative and shall continue for a minimum of 1095 calendar days until Final Acceptance.

### 3.02 PROGRESS MAINTENANCE OBSERVATION

- A. General: Notify the City Representative 30 days after commencement of Landscape Maintenance period for a Progress Maintenance Observation. All items determined to be deficient during the previous observation shall be completed prior to the meeting. Failure to do so may result in an extension of the maintenance period. In addition, prior to first Progress Maintenance observation, furnish the City Representative with the following information:
  - 1. An “as-built” planting plan of all plantings installed, as specified.
  - 2. All supplier invoices for the nursery stock, commercial fertilizers, soil amendments, mulches and herbicides as shown and specified and as installed.
  - 3. Maintenance schedule for fertilization, watering, and for all planting areas.
- B. Failure to provide the above submittals may result in the re-scheduling of the Progress Maintenance Observations and to extend the 1095-Day Maintenance Period.
- C. Notify the City Representative in writing, prior to any of the Progress Maintenance Observations of any conditions which may impede proper plant establishment and or growth.
- D. Final Maintenance Observation: Notify the City Representative 1095 days after commencement of the Plant Establishment Period for Final Maintenance Observation. Prior to this observation, all items determined to be deficient during the Progress Maintenance Observations shall be completed and signed off by the City Representative.

### 3.03 FINAL ACCEPTANCE

- A. General: Work under this Section will be accepted by the City Representative upon satisfactory completion of all work of this Section, Section 32 90 00 Landscape Planting, including 1095 Maintenance Period, exclusive of replacement of plant material under the terms of the Warranty. Bureau of Urban Forestry representative must be on site and agree to final acceptance of landscape maintenance period.
- B. Termination of Observation: During the Final Acceptance Observation, any landscape item previously identified as deficient in the Progress Maintenance Observations and determined by the City Representative to be still deficient, shall automatically terminate the Final Observation and result in the extension of the Maintenance Period an additional 30 days. Additional costs associated with subsequent Observations that are required as a result of the Contractors failure to correct deficient items shall be paid by the Contractor. There shall be no conditional final acceptance agreement for any work.

### 3.04 NOTIFICATION TO PUBLIC WORKS URBAN FORESTRY AND THE PORT OF SAN FRANCISCO

- A. At least one month prior to the end of the Plant Establishment Period, the Contractor shall notify the City Representative to coordinate a meeting between the City’s Urban Forestry Dept. – contact person Chris Buck, (415)-641-2677, [Chris.Buck@sfdpw.org](mailto:Chris.Buck@sfdpw.org) and the Contractor to ensure a smooth transition for plant maintenance.
- B. At least one month prior to the end of the Plant Establishment Period, the Contractor shall notify the City Representative to coordinate a meeting between the Port of San Francisco maintenance representative and the contractor to ensure a smooth transition for plant maintenance.

END OF SECTION

## SECTION 32 11 23

## AGGREGATE BASE COURSES

## PART 1 – GENERAL

## 1.01 DESCRIPTION

- A. This Section includes specifications for materials and work necessary for constructing aggregate base at the locations and to the dimensions shown on the Plans, in accordance with the Project Manual and as directed by the Engineer.

## 1.02 REFERENCE STANDARDS

- A. State of California Department of Transportation Standard Specifications (CTSS), dated July, 2013.
- B. Standard Specifications of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SSDPWSF), revised November, 2000.

## 1.03 SUBMITTALS

- A. Submittals: In accordance with Section 205.03, Samples and Testing, of SSDPWSF.

## PART 2 – PRODUCTS

## 2.01 MATERIALS

- A. Aggregate Base: All aggregate shall be in accordance with the requirements of Section 26-1.02A of CTSS, Class 2 Aggregate Base. The particle size distribution shall be in accordance with the grading specified for 3/4-inch maximum size aggregate.

## PART 3 – EXECUTION

## 3.01 SURFACE PREPARATION

- A. Subgrade: In accordance with the requirements of Section 26-1.03 of CTSS:
  - 1. Preparation of subgrade to proper grade, including excavating, backfilling and compacting shall be considered as Incidental Work to the applicable bid items where excavation is required to perform the work.

## 3.02 INSTALLATION

- A. Adding Water: In accordance with the requirements of Section 26-1.035 of CTSS.
- B. Spreading: In accordance with the requirements of Section 26-1.04 of CTSS.
- C. Compacting: In accordance with the requirements of Section 26-1.05 of CTSS.
  - 1. All water used for watering shall be applied as Incidental Work.

END OF SECTION



SECTION 32 12 16

ASPHALT PAVING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This Section includes provisions for constructing new asphalt concrete wearing surface, Type A, 1/2-inch maximum with medium grading at the locations and to the dimensions shown on the Drawings, in accordance with the Project Manual and as directed by the City.

1.2 REFERENCE STANDARDS

- A. DPW Standard Specifications (SSDPWSF), revised November, 2000.
- B. Caltrans Standard Specifications (CTSS), revised July, 2013.
- C. Caltrans Standard Special Provisions, dated 2010.

1.3 PERFORMANCE QUALITY CONTROL

- A. Compaction: In accordance with the requirements of Section 212.09 of the DPW Standard Specifications.

- B. Pavement Finish Irregularity Requirements

- 1. The Contractor shall spread and compact the asphalt concrete wearing surface such that when a City furnished 10-foot rolling straight edge is rolled over the finished pavement surface, it will disclose no more than the following irregularities per lane mile:

Irregularity Range Per Lane Mile	Maximum Allowable Irregularities Per Lane Mile
3/16 inch to less than 1/4 inch	200 irregularities
1/4 inch to less than 5/16 inch	100 irregularities
5/16 inch or greater	0 irregularities

- 2. In addition, the above criteria will be used as a basis for calculating the maximum allowable amount of irregularities for each lane for each block throughout the Work limits. The maximum allowable amount of irregularities per lane block will be calculated by multiplying the maximum allowable number of irregularities per lane mile by the length of the block in feet and dividing by 5,280 feet.
- 3. The Contractor shall give the City 24 hours advance notice for the rolling straight edge tests.
- 4. The Contractor shall transport the said City furnished straight edge from 2099 Kearny Street, San Francisco, 415-274-0278, or other place of storage, to the site and return said equipment to the place of storage when the need has ended.
- 5. City forces will perform the rolling straight edge operation at no cost to the

Contractor. As City forces perform the rolling straight edge operation, the City Representative will observe same and the Contractor shall provide the necessary or required labor, flagman and equipment to complete said operation.

- 6. The Contractor shall furnish the City Representative with all the necessary or required labor, flagman and equipment, other than the 10-foot rolling straight edge, to complete the inspection of the finished pavement.
- C. The City will have the option of requiring correction of pavement irregularities in excess of the maximum allowable or a reduction of payment due to the Contractor, based on the official rolling straight edge report. The reduction of payment will be as follows:

Irregularity Range	Payment Reduction Per Each Excess Irregularity
3/16 inch to less than 1/4 inch	\$ 20.00
1/4 inch to less than 5/16 inch	\$ 100.00
5/16 inch or greater	\$ 200.00

1.4 SUBMITTALS

- A. Prior to starting construction, the Contractor shall submit the asphalt concrete mix design, including the amount of asphalt binder to be mixed with the dry aggregate to the City Representative for approval. No resurfacing work will be allowed prior to the approval of the mix design. Asphalt concrete mix design will conform to Section 39 of the 2010 Caltrans Standard Specifications and as modified below under Article "Materials".
- B. The Contractor shall submit (8) copies of the manufacturer’s literature, Specifications, applications and installations for filler and/or sealer material to the City Representative for approval at least five (5) calendar days in advance of performing the filling and/or sealing work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The Contractor is encouraged to use Reclaimed Asphalt Pavement (RAP) in accordance with the 2010 Caltrans Standard Specifications and Standard Special Provision (SSP) 39-010. Specifically, refer to 2010 CTSS Section 39-1.02F outlining current maximum RAP substitution rate. Minimum RAP substitution rate shall be 15% of the aggregate blend.
- B. Asphalt: In accordance with the requirements of Section 39–1.02C of the 2010 Caltrans Standard Specifications, except that asphalt will be either PG 64–10 or AR–4000.
- C. Aggregate: In accordance with the requirements of Section 39–1.02E of the 2010 Caltrans Standard Specifications, except that aggregate grading will be as follows:

Sieve Sizes	Limits of Proposed	Operating Range	Contract Compliance
3/4"	–	100	100
1/2"	–	95–100	89–100
3/8"		80–95	75–100



No. 4	59–66	X±5	X±8
No. 8	43–49	X±5	X±8
No. 30	22–27	X±5	X±8
No. 200	–	3–8	0–11

Minimum Durability Index: When tested in accordance with Caltrans Test Method 229, will be 50.

- D. Paint Binder: In accordance with the requirements of Section 212.06 of the DPW Standard Specifications, except that paint binder shall be emulsified asphalt Type SS-1 or SS-1h.
- E. Sealer: It will be a combination of polymeric compounds, cures to a soft, highly flexible, rubber like material that is capable of maintaining a sealed joint or crack over a wide temperature range. Sealer will be cold applied SOF–SEAL, low modulus horizontal sealant, manufactured by:

W.R. Meadows, Inc.  
865 Teal Drive  
Benicia, CA 94510  
Phone (707) 745-6666

or equal (no known equal).

## 2.2 EQUIPMENT

- A. Spreading Equipment: In accordance with the requirements Section 212.07 of the DPW Standard Specifications.
- B. Compacting Equipment: In accordance with the requirements of Section 212.09 of the DPW Standard Specifications.

## PART 3 – EXECUTION

### 3.1 SURFACE PREPARATION

- A. Immediately before resurfacing, the Contractor shall, as Incidental Work, clean, repair cracks and apply paint binder in areas to be paved.
- B. Cracks larger than one inch will be filled or sealed with hot asphalt concrete as directed by the City.
- C. All cracks equal to or smaller than one inch and not smaller than 1/4 inches will be filled or sealed with approved sealer.
- D. Placement of asphalt concrete wearing surface is to be completed within 120 hours after asphalt planing or placement of concrete base.
- E. The Contractor shall not proceed with paving work until given written approval from the City.
- F. The temporary asphalt concrete fill or wedges on the concrete base repair areas will be removed by the Contractor before placing asphalt concrete wearing surface.

### 3.2 INSTALLATION

- A. Paint Binder: In accordance with the requirements of Section 212.06 of the DPW Standard Specifications.
- B. Conform Areas: In accordance with the requirements of Section 212.10 of the DPW Standard Specifications.
- C. Spreading: In accordance with the requirements of Section 212.08 of the DPW Standard Specifications.
- D. Compaction: In accordance with the requirements of Section 212.09 of the DPW Standard Specifications.

### 3.3 SURFACE CONDITIONS

- A. The Contractor shall examine the areas and conditions under which Work of this Section will be performed. Conditions detrimental to the timely and proper completion of the Work will be corrected. The Contractor shall not proceed until unsatisfactory conditions have been corrected.
- B. The Contractor shall notify the County Surveyor at (415) 554-5833 to report any monuments in danger of disturbance, destruction or removal. All City monuments are to be protected per State Land Surveyors Act and Section 01 71 33 – Protection of Adjacent Construction. The Contractor shall not disturb, destroy or remove any survey monuments without the approval from the County Surveyor. The Contractor shall salvage any monuments removed during construction and deliver these monuments to the Survey Department at 1155 Market Street, 3rd Floor, San Francisco.

### 3.4 FIELD QUALITY CONTROL

- A. The Contractor may be required to perform water tests to satisfactorily demonstrate the proper drainage of the constructed asphalt pavement. The Contractor shall flush with water approximately 50 feet of the upstream end of each gutter for 2 minutes with minimum flow rate of 0.02 cubic feet per second or approximately 20 gallons equivalence. After 5 minutes, the City Representative and the Contractor shall make visual inspection of the gutter to demonstrate proper drainage and no ponding. All water tests will be considered Incidental Work.
- B. The Contractor shall make corrections necessary to demonstrate proper drainage with no ponding, and no separate payment will be made. The Contractor's correction method will be approved by the City. The City's approval does not release the Contractor from the successful execution of the remedy and the requirement to demonstrate proper drainage of the constructed gutter.

END OF SECTION

## SECTION 32 13 13

## CONCRETE PAVING

## PART 1 – GENERAL

## 1.1 DESCRIPTION

- A. This Section includes provisions for constructing concrete base, concrete pavement, concrete parking strip, reinforced concrete bus pad, concrete gutter, concrete curb, concrete sidewalk and concrete curb ramps at the locations and to the dimensions shown on the Drawings, in accordance with the Project Manual and as directed by the City Representative.
- B. Preparation of subgrade to proper elevation, including excavating, backfilling, removal of existing pavement, existing gutter, existing curb, existing sidewalk, existing curb ramp, and compaction as required will be done as Incidental Work to the above mentioned new concrete work.
- C. Tree roots under pavement and sidewalk areas will be removed with a sharp edge instrument to a depth of 8 inches below finished grade as Incidental Work. Feeder roots greater than 2 inches in diameter will be checked by the Bureau of Urban Forestry. Call the 311 Customer Service, prior to removal by the Contractor.

## 1.2 REFERENCE

- A. DPW Standard Specifications (SSDPWSF), revised November, 2000.
- B. DPW Standard Plans, dated April, 2007.
- C. ACI 318 Building Code Requirements for Structural Concrete.

## 1.3 SPECIAL INSTRUCTIONS

- A. Notifications
  - 1. Underground Service Alert
    - a. Before commencing any excavation, the Contractor shall obtain an Underground Service Alert (USA) inquiry identification number by calling (800) 642-2444.
    - b. The Contractor shall allow four (4) calendar days after the identification number is obtained and before excavation work is started so that utility owners can be notified by the Contractor.
    - c. Identification numbers will not be given more than ten (10) calendar days prior to starting excavation work.
- B. Curb Ramps
  - 1. Curb ramps will be constructed in accordance with the details shown in the DPW Standard Plans.
  - 2. The Contractor shall investigate subsidewalk basement in sidewalk areas prior to saw cutting and excavation for curb ramps. If there is a subsidewalk basement and there is sufficient cover to construct the curb ramp, saw cutting and excavation will proceed with care. If there is not sufficient cover to construct the curb ramp, the Contractor shall notify the City Representative and stop the construction of the curb ramp.
  - 3. The Contractor shall notify the County Surveyor at (415) 554-5833 to report any monuments in danger of disturbance, destruction or removal. All City monuments are to be protected per State Land Surveyors Act and Section 01 71 33 – Protection of Adjacent Construction. The Contractor shall not disturb, destroy or remove any survey monuments without the approval from the County Surveyor. The Contractor shall salvage any monuments removed during construction and deliver these monuments to the Survey Department at 1155 Market Street, 3rd Floor, San Francisco.

4. The Contractor shall complete the construction of curb ramps, sidewalk, curb and gutter within 72 hours from the commencement of excavation work, so as not to obstruct pedestrian traffic or travel thereon more than is reasonably necessary.
- C. Broken Water Meter Boxes
1. Broken San Francisco Water Department (SFWD) meter boxes will be replaced before placing new sidewalk. Call SFWD at (415) 550-4945 to pick up the meter boxes free of charge.
- D. Temporary Wearing Surface for Restored Concrete Base
1. After achieving the concrete base depth as shown on the plans or stated in the specifications, the Contractor may use temporary asphalt on the restored concrete base. The temporary asphalt concrete on the restored concrete base shall be removed by the Contractor before placing the final asphalt concrete wearing surface.
  2. The final asphalt concrete wearing surface and restored base depths shall be as shown on the cross sections in the plans.
  3. Installing temporary asphalt concrete surface on the concrete base areas will be considered as Incidental Work to the Concrete Base bid item. Refer to 01 55 26 Special Instructions for temporary ramp requirements.
- E. California Code and Regulations
1. The Contractor shall comply with all Cal-OSHA Code requirements during this Contract – Article 37, Section 2946 “Provisions for Preventing Accidents Due to Proximity to Overhead Lines” and Article 37, Section 2947 “Warning Signs Required”.
- F. MUNI Railway
1. If MUNI overhead wires are encountered, the overhead wires will be kept energized at all times. The overhead trolley wires carry a minimum of 600 Volts DC and have an 18 +/- foot clearance from the existing roadway. The Contractor shall adapt its methods and equipment to this condition, and take precautions against accidents and damage to the overhead wires and feeder cables when performing paving work and/or concrete work with overhead wires and feeders energized.
- G. Local Access
1. The Contractor shall provide local access to garages by the end of each work shift by placing steel plate(s) over excavated area(s). It is the responsibility of the Contractor to notify residents of the Construction Schedule prior to any Work that may disrupt access to garages or other entrances and provide access during construction where as needed or requested by the City.
- H. Spray Paint
1. Prior to the start of construction, the Contractor shall provide the City Representative with sufficient spray paint, at no cost to the City, for markings necessary for this Contract.
- I. Limit Construction Activities
1. Excavation site may not exceed two (2) consecutive blocks at any time.
- J. Survey Control
1. Where roadway pavement reconstruction occurs, the Contractor is responsible for providing primary control, with control line and grades, from existing off site monument markers and lines. The Contractor shall maintain and preserve all lines, grades and benchmarks and provide for all other survey control work. The Contractor shall establish construction control line with hubs every 25 feet prior to construction work.
  2. The Contractor shall replace or reestablish hubs missing or displaced during construction at no cost to the City.
  3. The Contractor shall retain the services of a State of California registered Land Surveyor

with a minimum of one year experience in engineering surveying and control procedure for public works construction, who will establish horizontal and vertical controls as needed by the Contractor.

4. The survey control work will be considered Incidental Work and no separate payment will be made.

K. Granite Curb

1. In the event granite curb is to be replaced with concrete curb, the Contractor shall remove them from the site as City property. All delivery must be initiated and authorized by City Representative. Only granite curb greater than 4 feet in length will be accepted. The granite curb will be neatly and securely placed on pallets so they can be moved about safely after delivery. The granite curb will be delivered, including off loading, to the Treasure Island Maintenance Yard at 701 14<sup>th</sup> Street at Avenue I, Treasure Island, or where directed by the City Representative within the City.
  - a. Contact Mike Kelly of the Bureau of Street and Sewer Repair at [Mike.Kelly@sfdpw.org](mailto:Mike.Kelly@sfdpw.org).
  - b. Provide a minimum of 48 hour notice for delivery / cancellation via written notification with the following information:
    - Project Name
    - Project Number
    - City Representative Name
    - Contractor Contact Number
    - Estimated Delivery Quantity
2. The Contractor shall clean the granite curb of dirt, debris, and other construction material and exercise care in transporting the granite curb so as to minimize damage.
3. Salvage, hauling and delivery of existing granite curb to the designated areas from the site will be done as Incidental Work.
  - a. Delivery is to be made between 8am to 3pm, Monday through Friday.
  - b. During delivery, driver is to check in with the Yard Master for designated deliver location.
  - c. Yard Master may reject mix and/or unclean load.
  - d. Additional charges will be incurred for:
    - 1) Cleaning and Sorting, if Yard must double-handle load to sort, clean and stack delivery
    - 2) Yard Opening and Operation during non-operation hours and unscheduled deliveries

L. Cobblestones

1. In the event cobblestones are encountered in any street under construction, the Contractor shall remove them from the site as City property. All delivery must be initiated and authorized by City Representative. The cobblestones will be neatly and securely placed on pallets so they can be moved about safely after delivery. The cobblestones will be delivered, including off loading, to the Treasure Island Maintenance Yard at 701 14<sup>th</sup> Street at Avenue I, Treasure Island, or where directed by the City Representative within the City.
  - a. Contact Mike Kelly of the Bureau of Street and Sewer Repair at [Mike.Kelly@sfdpw.org](mailto:Mike.Kelly@sfdpw.org).
  - b. Provide a minimum of 48 hour notice for delivery / cancellation via written notification with the following information:
    - Project Name
    - Project Number
    - City Representative Name
    - Contractor Contact Number
    - Estimated Delivery Quantity

- b. The Contractor shall clean the cobblestones of dirt, debris, and other construction material and exercise care in transporting the cobblestones so as to minimize damage.
3. Salvage, hauling and delivery of existing cobblestones to the designated areas from the site will be done as Incidental Work.
  - a. Delivery is to be made between 8am to 3pm, Monday through Friday.
  - b. During delivery, driver is to check in with the Yard Master for designated deliver location.
  - c. Yard Master may reject mix and/or unclean load.
  - d. Additional charges will be incurred for:
    - 1) Cleaning and Sorting, if Yard must double-handle load to sort, clean and stack delivery
    - 2) Yard Opening and Operation during non-operation hours and unscheduled deliveries

#### 1.4 SUBMITTALS

- A. The Contractor shall submit concrete mix design(s) for all intended applications in accordance with project specifications, DPW Standard Specifications Section 800.01, and ACI 318.
- B. The Contractor shall submit manufacturer's literature, specifications, applications and installations for color pigment to be used in curb ramps for the Engineer's approval: L.M Scofield "C-24 Charcoal Gray", QC Integral Colors "IC-3 Ash Gray", Solomon Colors "Charcoal Gray 920", or approved equal.
- C. Shop Drawings (Reinforced Bus Pads Only)
  1. Contractor shall submit the reinforcing steel shop drawings to City Representative for review and approval, prepared in accordance with ACI SP-66, showing list of materials, sizes, dimensions, cutting, placement details, and splicing, and lapping.
  2. Reinforcing steel shall not be fabricated or placed before the shop drawings are reviewed and approved by the City Representative, and returned to the Contractor. Such review does not relieve the Contractor from the full responsibility for both the accuracy of the shop drawings, and the accurate and complete placing of the work.
  3. Shop drawings shall not be reproductions of the Contract Documents, nor shall they use or incorporate reproductions of parts of the Contract Documents.
- D. Mill Test Reports
  1. Certified mill test reports (tensile and bending), for each heat or melt of steel, showing physical and chemical analyses, shall be submitted to the City Representative for review and approval before the material delivery to the job site.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Concrete Batching: A concrete batching ticket specifying mix design information shall accompany all concrete deliveries subject to verification by City Representative.
- B. Reinforcement shall be shipped and stored with reinforcement of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same designations as shown on the submitted placing drawings.
- C. Reinforcement shall be stored off the ground and be protected from moisture. Keep free from soil, oil, or other injurious contaminants. All steel, which cannot be properly identified, will be rejected, and shall be immediately removed from the job site.

## PART 2 – PRODUCTS

## 2.1 MATERIALS

- A. Portland Cement: In accordance with the requirements of Section 800.02 of the DPW Standard Specifications. The Contractor may substitute supplementary cementitious materials such as fly ash or natural pozzolan; silica fume; or ground granulated blast furnace slag (GGBFS) such that the total amount of portland cement shall not be less than 40% by weight of the total amount of cementitious material. The minimum amount of portland cement shall not be less than 225 pounds per cubic yard. Supplementary cementitious materials can be used in all concrete products with the exception of concrete base.
1. If fly ash or natural pozzolan is used, the total amount of fly ash or natural pozzolan shall not exceed 30% by weight of the total amount of cementitious material.
    - a. Fly ash shall conform to AASHTO M 295, Class F. The available alkali, as sodium oxide equivalent, shall not exceed 1.5% when determined in conformance with ASTM C311 or the total alkali, as sodium oxide equivalent, shall not exceed 5% when determined in conformance with AASHTO T105.
  2. If silica fume is used, the total amount of silica fume shall not exceed 10% by weight of the total amount of cementitious material.
    - a. Silica fume shall conform to AASHTO M307 with reduction in mortar expansion of 80% minimum using the cement from the proposed mix design.
  3. If ground granulated blast furnace slag is used, the total amount of GGBFS shall not exceed 50% by weight of the total amount of cementations material.
    - a. GGBFS shall conform to AASHTO M302, grade 100 or grade 120.
- B. Aggregate: In accordance with the requirements of Sections 800.03, 800.04, 800.05 and 800.06 of the DPW Standard Specifications. The Contractor shall substitute recycled concrete for a portion of the virgin aggregate in an amount no less than fifteen percent (15%) of the total dry aggregate mass. The recycled concrete material will meet or exceed the specified requirements. When recycled material is used for concrete base, exposed concrete applications such as gutter, curb, sidewalk and curb ramp, the Sodium Sulfate Soundness Test (ASTM C88) is waived. Recycled concrete material will not be allowed in structural concrete or decorative concrete with an exposed aggregate finish.
- C. Concrete Curb Ramps: Color pigment will be extra high strength, non-floating, dispersible, non-glare, permanent and unaffected by sunlight. It will be composed of extremely fine sub-micron particle size and will not create the loss of concrete strength.
- D. Cast-In-Place Detectable Surface Tiles: In accordance with the requirements of Section 32 17 33 – Cast-In-Place Detectable Surface Tiles.
- E. Reinforcing Bars: Reinforcing bars shall be deformed.
1. Reinforcing bars shall conform to ASTM A615, Grade 60, unless otherwise indicated.
- F. Accessories
1. Tie wire: Minimum 16 gage black annealed wire.
  2. Supports and spacers: Provide spacers, chairs, bolsters, and other devices to support and secure the reinforcement in place. Supports for reinforcing bars on ground, aggregate base or sand over vapor barrier shall be precast concrete blocks of sufficient strength, size and spacing to support the bars in proper locations.

## 2.2 MIXES

- A. **Concrete Mix Design Requirements (Concrete Base and Reinforced Concrete Bus Pad):** Proportioning for concrete mix designs shall be in accordance with ACI 318 Section 5.3- Proportioning on the basis of field experience or trial mixtures, or both. The target concrete slump shall be 4 inches and the maximum allowed water-cementitious materials ratio shall be 0.5.
1. **Concrete Base:** Concrete base shall have a minimum compressive strength of 5,000 psi at 28 days and contain calcium chloride with a dosage between 1.7 and 2.1 percent by weight of cement to accelerate the setting of the concrete in accordance with the requirements of Section 800 of the DPW Standard Specifications.
  2. **Reinforced Concrete Bus Pad:** Concrete for reinforced concrete bus pad shall have a minimum strength of 5,000 psi at 28 days and be in accordance with the requirements of Section 210.04 of the DPW Standard Specifications. Also, following admixture requirements shall be met:
    - a. Admixtures shall be compatible and contain no chlorides, sulfides, or nitrides.
    - b. Admixtures for water reduction and setting time modification shall conform to ASTM C494.
    - c. Admixtures for use in producing flowing concrete shall conform to ASTM C 1017.
- B. **Concrete Pavement, Concrete Parking Strip:** In accordance with the requirements of Sections 210.04, 800.08 and 800.11 of the DPW Standard Specifications.
- C. **Concrete Curb:** In accordance with the requirements of Sections 202.06 and 800.11 of the DPW Standard Specifications.
- D. **Combined Concrete Curb and Gutter:** In accordance with the requirements of Sections 202.06 and 800.11 of the DPW Standard Specifications.
- E. **Concrete Sidewalk:** In accordance with the requirements of Sections 204.01 and 800.11 of the DPW Standard Specifications. Also, following admixture requirements shall be met:
1. Admixtures shall be compatible and contain no chlorides, sulfides, or nitrides.
  2. Admixtures for water reduction and setting time modification shall conform to ASTM C494.
  3. Admixtures for use in producing flowing concrete shall conform to ASTM C 1017.
- F. **Curb Ramps**
1. **Curb Portion of Work:** In accordance with the requirements of Sections 202.06 and 800.11 of the DPW Standard Specifications.
  2. **Sidewalk Portion of Work:** In accordance with the requirements of Sections 204.01 and 800.11 of the DPW Standard Specifications.
  3. **Curb Ramp Color:** To obtain the approved permanent dark visual color contrast of 70 percent between the ramp and the adjacent sidewalk, use one of the following approved manufacturers and color types, or approved equal:
    - a. L.M. Scofield "C-24 Charcoal Gray".
    - b. QC Integral Colors "IC-3 Ash Gray".
    - c. Solomon Colors "Charcoal Gray 920".



## PART 3 – EXECUTION

### 3.1 PREPARATION

- A. Preparation and Compaction of Subgrade: In accordance with the requirements of Section 200 of the DPW Standard Specifications.
  - 1. Concrete Base: In accordance with the requirements of Section 207 of the DPW Standard Specifications.
  - 2. Concrete Pavement, Concrete Parking Strip and Concrete Bus Pad: In accordance with the requirements of Section 210 of the DPW Standard Specifications.
  - 3. Concrete Curb: In accordance with the requirements of Section 202 of the DPW Standard Specifications.
  - 4. Combined Concrete Curb and Gutter: In accordance with the requirements of Section 203 of the DPW Standard Specifications.
  - 5. Concrete Sidewalk: In accordance with the requirements of Section 204 of the DPW Standard Specifications.
  - 6. Concrete Curb Ramps
    - a. Curb Portion of Work: In accordance with the requirements of Section 202 of the DPW Standard Specifications.
    - b. Sidewalk Portion of Work: In accordance with the requirements of Section 204 of the DPW Standard Specifications.
- B. Preparation of subgrade to proper grade, excavating, backfilling and compacting will be considered as Incidental Work to the applicable bid items where excavation is required to perform the Work.
- C. Asphalt shaving or grindings will not be used as fill material.
- D. Saw cutting and removal of concrete base, concrete pavement, concrete parking strip, concrete gutter, concrete curb, concrete sidewalk and concrete curb ramps to construct and/or reconstruct curb ramps, and to remove existing curb ramps will be considered as Incidental Work to the applicable bid items where removal of the said items are required to perform the Work.

### 3.2 INSTALLATION

- A. Concrete Installation (All Applications): The Contractor shall install concrete in accordance with proportioning, mixing, transporting, and placing requirements identified in DPW Standard Specification Sections 800.13 and 800.14.
- B. Concrete Base
  - 1. Concrete Base: In accordance with the requirements of Section 207 of the DPW Standard Specifications.
  - 2. Placing Concrete: In accordance with the requirements of Section 207.05 of the DPW Standard Specifications.
  - 3. Construction Joints: In accordance with the requirements of Section 207.06 of the DPW Standard Specifications.
  - 4. Dummy Joints: In accordance with the requirements of Section 207.07 of the DPW Standard Specifications.
  - 5. Protection and Curing: In accordance with the requirements of Section 207.08 of the DPW Standard Specifications.
- C. Concrete Pavement and Concrete Parking Strip
  - 1. Concrete Pavement and Concrete Parking Strip: In accordance with the requirements of Section 210 of the DPW Standard Specifications, except that the thickness for concrete pavement and concrete parking strip will be 8 inches unless otherwise noted.

2. Placing Concrete: In accordance with the requirements of Section 210.05 of the DPW Standard Specifications.
  3. Construction Joints: In accordance with the requirements of Section 210.07 of the DPW Standard Specifications.
  4. Dummy Joints: In accordance with the requirements of Section 210.08 of the DPW Standard Specifications.
  5. Protection and Curing: In accordance with the requirements of Section 210.09 of the DPW Standard Specifications.
- D. Reinforced Concrete Bus Pad
1. Placing Concrete: In accordance with the requirements of Section 210.05 of the DPW Standard Specifications.
  2. Construction Joints: In accordance with the requirements of Section 210.07 of the DPW Standard Specifications.
  3. Dummy Joints: In accordance with the requirements of Section 210.08 of the DPW Standard Specifications.
  4. Protection and Curing: In accordance with the requirements of Section 210.09 of the DPW Standard Specifications.
  5. Reinforced Steel Bars: In accordance with the requirements of Standard Plan 96,607.
    - a. Before placing concrete, reinforcement shall be cleaned of oil, grease, soil, loose mill scale, loose rust, and any other coating of a character that would destroy or reduce the bond.
    - b. Reinforcing bars shall be secured firmly in position. Use No. 16-gauge black annealed wire at each steel intersection. Use precast mortar blocks, metal chairs, spacers, metal hangers, supporting wires, and other approved devices to set steel in position with sufficient strength to resist crushing under full load and to prevent displacement during concrete placing operations.
    - c. Precast Concrete Blocks: Precast concrete blocks shall not be less than 3 inches square with embedded wires and shall have at least the same 28-day compressive strength as the surrounding concrete. Space concrete blocks no less than 1'-6" and no more than 3 feet apart.
    - d. Minimum concrete cover for reinforcement and minimum clear bar spacing shall be as specified on Contract Drawings, but in no case shall be less than values specified in ACI 318.
    - e. Placing bars on layers of fresh concrete as the work progresses, or adjusting bars during the concrete placement, will not be permitted.
    - f. Splicing: In accordance with the "Building Code Requirements for Reinforced Concrete," (ACI 318) of the American Concrete Institute.
    - g. Reinforcement Around Opening: Whenever conduit, piping, sleeves, bolts hangers, boxes or other embedded items interfere with the proper placement of reinforcing steel as detailed, the Contractor shall submit to the City Representative the proposed reinforcement adjustment for review. Reinforcing bars shall not be bent around openings or sleeves, except with the City Representative's prior approval.
    - h. Inspection: No concrete shall be deposited until the Engineer has inspected the reinforcement and given permission to place concrete.
- E. Concrete Curb
1. Concrete Curb: In accordance with the requirements of Section 202 of the DPW Standard Specifications.
  2. Placing Concrete: In accordance with the requirements of Section 202.07 of the DPW Standard Specifications.
  3. Construction Joints: In accordance with the requirements of Section 202.08 of the DPW Standard Specifications.
  4. Finishing: In accordance with the requirements of Section 202.09 of the DPW Standard Specifications.
  5. Protection and Curing: In accordance with the requirements of Section 202.10 of the

- DPW Standard Specifications.
6. Repair and Replacement: In accordance with the requirements of Section 202.12 of the DPW Standard Specifications.
  7. Painting: In accordance with the requirements of Section 202.13 of the DPW Standard Specifications.
- F. Combined Concrete Curb and Gutter
1. Concrete Curb and Gutter: In accordance with the requirements of Section 203 of the DPW Standard Specifications.
  2. Placing Concrete: In accordance with the requirements of Section 202.07 of the DPW Standard Specifications.
  3. Construction Joints: In accordance with the requirements of Sections 210.07 and 210.08 of the DPW Standard Specifications.
  4. Finishing: In accordance with the requirements of Section 202.09 of the DPW Standard Specifications.
  5. Protection and Curing: In accordance with the requirements of Section 202.10 of the DPW Standard Specifications.
  6. Repair and Replacement: In accordance with the requirements of Section 202.12 of the DPW Standard Specifications.
  7. Painting: In accordance with the requirements of Section 202.13 of the DPW Standard Specifications.
- G. Concrete Sidewalk
1. Concrete Sidewalk: In accordance with the requirements of Section 204 of the DPW Standard Specifications.
  2. Placing Concrete: In accordance with the requirements of Section 204.05 of the DPW Standard Specifications.
  3. Joints: In accordance with the requirements of Section 204.07 of the DPW Standard Specifications and Standard Plan 87,173.
  4. Reinforced Steel Bars: In accordance with the requirements of Standard Plan 96,608.
  5. Finishing: In accordance with the requirements of Section 204.06 of the DPW Standard Specifications.
  6. Protection and Curing: In accordance with the requirements of Section 204.09 of the DPW Standard Specifications.
  7. Sidewalk will not be constructed monolithic with curb.
  8. Street Names: In accordance with the requirements of Section 204.08 of the DPW Standard Specifications.
  9. Installation of Reinforced Steel Bars at re-entrant corners on a diagonal: In accordance with the requirements of Standard Plan 96,608.
- H. Concrete Curb Ramps
1. Curb Portion of Work: In accordance with the requirements of Section 202 of the DPW Standard Specifications.
  2. Sidewalk Portion of Work: In accordance with the requirements of Section 204 of the DPW Standard Specifications.
  3. All curb ramps will be poured separately from any adjacent construction such as, gutter, curb or sidewalk.
  4. Curb ramps will be constructed in accordance with the requirements of the DPW Standard Plans.

### 3.3 FIELD QUALITY CONTROL

- A. The Contractor shall perform water tests to satisfactorily demonstrate the proper drainage of the constructed curb and gutter, including curb and gutter at constructed curb ramps. The Contractor shall flush with water approximately 50 feet of the upstream end of each curb and gutter, including curb and gutter at curb ramps, for 2 minutes with a minimum flow rate of 0.02 cubic feet per second or approximately 20 gallons equivalence. After 5 minutes, the City Representative and the Contractor shall make visual inspection of the gutter to demonstrate proper drainage and no ponding. All water tests will be considered Incidental Work.
- B. The Contractor shall make corrections necessary to demonstrate proper drainage with no ponding, and no separate payment will be made. The Contractor's correction method will be approved by the City. The City's approval does not release the Contractor from the successful execution of the remedy and the requirement to demonstrate proper drainage of the constructed curb and gutter work, including curb and gutter at constructed curb ramps.

END OF SECTION

SECTION 32 14 43  
PERMEABLE UNIT PAVING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Permeable unit pavers.
  2. Crushed stone bedding material.
  3. Open-graded base aggregate.
  4. Bedding and joint filler aggregate.
  5. Geotextile.

1.02 RELATED SECTIONS

- A. Section 02 41 00 - Demolition

1.03 REFERENCES

- A. ASTM International (ASTM):
1. ASTM C131: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
  2. ASTM C136/C136M: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  3. ASTM C140: Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
  4. ASTM C33: Specification for Concrete Aggregates
  5. ASTM C936: Standard Specification for Solid Concrete Interlocking Paving Units
  6. ASTM D2940: Standard Specification for Graded Aggregate Material for Bases
  7. ASTM C1781: Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavements Systems

1.04 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Section.
- B. A copy of the Subcontractor's current certificate from the Interlocking Concrete Pavement Institute's Concrete Paver Installer Certification program and job references from three (3) projects of similar size and scope.

- C. Sieve analysis of aggregates for base and bedding materials per ASTM C936. Testing shall be done by independent laboratory with samples taken at the supplier's yard from stockpile to be used for the project. Age of sieve test shall not be any older than one (1) year old.
- D. Permeable Unit Pavers:
1. Manufacturer's product catalog cut sheets with specifications for unit paver type.
  2. Four representative full-size samples of each paver type, thickness, color and finish. Submit samples indicating the range of color expected in the finished installation.
  3. Accepted samples become the standard of acceptance for the work of this section.
  4. Laboratory test reports certifying compliance of manufacturer's concrete pavers with ASTM C 936.
  5. Manufacturer's material safety data sheets for safe handling of the specified materials and products.
  6. Laboratory test reports certifying compliance of anti-slip coefficient requirements per current San Francisco Public Works Order on anti-slip coefficients.
  7. Laboratory test reports certifying
- E. Joint Filler:
1. Manufacturer's product cut sheets with specifications.
  2. Color to match color of pavers.

#### 1.05 QUALITY CONTROL

- A. Installer Qualifications: At least 3 years' successful experience in unit paver projects of similar type and scope.
1. Installers' job foreman on the project shall have a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
  2. Written Method Statement and Quality Control Plan that describes material staging and flow, paving direction and installation procedures, including representative reporting forms that ensure conformance to the project specifications.
- B. Source Limitations: Obtain each type of paver, cementitious material, grout, admixture, accessory, sealant, and other material from a single manufacturer for each product.
- C. Mockup: Before installing pavers, build a mockup to verify aesthetic effects and qualities of materials and execution. Build mockup to comply with the following requirements, using materials indicated for the completed Work, including same base construction, special features for expansion joints, and contiguous work as indicated:
1. Construct in the location approved by the City Representative.
  2. Size: Approximately 8-foot square and that will include their interface with adjacent concrete gutter and recycled granite curbs.

3. Notify City Representative 5 working days in advance of dates and times when mockup will be constructed.
  4. Obtain approval by City Representative of mockup before starting unit paver installation.
  5. The City Representative may require minor modifications to be made to the mockup. Revised mockup shall be provided at no additional cost to the City. Contractor shall allow for up to two modifications in the Contract.
  6. Maintain approved mockup during construction in an undisturbed condition as a standard for judging the completed Work.
  7. Demolish and remove mockup after verification of compliance with completed work by City Representative.
  8. If constructed as part of completed installation, approved mockup in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.
  9. Comply with additional requirements of Section 01 43 39 "Mockup Requirements."
- D. Post-Construction Infiltration Testing: Perform surface infiltration tests per ASTM C1781 as described below:
1. Three (3) test locations of permeable unit pavers in place. Locations shall be spread out and at different cut-outs in the gutter.
  2. Acceptance
    - a. The surface elevation of pavers shall be 1/8 to 1/4 inch (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.
    - b. Lippage: No greater than 1/8 inch difference in height between adjacent pavers.
    - c. The final surface tolerance of compacted pavers shall not deviate more than  $\pm 3/8$  inch (10 mm) under a 10-foot (3 m) long straightedge.
    - d. Infiltration Rate: The average of all tests shall be greater than 50 inches per hour with no single test less than 25 inches per hour.

#### 1.06 DELIVERY, STORAGE, HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged container packaging with identification tags intact on each paver bundle. Bundles or cubes shall be capable of transfer by forklift or clamp lift.
- B. Stack pavers on timber or platforms at least 4-inches above the ground. Place polyethylene or other suitable plastic film between wood and pavers, and as an overall protective film when on-site storage of units exceeds 7 days.
- C. Carefully handle paver units so as to prevent chipping, scratching, or cracking. Units damaged prior to installation shall be removed from the site and replaced.
- D. Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials.
- E. Cover sand and topsoil with waterproof covering to prevent exposure to rainfall or removal by wind. Secure the covering in place.
- F. Comply with applicable requirements specified in Section 01 60 00 "Product Requirements."

1.07 FIELD CONDITIONS

- A. Field-verify critical dimensions for proper placement of pavers prior to delivery to the Project site. Notify the City Representative of unsatisfactory conditions prior to proceeding.
- B. Ambient Conditions: Do not install in rain or wet conditions.
- C. Protection of Installation Area:
  - 1. Prevent sediment from entering the excavated area where pavers will be installed.
  - 2. Protect the installation area from sediment due to construction materials and construction traffic.

1.08 COORIDNATION OF WORK

- A. Coordinate with work under other Sections to obtain neat, workmanlike finished result. Deliver materials to site on time to avoid delays in construction progress.

1.09 MAINTENANCE

- A. Extra materials: Provide 10% additional materials to City for maintenance and repair. This material shall be from the same production run as the installed materials.

PART 2 - PRODUCTS

2.01 PERMEABLE UNIT PAVERS

- A. Manufacturer: Pacific Interlock Pavers or approved equal.  
 Product: HydroFlo pavers City Estate w/ Microchamfer; or approved equal.  
 Dimensions: 12"x 6" x 3 1/8"  
 Pattern: Soldier Course border w/ Running Bond per drawings.  
 Joint Type and Size: 1/16" – 1/8" wide w/ fine aggregate swept into joint openings.

2.02 JOINT FILLER

- A. ASTM C33 Fine Aggregate Joint Filler.
- B. A small fraction of ASTM C33 fine aggregate or equivalent shall be swept into joints and openings until it is within 1/2" from the top surface.
- C. Grading Requirements:

Sieve	Percent
9.5 mm (3/8 inch)	100
4.75 mm (No. 4)	95 to 100
2.36 mm (No. 8)	80 to 100
1.18 mm (No. 16)	50 to 85
600 μm (No. 30)	25 to 60
300 μm (No. 50)	5 to 30
150 μm (No. 100)	0 to 10



## 2.03 GRAVEL LEVELING COURSE

- A. ASTM No. 8 Leveling Course or Bedding Aggregate
- B. Depth per drawings.
- C. Grading Requirements

Sieve	Percent
12.5 mm (1/2 inch)	100
9.5 mm (3/8 inch)	85 to 100
4.75 mm (No. 4)	10 to 30
2.36 mm (No. 8)	0 to 10
1.18 mm (No. 16)	0 to 5

## 2.04 GRAVEL BASE COURSE

- A. ASTM No. 57 Gravel Base Course or Base Aggregate
- B. Depth per drawings
- C. Grading Requirements

Sieve	Percent
37.5 mm (1-1/2 inches)	100
25 mm (1 inch)	95 to 100
12.5 mm (1/2 inch)	25 to 60
4.75 mm (No. 4)	0 to 10
2.36 mm (No. 8)	0 to 5

## 2.05 GRAVEL RESERVOIR COURSE

- A. ASTM NO. 2, 3 OR 57 Gravel Reservoir Course or Subbase Aggregate
- B. Depth per Drawings
- C. Grading Requirements

Sieve	Percent
75 mm (3 inches)	100
63 mm (2 1/2 inch)	90 to 100
50 mm (2 inch)	35 to 70
37.5 mm (1-1/2 inches)	0 to 15
19 mm (3/4 inch)	0 to 5

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

- A. Verify that subgrade preparation, compaction, density, permeability, and elevations conform to specified requirements. Do not proceed with installation of geotextile and subbase aggregate until subgrade soil conditions are corrected.
- B. Compaction of subgrade to be 90% standard Proctor density for open-graded aggregate bases. Density should be monitored in the field with a nuclear density gauge. Compaction of open-graded bases should be with at least five passes of roller compactor without vibration. Stabilization of the soil and/or base material may be necessary with weak or saturated soils.
- C. Verify location, type, and elevations of edge restraints, utility structures, and drainage pipes and inlets.
- D. Verify that the soil subgrade is free from standing water prior to starting work.

**3.02 INSTALLATION****A. Subgrade Preparation and Protection**

- 1. Compact subgrade to 90% per Proctor test (ASTM D698) or as directed by City Representative.
- 2. Proof-roll prepared subgrade with loaded dump truck, remove soft spots, and replace with permeable structural fill as directed by City Representative to achieve uniform subgrade.
- 3. After compaction and proof roll, scarify subgrade  $\frac{1}{4}$  to  $\frac{1}{2}$  inch deep by hand rack. Once scarified, materials or equipment shall not be permitted within the prepared subgrade area so as to avoid recompacting or clogging of the scarified subgrade.
- 4. The subgrade shall be protected from over-compaction or contamination by silty run-off or other contaminants.
  - a. Provide physical barriers to parking or direct traffic to eliminate unnecessary vehicular traffic on the subgrade during construction in accordance with SFDPW ordinances and specifications.
  - b. Provide flow diversion and erosion control measures to protect the permeable paver areas from sedimentation until the upstream catchment area is thoroughly stabilized.
- 5. Areas of subgrade over-compacted by construction traffic or other impacts by the Contractor or Subcontractors shall be ripped/tilled and re-compacted in accordance with Section 3.01.D. All work and materials required to correct the over-compacted subgrade, including utility locates within the pavement footprint, shall be at the Contractor's expense.
- 6. Areas of subgrade contamination by the accumulation of silty material following rains or other debris or contamination shall be removed and disposed at the Contractor's expense.
- 7. The subgrade shall be inspected and accepted by the City Representative prior to placement of the geotextile or pavement base.

8. Place on bottom and sides of soil subgrade and concrete curb in accordance with manufacturer's recommendations.
9. Place geotextile, per manufacturer's recommendation on scarified subgrade. Care shall be taken to provide full coverage and to prevent the geotextile from being torn. Damaged geotextile shall be repaired as indicated by the manufacturer and to the satisfaction of the Engineer, at no additional cost to the Owner. Overlaps of the geotextile shall be a minimum of 1 foot or to the manufacturer's recommendation, whichever is greater.
10. Secure in place to prevent wrinkling from vehicle tires and tracks prior to installation of subbase.
11. Overlap a minimum of 12 inches in the direction of drainage.

B. Paver Base:

1. Moisten, spread and compact the specified aggregate subbase in maximum 8 inch lifts without wrinkling or folding the geotextile.
2. Place subbase to protect geotextile from wrinkling under equipment tires and tracks.
3. For each lift, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 8 ton vibratory roller until there is no visible movement of aggregate. Do not crush aggregate with the roller.
4. Use a minimum 13,500 pound-force vibratory plate compactor to compact aggregate that cannot be reached by the vibratory roller compactor.
5. The surface tolerance of the compacted subbase shall be plus or minus 2-1/2 inches) over a 10-foot straightedge.

C. Edge Restraints: Where shown, install in accordance with the Drawings at the indicated elevations on the compacted subbase.

D. Leveling Course:

1. Moisten, spread and screed the gravel bedding material. Fill voids left by removed screed rail.
2. The surface tolerance of the screeded leveling layer shall be plus or minus 3/8 inch) over a 10 foot straightedge.
3. Do not subject screeded leveling material to pedestrian traffic before paving unit installation begins.

E. Concrete Paving Units

1. Lay the paving units in the pattern and joint widths shown on the Drawings. Maintain straight joint lines.
2. Fill gaps at the edges of the paved area with cut units.
3. Cut pavers and place along the edges with a double-bladed splitter or masonry saw.

## F. Jointing Aggregate

1. Fill the openings and joints with specified aggregate. The specified aggregate shall be swept into joints and openings until it is within 1/2" from the top surface
  2. Remove excess aggregate on the surface by sweeping pavers clean.
    - a. Compact and seat the pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 7,000 pound-force centrifugal compaction force.
  3. This will require at least two passes with the plate compactor.
  4. Do not compact within 6 feet of the unrestrained edges of the paving units.
    - a. Apply additional aggregate to the openings and joints if needed, filling them completely.
  5. Remove excess aggregate from the paving unit surface by sweeping, and then compact the pavers again. This will require at least two passes with the plate compactor.
  6. Pavers within 6 feet of the laying face shall be left fully compacted at the completion of each day.
- G. Do not allow construction traffic on the surface until the jointing aggregate has been placed and vibrated into the joints, and debris and excess material has been swept off.

## 3.03 FIELD QUALITY CONTROL

## A. Installation Tolerances:

1. The final surface tolerance of compacted pavers shall not deviate more than plus or minus 3/8 inch under a 10-foot-long straightedge.
  2. Lippage among adjacent paver surfaces shall not exceed 1/8 inch.
- B. Areas not meeting the specified tolerances shall be removed, adjustments made, and the paving units reinstated with new bedding and jointing aggregates.

## 3.04 PROTECTION

- A. Completed paver installation shall not be used as storage areas or for passage of construction traffic not related to the paver installation.

## 3.05 MAINTENANCE

- A. The Contractor shall have its installer return to site after 6 months from the completion of the work and provide the following as required:
1. Replace broken or cracked pavers/
  2. Re-level settled pavers to initial elevations.
  3. Any additional work shall be considered part of original Contract and with no additional cost to City.
- B. Provide one 4-hour training session to City's operation and maintenance staff within 6 months of completion of the work.

1. The training shall cover industry best practices on the following:
  - a. Surface infiltration testing.
  - b. Surface cleaning.
  - c. Removing broken pavers.
  - d. Replacing and re-leveling pavers.
  
- C. Contractor shall provide a minimum of 10 workday notification to City Representative prior to the date set for training sessions.

END OF SECTION



## SECTION 32 17 53

## ADJUSTMENT OF FRAMES AND CASTINGS

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. This Section includes provisions for resetting existing and castings to finished grade after resurfacing work.

## 1.2 CITY-OWNED FRAMES AND CASTINGS

- A. City-owned street frames and castings are facilities of City departments, which include, but are not limited to, the following:
  - 1. Department of Public Works
  - 2. Department of Electricity
  - 3. Police Department
  - 4. Fire Department
  - 5. San Francisco Public Utility Commission
  - 6. Municipal Transportation Agency.
  - 7. Department of Technology

- B. Adjustment of City-owned frames and castings will be paid per the applicable bid items. If no such bid items exist, the Work is considered incidental to the reconstruction work.

## 1.3 NON-GOVERNMENTALLY-OWNED FRAMES AND CASTINGS

- A. Non-governmentally-owned include, but not limited to, the following companies:
  - 1. Pacific Gas and Electric Company
  - 2. AT&T
  - 3. Comcast
- B. All frames and castings shall be identified for the owners and made accessible immediately after paving operations.
- C. The Contractor shall notify utility companies of completion of asphalt paving work within one week.
- D. Copies of notifications to utility companies shall be submitted to the City Representative.

## 1.4 REFERENCE STANDARDS

- A. DPW Standard Specifications (SSDPWSF), revised November, 2000.
- B. DPW Standard Plans, dated April, 2007.
- C. San Francisco Water Department Standard Drawings.

## 1.5 PERFORMANCE QUALITY CONTROL

- A. For San Francisco Water Department (SFWD) facilities, all adjusted or reconstructed valve box covers shall not rattle, and shall be flushed with the finished pavement grade. The valve box covers shall be free of excess asphalt or other material covering the perimeters of the covers. After the paving work, the Contractor shall check to make sure that valve box covers are easily removable from the valve box.

- B. The Contractor shall be fully liable for any accidents created by valve box covers installed by the Contractor until the installation is accepted by SFWD inspectors.
- C. The SFWD will remove the valve box covers and check the operability of the valve. The Contractor shall remove all materials that have fallen into the valve box due to the Contractor's operations, to the satisfaction of the SFWD inspector.

#### 1.6 COST FOR PRIVATELY OWNED ITEMS

- A. The Contractor shall be responsible for negotiating an agreement for payment with the owner(s) of privately owned manhole covers, frames and castings to be adjusted to finished grades.

### PART 2 - PRODUCTS

#### 2.1 SFWD MATERIALS

- A. The SFWD will provide, at no cost to the Contractor, adjusting rings for resetting SFWD valve box covers, pipe risers and base plates for valve box reconstruction. The Contractor shall provide all other materials. After determining the quantities of each type of adjusting rings (1", 1-1/2", 2"), pipe risers and base plates, the Contractor shall make the material request to the SFWD inspector. The Contractor shall pick up the materials to be furnished by SFWD from the SFWD Yard per the quantities approved by the SFWD inspector.

### PART 3 - EXECUTION

#### 3.1 SPECIAL INSTRUCTIONS

- A. Existing SFWD and San Francisco Fire Department (SFFD) valves shall be made accessible at all times.

#### 3.2 INSTALLATION

- A. Contractor shall adjust City-owned frames and castings no later than one week after completing asphalt paving work on a block or intersection.
- B. The final layer of asphalt concrete shall be placed around each City-owned casting no later than two (2) calendar days after said casting has been adjusted and concrete has been placed.
- C. The adjustment of manhole frames and other castings shall be in accordance with the requirements of Section 217 of the DPW Standard Specifications.

#### 3.3 SFWD VALVE BOX COVERS ADJUSTMENT (6", 8", 12" AND 16")

- A. Before any asphalt concrete grinding operations, the Contractor shall identify all valve box covers by marking from nearby reference points like curbs, sidewalks, or other street furniture, but not by marking on the street surface to be grinded. SFWD inspectors will mark the locations of valve box covers that had been paved over. The Contractor shall pay special attention to all identified valve box covers during grinding to avoid damaging these SFWD facilities.
- B. Grinding machines will not be allowed to be closer than one foot from the edge of these covers. Asphalt concrete surrounding a valve box cover will be removed by hand.



- C. The Contractor shall reconstruct the surrounding asphalt concrete edge prior to resurfacing the rest of the asphalt concrete wearing surface.
- D. The Contractor shall take necessary precautions to prevent grindings or new asphalt from falling into SFWD valve boxes during these operations.
- E. Grinding the top of the valve box during the cold planing is absolutely prohibited.
- F. The Contractor shall reconstruct the valve box as described below under Article "SFWD valve box reconstruction", at the Contractor's cost if the valve box be ground at the top.
- G. The placement of steel rings on SFWD-owned castings will be performed during the paving operation, except when it is necessary to reconstruct as described below under Article "SFWD valve box reconstruction".
- H. A maximum of two (2) steel rings may be used for adjustment of SFWD castings to grade during paving operation. Any SFWD-owned casting, which cannot be satisfactorily adjusted by using no more than two (2) steel rings will require reconstruction as described below under Article "SFWD valve box reconstruction".

#### 3.4 SFWD VALVE BOX RECONSTRUCTION (6", 8", 12" AND 16")

- A. During construction or repair of the concrete base, or when the cover adjustment cannot be done with two (2) rings, the Contractor shall remove valve box assemblies. The Contractor shall obtain from SFWD, materials for reconstructing the new valve box assemblies, including pipe risers and base plates. The Contractor shall cut the pipe to length according to field conditions, install the base plate, cover the plate with asphalt or concrete as appropriate, and set the pipe riser, ensuring that its cover is flush with the finished pavement grade.

#### 3.5 SFWD CASTINGS LARGER THAN 16"

- A. The Contractor shall notify the SFWD inspector of any SFWD castings that are larger than 16", and submit proposed adjustment method for approval.

END OF SECTION



## SECTION 32 90 00

## PLANTING

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. Provide all material, labor, equipment, and service necessary for the furnishing and installation of all required landscape planting as shown on the Drawings and as specified herein. The work of this Section includes but is not limited to:
1. Preparation of planting areas and tree pits
  2. Placement of amended backfill, soil mix and fertilizers and mulch
  3. Submittals
  4. Drainage test in tree pits
  5. Tree planting & staking
  6. Pre-Maintenance Inspection
  7. Weed Barrier Fabric
  8. Final inspection and acceptance
  9. Acceptance & Approval for 1095 Day Maintenance Period
  10. Warranty replacement

## 1.02 RELATED SECTIONS

- A. Section 02 41 00 – Demolition
- B. Section 32 01 90 – Landscape Maintenance
- C. Section 32 91 19 – Planting Preparation
- D. Standard Specifications, Department Of Public Works, Bureau Of Engineering, Section 1007.

## 1.03 REFERENCE STANDARDS

Comply with the Applicable Provisions of the following:

- A. FS 0-F-241 - Fertilizers, Mixed, Commercial.
- B. ANSI Z60.1 - Nursery Stock.
- C. Plant Material Standards: "American Standard for Nursery Stock", 1981 Edition, and American Association of Nurserymen.
- D. STANDARD SPECIFICATIONS (DPWSS), City and County of San Francisco, Department of Public Works, 1986. Section 1007-Planting, 1008-Maintenance and Plant Establishment.
- E. GUIDELINE SPECIFICATIONS FOR NURSERY TREE QUALITY, copyright Brian Kempf, 2011. Urban Tree Foundation, [www.urbantree.org](http://www.urbantree.org).
- F. "Tree Planting Guidelines", Bureau of Street-Use and Mapping, Department of Public Works, 415-554-6700.

## 1.04 QUALITY ASSURANCE

- A. Testing Laboratory: Recognized local laboratory for soil and plant disease analysis of ornamental horticulture, approved by the City Representative. Testing laboratory is to perform all work in accordance with the current methods of the Association of Agricultural Chemists.
- B. Nurseries: See Qualifications 1.05.
- C. All plant material shall comply with federal and state laws requiring inspection for plant diseases and pest infestations. Inspection certificate required by law shall accompany each shipment of plants. Clearance from the county agricultural commissioner, as required by law, shall be obtained before planting trees delivered from outside the county in which they are to be planted.
- D. All plant material species and size listed on the drawings to be reserved for the project or grown by a contract growing service which will guarantee procurement of healthy, uniformly, sized trees and shrubs with timely delivery available to the Contractor. Within 30 days of Award of Contract, Contractor shall submit copy of Purchase Order Agreement/Contract Grow Agreement stating the nurseries and species of plant material with sizes to be grown and date of delivery to the job site. An extra 10% shall be grown per species to allow for replacement.
- E. Before delivery contact City Representative twenty days in advance of plant delivery to site. All nursery stock shall be available for inspection at a nursery located within fifty road miles from San Francisco's City Hall. If not available within this area, all additional expenses for transportation, board and lodging resulting from City Representative's inspection shall be borne by the Contractor.

#### 1.05 QUALIFICATIONS

- A. Nurseries: Companies specializing in growing and cultivating and transporting of trees, palms, shrubs and succulents with five years minimum documented experience comparable to:
  - 1. Valley Crest Tree Company: Sunol, CA 925-862-2485
  - 2. Pacific Nursery: Colma, CA 650-755-2330
  - 3. The Palm Broker: San Francisco, CA 415-626-7256
  - 4. Boething Treeland, Portola Valley, CA 650-851-4770
- B. All trees shall comply with Federal and State laws requiring inspection for plant diseases and pest infestations. Inspection certificate required by law shall accompany each shipment of plants. Clearance from the county agricultural commissioner, as required by law, shall be obtained before planting trees delivered from outside the county in which they are to be planted.
- C. Any tree pruning shall only be performed by a licensed arborist.
- D. Landscape Contractor shall have a valid C-27 Landscaping Contractor's license.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under STANDARD SPECIFICATIONS, Department of Public Works, Bureau of Engineering, Section 1007.

- B. The Contractor is required to coordinate all delivery of planting material with planting installation. A written schedule shall be submitted for review and acceptance as part of the submittal package.
- C. Contractor shall notify City Representative of tree delivery 21 days prior to delivery of trees.

#### 1.07 SUBMITTALS

- A. General: Submittals to be in accordance with the requirements of Section 01 33 00
- B. Samples: Submit the following:
  - 1. Mulch – one quart
  - 2. Decomposed granite- one quart
  - 3. Amended Planting Soil-One quart with soil testing information
  - 4. Paint color for tree staking system
- C. Product Data: Submit the following product information to the City Representative for acceptance and approval:
  - 1. Imported Planting Soil: Soil Testing Information
  - 2. Tree Stakes: Manufacturer's literature.
  - 3. Rubber Tree Ties
- D. Test Reports: In accordance with Section 32 91 19 – Planting Preparation
- E. Photographs of each plant species per variety and size shall be submitted for review as part of the Purchase Order/Contract Grow Agreement document. Photographs shall be submitted at start of Contract Grow and every 6 months thereafter until time of planting. Data including height, width and caliper size shall be submitted.

#### 1.08 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies and the San Francisco Department of the Environment, for fertilizer and pre-emergent herbicide composition.
- B. Plant Materials: Certified by federal and state codes. Described by ASTM Z60.1; free of disease or hazardous insects.

#### 1.09 ENVIRONMENTAL REQUIREMENTS

- A. Do not install plants when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.
- B. Do not install plants when wind exceeds 30 mph.
- C. Provide drainage test in tree pits as directed by City Representative prior to backfilling.
  - 1. Test for drainage by filling areas with six inches of water. Standing water after 12 hours indicates drainage deficiencies. Provide remedial measures to correct deficiencies by constructing in each area six 4-inch diameter by 12 inch drain hole, using perforated PVC pipe, filled with coarse sand and wrapped with filter fabric. Retest for drainage rate under the direction of the City Representative.
  - 2. Report in writing to the City Representative all areas not passing these tests, and all soil conditions the Contractor considers detrimental to growth of plant material. State condition, and proposal and cost estimate for correcting the condition beyond remedial measure. Obtain the City Representative's instructions prior to proceeding with the work affected.

3. Failure to perform drainage tests and to notify the City Representative in writing of the conditions specified above, renders the Contractor responsible for all plant failure that occurs as a result of inadequate drainage or detrimental soil conditions, as determined by the City Representative.

#### 1.10 COORDINATION

- A. Coordinate with irrigation system installation.
- B. Drainage Test:
- C. Fill pit with 152 mm (6 inches) water. Record drainage rate after one hour and 4 hours. If water remains after 4 hours, construct up to six 102 mm (4 inch) diameter by 300 mm (12 inch) deep drain holes and fill with 6 inches of water. If water drains after 4 hours, fill with coarse sand, and cover with filter fabric. Supply quantity of drain holes as directed by the City Representative.

#### 1.11 WARRANTY

- A. General: Become familiar with the anticipated growing conditions prior to commencement of work. Notify the Engineer immediately in writing of any conditions which will prevent the proper execution of the warranty responsibilities specified. Failure to notify the City Representative constitutes acceptance of the growing conditions. Any removal, repair or replacement of plant material required for unsuitable conditions found after work has begun shall be done at no additional cost to the City.
- B. Requirements:
  1. Plant Material: Warrant that all plant material under this Contract will be vigorous, healthy, free of dead or dying branches and branch tips, bearing foliage of normal density and color, and will otherwise comply with the Specifications noted in the Products Section of this Section, for a period of one year from date of final acceptance. Any delay in completion of planting operations which extends the planting into more than one growing season shall extend the warranty period correspondingly.
  2. Replacements: Without cost to the City, in a timely manner and as directed by the City Representative, replace all plants not meeting the requirements above during and at the end of the warranty period. Replacements shall closely match adjacent specimens of the same species in size and shall comply with all requirements of these Specifications.

### PART 2 PRODUCTS

#### 2.01 PLANTS

- A. General: Plants shall be nursery and/or field grown in accordance with good horticultural practices under climatic conditions similar to those of Contract for at least ten months as per Contract growing agreement.
- B. Acclimatization: : Plant material shall be properly acclimated and conditioned, in accordance with good horticultural practices, for the exposure, wind and humidity levels, soil and other conditions, occurring at the Contract site and in the proposed plant locations..
- C. Coordination: The Contractor shall coordinate his acclimatization schedule with the City Representative to allow an adequate conditioning period for the plant material prior to the

approved date of plant installation. Notify the City Representative in writing prior to proceeding with any acclimatization work if approved work schedule allows insufficient time to acclimate the material.

- D. Quality: Plants shall be superior in form, compactness and symmetry, sound, healthy vigorous, well branched and densely foliated when in leaf; free of disease, insect pests, eggs or larvae, and free from physical damage or adverse conditions that would prevent thriving growth.
- E. Size: See Drawings for height, canopy size and caliper dimensions.
- F. Species: All plant material shall be pre-selected and identified by tagging as specified herein prior to delivery to the site. Replace all plant material, determined by the City Representative within two years following the final acceptance of the Contract, to be untrue to the species, clone and/or variety specified, to the equal condition of adjacent plants at the time of replacement, at no additional cost to the City.
- G. Root ball:
  - 1. Sizes: As specified on the plans. Where no root ball dimensions have been specified, supply material in container sizes specified.
  - 2. Root Pruning: Where root pruning is required to provide material of the specified size, such pruning is to be done under the direction of an inspector as approved by the City Representative. No root pruning is to be done within one year of installation unless approved by the City Representative.
- I. Pre-selected Plant Material: Plant material that has been reviewed and selected at place of growth by the City Representative does not constitute waiver of the requirements of this Section, nor does it waive the Contractor's warranty responsibilities as stated herein. The Contractor does not have the option to substitute for pre-selected material, unless such pre-selected material is rejected by the City Representative during the course of the work.
- J. Do all work necessary to bring and maintain material in conformance with the requirements of this Section.

## 2.02 PLANTING PIT BACK FILL

- A. General: See same Section 32 91 19 – Planting Preparation for import soil used a planting-trench backfill and planting-pit backfill.

## 2.03 SOIL ADDITIVES

- A. General:
  - 1. Refer to Section Section 32 91 19 – Planting Preparation
  - 2. Refer to Standard Specifications, Department Of Public Works, Bureau Of Engineering, Section 1007.04: Soil Amendment.

## 2.04 FERTILIZERS AND AMENDMENTS

- A. Refer to Section 32 91 19 – Planting Preparation.

## 2.05 MATERIALS

- A. General: All materials supplied shall be free of deleterious and extraneous substances, including contaminants detrimental to plant growth, such as excess salts, boron, solvents, etc.

- B. Mulches:
1. Gravel mulch: Crushed 3/8" inch diameter crushed Felton gold rock mulch, as available from Lyngso Garden Supply, Redwood City, CA (415) 364-1730; or American Soil Products Inc, Berkeley, CA 94710, (510) 540-8011; or equal.
  2. Decomposed granite at tree wells: Crushed 1/4" max to dense graded Felton gold with stabilizer, 3" deep min. Compacted to 80%, as available from Lyngso Garden Supply, Redwood City, CA (415) 364-1730; or American Soil Products Inc, Berkeley, CA 94710, (510) 540-8011; or equal.
  3. Drain Rock: Drain rock shall be 1/2" open graded crushed rock with no fines.
- C. Water: Clean, potable and free of deleterious matter. Source, in accordance with regulations and codes governing water conservation measures for the City.
- D. Pre-Emergent Herbicide: Refer to Standard Specifications, Department Of Public Works, Bureau Of Engineering, Section 1007.02: Soil Sterilization.
- E. Tree Paint: "Tree Seal" by Morrison; "Flexiblac 3230" as manufactured by Samuel Cabot, Inc., Boston, Mass.; Ortho "Pruning Seal"; or equal.
- F. Anti-Desiccant: Type as approved by the City Representative. Use for preventing excessive loss of plant moisture and inhibiting wilt; sprayable, water insoluble vinyl-vinylethylene complex which will produce a moisture retarding barrier. Film formed shall have a mvt (moisture vapor transmission rate) of not more than 10 grams per 24 hours at 70 percent humidity. Contractor to furnish information with submittal that the material can be used safely on plant materials specified and obtain approval prior to use.
- G. Tree Staking at Tree wells:
- a. Ties: Corded rubber type, with a broad smooth surface in contact with the tree.
  - b. Stakes: 3-inch diameter by 12-feet long, pointed at one end, copper naphthanate treated wood painted black. Provide four (3) minimum per tree.
  - c. Staking System: Tie sleeves, cross brace sleeves, and cross brace: GS300. 2.95" ID four stake system:  
Available from:  
Green Sleeves  
1206 18th Street  
San Francisco, CA 94107  
(415) 863-9880 Voice  
(415) 861-5228 Fax  
info@greensleeves.com

## PART 3 EXECUTION

### 3.01 FIELD QUALITY CONTROL

- A. Landscape Pre-Construction Conference: Request in writing a pre-construction conference with the City Representative at least 7 days before beginning work under this Section. Purpose of this conference is to review questions Contractor may have regarding the work and administrative procedures during construction and Contract work schedule.



- B. Progress Observations: In addition to the installation observations specified below, periodic progress observations will be made by the City Representative.
- C. Installation Observations: Specifically request the following observations:
  - 1. Observation of plant pits.
  - 2. Observation of planter back fill and finish grading prior to planting.
  - 3. Observation of plant material upon delivery to the site.
  - 4. Observation of layout and placement of plant material at time of planting.

### 3.02 ORDERING REVIEW AND ACCEPTANCE OF PLANT MATERIAL

- A. Ordering:
  - 1. Within 30 days after award of Contract, submit written certification to the City Representative of the quantity and species of plant material ordered, and the nurseries supplying the material.
  - 2. The Contractor is responsible for providing all plant material in the quantities and sizes specified on the Drawings, and for making all arrangements in advances per terms of the Contract growing requirements.
- B. Review and Rejection of Plant Material: Submit written request for review of plant material at least 10 days prior to commencement of planting operations. Review by the City Representative does not waive the City Representative 's right of rejection during planting or any time thereafter.
- C. Pre-selected Material: All plant material shall be tagged at the place of growth by the City Representative. All such material shall be governed by the requirements set forth herein and such pre-selection does not constitute waiver of these requirements.
- D. Rejection of Material: The City Representative reserves the right to review and reject plant material at any time, and at the place of growth, for non conformance to the Drawings and Specifications. Do not install plant material which has not been reviewed at the Contract site by the City Representative.

### 3.03 HANDLING OF PLANT MATERIAL

- A. General: Do not bind or handle any plant in such a way that would result in damage to the plant material. Lift and handle plants only from bottom of root ball.
- B. Access: The Contractor shall be responsible for accessing and installing all plant material at the job site. The Contractor shall inspect the job site and become familiar with all requirements and restrictions. Plant material shall be carefully bound with saran, burlap or other lightweight fabric as required allowing access. Care should be exercised to prevent damage or breakage to limbs; and ropes or other lines should not be allowed to damage bark. At the time of submitting bid, the Contractor shall notify the City Representative in writing, of any conditions that would prevent the accessing and installation of the specified plant material.
- C. Plants: Maintain all plant material in a healthy growing condition prior to and during planting operations. Protect plants at all times from sun and drying winds. Plants are to be planted within two days of delivery to site. Plants that cannot be installed on this work schedule shall be returned to the grower until installation requirements can be met.
- D. Container Stock:
  - 1. General: Do not lift or handle container plants by tops, stems, or trunks at any time.

2. Boxed Stock: Remove bottom of box prior to placement of plant in planting pit. Cut bands and remove box sides just prior to backfilling.

### 3.04 LAYOUT OF PLANT MATERIAL

- A. General: The City Representative will review for conformance to the design intent of the Contract Documents, the locations of all plants in the field prior to planting. Notify the City Representative and schedule layout review sufficiently in advance of planting to allow for review and adjustment without disrupting construction schedule.
- A. Trees: The City Representative will review locations of trees in the field, after trees are delivered to the site, but before placement and positioning. After placement of trees in approved locations, but before final planting, notify City Representative to review final positioning of trees.
- C. Other Plant Material: Layout all other plant material with lath stakes or otherwise and obtain approval from Engineer prior to installation.
- D. Adjustments: The City Representative reserves the right to make minor adjustments in the layout of all plant material; the Contractor is to adjust irrigation system as necessary to accommodate all adjustments.

### 3.05 EXCAVATION OF PLANTING PITS

- A. General: Excavate plant pits by hand. **USE OF AUGERS AND/OR BACKHOE IS PROHIBITED.** Prior to planting and back fill, scarify the sides and bottom of the pit as required to eliminate any glazed surfaces. Excavate plant pit as shown on the Drawings.
- B. Obstructions: If rocks, underground construction work, tree roots or other unknown obstructions are encountered in the excavation of plant holes the Contractor shall report all such conditions in writing to the City Representative. Where locations cannot be changed, submit a written proposal and cost estimate for removing the obstructions to a depth of not less than 6 inches below the required hole depth. Obtain the City Representative's instructions prior to proceeding.
- C. The Contractor is to become familiar with all scheduling requirements concerning: plant pit excavation and plant material delivery.

### 3.06 DETRIMENTAL SOILS AND DRAINAGE

- A. General: Prior to planting, test drain all planting areas as follows:
  1. All Plant Pits: Fill with twelve inches of water. Water should drain completely in 48 hours.
  2. Plant Beds: Irrigate until soil is saturated. Saturated condition should not remain after 24 hours.
- B. Failure of Drainage Test:
  1. Report in writing to the City Representative all areas not passing these tests, and all soil conditions that the Contractor considers detrimental to growth of plant material.
  2. In all cases the Contractor is to consult with a horticulturist under the direction of the City Representative.
  3. The Contractor is to use recommendations as provided by the City Representative and make a proposal that states condition, and cost estimate for correcting the unsatisfactory conditions.
  4. Obtain the City Representative's instructions prior to proceeding with the work.

5. Re-test after correction have been made under the direction of the City Representative.
6. Failure to perform drainage tests, and/or to notify the City Representative in writing of the conditions specified above, renders the Contractor responsible for all plant failure that occurs as a result of inadequate drainage or detrimental soil conditions, as determined by the City Representative.

### 3.07 PLANTING OPERATIONS

- A. General: Do not plant under unfavorable weather conditions.
- B. Boxed Plant Material: After removing plants from their containers, disentangle any small roots that encircle the container. Do not cut or otherwise disturb the root ball. Inspect all plants for root bound condition; do not install root bound plants, or plants found to have cracked or broken root balls when taken from the container. All root-balls of plant material shall be inspected and approved by the City Representative prior to installation.
- C. Backfill for boxed plant material:
  1. Scarify the bottom and sides of the tree pit. Place back fill amended or otherwise to an elevation as shown on the Drawings to support the root-ball and then flood the pit with water to settle the soil. Set the tree in the pit on firm and compacted soil.
  2. After setting the tree, place back fill soil, tamping and settling one foot lifts. Do not use muddy soil for back-filling.
  3. Place fertilizer tablets evenly distributed in plant pit when back fill operation is 2/3 full as follows: 6 tablets for 24 inch box sized material and 8 tablets for a 36 inch box sized material.
  4. The crowns of plants shall be set at a minimum height of 1 1/2 inch as required to account for any settling. The crown of tree shall remain above finish grade after any adjustments have been made.
  5. Watering: Thoroughly water all plants immediately after planting, taking care to avoid erosion.

### 3.08 PRUNING

- A. Boxed plant material:
  1. Prune plants only at the direction of the City Representative and/or a licensed arborist and according to reference standards to preserve the natural character of the plant.
  2. Remove all dead wood, suckers and broken or badly bruised branches.
  3. Remove sucker basal and lateral growth to prevent re-sprouting; retain normal side branching. Use only disinfected, sharp tools.
  4. Improperly pruned trees will be subject to rejection by the City Representative.
  5. Apply tree seal to cuts over 1 inch diameter in accordance with manufacturer's instructions.

### 3.09 WARRANTY

- A. Provide warranty for healthy, vigorous trees and all other plants beginning from time installation until Final Acceptance date.
- B. Replacements: Trees as specified, planted in the next growing season, with a new warranty commencing on the date of replacement.

END OF SECTION



SECTION 32 91 13  
STRUCTURAL SOIL

PART 1 - GENERAL

**1.1 SUMMARY**

- A. The specifications provided in this section consist of and are applicable to the research-based structural soil, urban tree soil mix, to safely increase rooting volumes and marketed under the registered trademarks CU-Structural Soil and/or CU-Soil or approved equal. Only AMEREQ-licensed companies are authorized to produce this material utilizing the specifications described in this text and the method provided only to licensed producers.
- B. For a list of licensed structural soil producers call AMEREQ, INC. at 800-832-8788 or email [bkalter@amereq.com](mailto:bkalter@amereq.com)

**1.2 RELATED SECTIONS**

- A. Section 32 90 00      Planting
- B. Section 32 91 19      Planting Preparation

**1.3 REFERENCES**

- A. Comply with the applicable provisions of the following:
1. ASTM: American Society of Testing Materials
  2. USDA: United States Department of Agriculture
  3. AASHTO: American Association of State Highway and Transportation Officials
  4. Standard Specifications: Regional or Municipal Standard Specifications  
Documentation for the location of proposed usage
  5. AOAC: Association of Official Agricultural Chemists
  6. STANDARD SPECIFICATIONS (DPWSS) City and County of San Francisco,  
Department of Public Works, 1986. Section 1001 - Site Preparation, Section  
1002 - Earthwork and Section 1007 - Planting.

**1.4 TESTING LABORATORY**

- A. Recognized local laboratory for soil and plant disease analysis of ornamental horticulture, approved by the City Representative. Testing laboratory is to perform all work in accordance with the current methods of the Association of Agricultural Chemists and/or in the US Composting Councils USCC Seal of Testing Assurance Program (STA) at Contractor's Cost.
- B. All testing to be done by Soil and Plant Laboratory, San Jose, (408) 727-0330, [soilandplantlaboratory.com](http://soilandplantlaboratory.com), or approved equal.

**1.5 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Section 01 33 00 Submittal Procedures.

- B. No materials shall be ordered until the required samples, certificates, manufacturer’s literature, producer’s current license and test results have been reviewed and approved by the landscape architect and/or City Representative. The City Representative reserves the right to reject any material that does not meet CU-Structural Soil® specifications. Delivered materials shall closely match the approved samples.
  
- C. Contractor to submit from AMEREQ-licensed producer,
  - 1. 1/2 cubic foot representative sample of clay loam
  - 2. one cubic foot representative sample of crushed stone
  - 3. one cubic foot representative sample of Structural Soil mix
  - 4. In the event of multiple source fields for clay loam, submit a minimum of one set of samples per source field or stockpile.
  - 5. The samples of all clay loam, crushed stone, and Structural Soil shall be submitted to the City Representative as a record of the soil color and texture.
  
- D. Contractor to submit from AMEREQ-licensed producer, soil test analysis reports for sample of clay loam from an independent soil-testing laboratory.
  - 1. Submit a mechanical analysis of the clay loam sample and particle size analysis including the following gradient of mineral content:
 

<u>USDA Designation</u>	<u>Size in mm.</u>
Gravel	+2 mm
Sand	0.05 – 2 mm
Silt	0.002-0.05 mm
Clay	minus 0.002 mm
  - 2. Sieve analysis shall be performed and compared to USDA Soil Classification System.
  - 3. Sieve analysis shall be done by a combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D422 after destruction of organic matter by hydrogen peroxide.
  - 4. Contractor to submit from AMEREQ-licensed producer, a chemical analysis, performed in accordance with current AOAC Standards, including the following:
    - a. pH and buffer pH.
    - b. Percent organic matter as determined by the loss of ignition of oven dried samples. Test samples shall be oven dried to a constant weight at a temperature of 230 degrees F, plus or minus 9 degrees.
    - c. Analysis for nutrient levels by parts per million.
    - d. Soluble salt by electrical conductivity of a 1:2 soil/water sample measured in Milliohm per cm.
    - e. Cation Exchange Capacity (CEC).
    - f. Carbon/Nitrogen Ratio.
  
- E. Contractor to submit from AMEREQ-licensed producer, one cubic foot sample of crushed stone which will be used in production of Structural Soil.
  - 1. Provide particle size analysis:
 

<u>USDA Designation</u>	<u>Size in mm.</u>
3"	+76 mm
2 1/2"	63-76 mm
2"	50-63 mm
1 1/2"	37-50 mm
1"	25-37 mm
3/4"	19-25 mm
Fine gravel	2-19 mm
  - 2. Provide the manufacturers analysis of the loose and rodded unit weight
  - 3. Losses from LA Abrasion tests- not to exceed 40%
  - 4. Minimum 90% with 2 or more fractured faces

- 5. Percent pore space analysis
- F. At the City Representative’s discretion, the sample of Structural Soil may be tested for the following:
  - 1. Compaction in accordance with ASTM D698/AASHTO T99 without removing oversize aggregate
  - 2. California Bearing Ratio in accordance with ASTM D1883- soaked CBR shall equal or exceed a value of 50
  - 3. Measured dry-weight percentage of stone in the mixture
- G. The approved Structural Soil sample shall be the standard.
- H. Any deviation from the specified crushed stone and clay loam specifications shall be approved by Amereq, Inc.

**1.6 DELIVERY, STORAGE AND HANDLING**

- A. Delivered Structural Soil shall be at or near optimum compaction moisture content as determined by AASHTO T 99 (ASTM D 698) and should not be placed in frozen, wet or muddy sites.
- B. Protect Structural Soil from exposure to excess water and from erosion at all times. Do not store Structural Soil unprotected. Do not allow excess water to enter site prior to compaction. If water is introduced into the Structural Soil after grading, allow water to drain to optimum compaction moisture content.

**1.7 EXAMINATION OF CONDITIONS**

- A. All areas to receive Structural Soil shall be inspected by the installing contractor before starting work and all defects such as incorrect grading, compaction, and inadequate drainage shall be reported to the City Representative prior to beginning this work.

**1.8 QUALITY ASSURANCE**

- B. Qualifications of installing contractor: The work of this section should be performed by a contracting firm which has a minimum of five years’ experience. Proof of this experience shall be submitted as per paragraph, SAMPLES and SUBMITTALS, of this section.

**PART 2 - MATERIALS**

**2.1 STRUCTURAL SOIL**

- A. A uniformly blended urban tree mixture of crushed stone, clay loam and Gelscape® Hydrogel Tackifier, as produced by an Amereq-licensed company, mixed in the following proportion:

<u>Material</u>	<u>Unit of Weight</u>
specified crushed Stone	100 units dry weight
specified clay loam	20 – 25 units (to achieve minimum CBR of 50)
Gelscape® Hydrogel Tackifier	0.035 units dry weight
	ASTM D698/AASHTO T-99 optimum moisture

**2.2 CLAY LOAM**

- A. Soil to produce Structural Soil shall be a “loam” with a minimum clay content of 20% or a “clay loam” based on the “USDA classification system” as determined by mechanical

analysis (ASTM D-422) and it shall be of uniform composition, without admixture of subsoil. It shall be free of stones, lumps, plants and their roots, debris and other extraneous matter. It shall not contain toxic substances harmful to plant growth. Clay loam shall contain not less than 2% or more than 6% organic matter as determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F., plus or minus 9 degrees.

B. Mechanical analysis for the loam or clay loam shall be as follows:

<u>Textural Class</u>	<u>% of Total Weight</u>
Gravel	less than 5%
Sand	20-50%
Silt	20-45%
Clay	20-40%

C. Chemical analysis: Meet, or be amended to meet the following criteria:

1. pH between 5.5 to 6.5 when using limestone, up to 7.2 when using granite or other non-limestone crushed stone.
2. Percent organic matter 2% - 6% by dry weight
3. Adequate nutrient levels
4. Soluble salt less than 1.0 mmho/cm
5. Cation Exchange Capacity (CEC) greater than 10
6. Carbon/Nitrogen ratio less than 33:1

D. Loam or clay loam shall not come from USDA - classified prime farmland.

### 2.3 FERTILIZER

A. Should nutrient analysis suggest that the loam or clay loam need additional nutrients, it shall be amended by Amereq's licensed producer.

### 2.4 SULFUR

A. Sulfur shall be a commercial granular, 96% pure sulfur, with material and analysis appearing on the labeled container.

B. Sulfur used to lower pH shall be a ferrous sulfate formulation.

C. Application rates shall be dependent on soil test results.

### 2.5 LIME

A. Agricultural lime containing a minimum of 85% carbonates, if needed per lab analysis

B. Application rates shall be dependent on soil test results.

### 2.6 CRUSHED STONE

A. The size of the crushed stone shall be 0.75 inches to 1.5 inches allowing for up to 10% being greater than 1.5 inches, and up to 10% less than 0.75 inches.

B. Acceptable aggregate dimensions will not exceed 2.5:1.0 for any two dimensions.

C. Minimum 90% with two or more fractured faces.

D. Results of Aggregate Soundness Loss test shall not exceed 18%.



- E. Losses from LA Abrasion tests shall not exceed 40%.

## 2.7 HYDROGEL

- A. Hydrogel shall be a coated potassium propenoate-propenamide copolymer (Gelscape® Hydrogel Tackifier) as manufactured by Amereq, Inc. 800-832-8788.

## 2.8 WATER

- A. The installing contractor shall be responsible to furnish his own supply of water (if needed) free of impurities, to the site.

# PART 3 - PRODUCTION AND INSTALLATION GUIDELINES

## 3.1 STRUCTURAL SOIL MIXING AND QUALITY CONTROL TESTING

- A. All Structural Soil mixing shall be performed at the licensed producer's yard using appropriate soil measuring, mixing and shredding equipment of sufficient capacity and capability to assure proper quality control and consistent mix ratios. No mixing of Structural Soil at the project site shall be permitted.
- B. Maintain adequate moisture content during the mixing process. Soils and mix components shall easily shred and break down without clumping. Soil clods shall easily break down into a fine crumbly texture. Soils shall not be overly wet or dry. The licensed producer shall measure and monitor the amount of soil moisture at the mixing site periodically during the mixing process.
- C. Raw materials shall be mixed off-site, only at the licensed producer's facility, on a flat asphalt or concrete paved surface to avoid soil contamination.
- D. Should the independent laboratory test results of the clay loam reveal a need to amend it to meet specifications, the amending materials should be added to the clay loam following the rates and recommendations provided by Amereq, Inc.

## 3.2 UNDERGROUND UTILITIES AND SUBSURFACE CONDITIONS

- A. The installing contractor shall notify the City Representative of any subsurface conditions which will affect the contractor's ability to install the Structural Soil.
- B. The installing contractor shall locate and confirm the location of all underground utility lines and structures prior to the start of any excavation.
- C. The installing contractor shall repair any underground utilities or foundations damaged during the progress of this work.

## 3.3 SITE PREPARATION

- A. Do not proceed with the installation of the Structural Soil material until all walls, curb footings and utility work in the area have been installed. For site elements dependent on Structural Soil for foundation support, postpone installation of such elements until immediately after the installation of Structural Soil.
- B. Install subsurface drain lines as shown on the plan drawings prior to installation of

Structural Soil material.

- C. Excavate and compact the proposed subgrade to depths, slopes and widths as shown on the drawings. Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not over excavate compacted subgrades of adjacent pavement or structures.
- D. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finished grade and/or toward the subsurface drain lines as shown on the drawings.
- E. Clear the excavation of all construction debris, trash, rubble and any foreign material. In the event that fuels, oils, concrete washout silts or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Fill any over excavation with approved fill and compact to the required subgrade compaction.
- F. Do not proceed with the installation of Structural Soil until all utility work in the area has been installed. All subsurface drainage systems shall be operational prior to installation of Structural Soil.
- G. Protect adjacent walls, walks and utilities from damage. Use ½" plywood and/or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work.
  - 1. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day.
  - 2. Any damage to the paving or architectural work caused by the installing contractor shall be repaired, as directed by the City Representative.
- H. Maintain all silt and sediment control devices required by applicable regulations. Provide adequate methods to assure that trucks and other equipment do not track soil from the site onto adjacent property and the public right of way.

### 3.4 INSTALLATION OF STRUCTURAL SOIL MATERIAL

- A. Install Structural Soil in 6-inch lifts and compact each lift.
- B. Compact all materials to at least 95% Proctor Density from a standard compaction curve AASHTO T 99 (ASTM D 698). No compaction shall occur when moisture content exceeds maximum as listed herein. Delay compaction if moisture content exceeds maximum allowable and protect Structural Soil during delays in compaction with plastic or plywood as directed by the City Representative.
- C. Bring Structural Soil to finished grades as shown on the drawings. Immediately protect the Structural Soil from contamination by toxic materials, trash, debris, water containing cement, clay, silt or materials that will alter the particle size distribution of the mix with plastic or plywood as directed by the City Representative.
- D. The City Representative may periodically check the material being delivered, prior to installation for color and texture consistency with the approved sample provided by the installing contractor as part of the submittal for Structural Soil. If the City Representative determines that the delivered Structural Soil varies significantly from the approved samples, the City Representative shall contact the licensed producer.
- E. City Representative shall ensure that the delivered structural soil was produced by the approved licensee by inspecting weight tickets showing source of material.

- F. Structural Soil should not be stockpiled long-term. Any Structural Soil not installed immediately should be protected by a tarp or other waterproof covering.

### 3.5 FINE GRADING

- A. After the initial placement and rough grading of the Structural Soil but prior to the start of fine grading, the installing contractor shall request review of the rough grading by the City Representative. The installing contractor shall set sufficient grade stakes for checking the finished grades.
- B. Adjust the finish grades to meet field conditions as directed.
  - 1. Provide smooth transitions between slopes of different gradients and direction.
  - 2. Fill all dips with Structural Soil and remove any bumps in the overall plane of the slope.
    - a. The tolerance for dips and bumps in Structural Soil areas shall be a 3" deviation from the plane in 10'.
  - 3. All fine grading shall be inspected and approved by the City Representative prior to the installation of other items to be placed on the Structural Soil.
- C. The City Representative will inspect the work upon the request of the installing contractor. Request for inspection shall be received by the City Representative at least 10 days before the anticipated date of inspection.

### 3.6 ACCEPTANCE STANDARDS

- A. The City Representative will inspect the work upon the request of the installing contractor. Request for inspection shall be received by the City Representative at least 10 days before the anticipated date of inspection.

### 3.7 CLEAN-UP

- A. Upon completion of the Structural Soil installation operations, clean areas within the contract limits. Remove all excess fills, soils and mix stockpiles and legally dispose of all waste materials, trash and debris. Remove all tools and equipment and provide a clean, clear site. Sweep, do not wash, all paving and other exposed surfaces of dirt and mud until the paving has been installed over the Structural Soil material. Do no washing until finished materials covering Structural Soil material are in place.

END OF SECTION 32 91 13



## SECTION 32 91 19

## PLANTING PREPARATION

## PART 1 - GENERAL

## 1.01 SECTION INCLUDES

- A. Provide all labor, material, equipment, and services necessary for the furnishing and installing of amended backfill and performing finished grading, as shown on the Drawings and as specified herein. The work includes but is not limited to:
  - 1. Submittals
  - 2. Soil testing
  - 3. Finished grading of landscaped areas
  - 4. Soil amendments and fertilizers
  - 5. Weed Barrier
  - 6. Root Barrier
  - 7. Removing excess soil materials
  - 8. Clean-up

## 1.02 RELATED SECTIONS

- A. Section 32 01 90 – Landscape Maintenance
- B. Section 32 90 00 – Planting

## 1.03 DEFINITIONS

- A. Site Soil: All existing topsoil.
- B. Amended Backfill: Homogeneous mixture of site soil or imported topsoil combined with amendments for use as a planting medium.
- C. Import Top Soil: For backfill in planting areas.
- D. Plant Pit Backfill: Amended site soil for backfill in planting pits.

## 1.04 QUALITY ASSURANCE

- A. Testing Laboratory: Recognized laboratory for soil and plant disease analysis for ornamental horticulture, approved by the City Representative. Testing laboratory is to perform all work in accordance with the current methods of the Association of Official Agricultural Chemists at the Contractor's cost. See section 1.06 below.

## 1.05 REFERENCE STANDARDS

- A. Comply with the applicable provisions of the following:
  - 1. Agricultural Experimental Station Extension Service, University of California, 1979, Publication No. 4091.
- B. STANDARD SPECIFICATIONS (DPWSS) City and County of San Francisco, Department of Public Works, 1986. Section 1001 - Site Preparation, Section 1002 - Earthwork and Section 1007 - Planting.

## 1.06 TESTING LABORATORY

- A. Recognized local laboratory for soil and plant disease analysis of ornamental horticulture, approved by the City Representative. Testing laboratory is to perform all work in accordance with the current methods of the Association of Agricultural Chemists or in the US Composting Councils USCC Seal of Testing Assurance Program (STA) at Contractor's Cost.
- B. All testing to be done by Soil and Plant Laboratory, San Jose, (408) 727-0330, soilandplantlaboratory.com, or approved equal.

#### 1.07 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section 01 33 00 - Submittals.
- B. Product Data and Samples: Furnish copies of manufacturer's literature and laboratory analytical data for review of the following items for approval by City Representative.
  - 1. Nitrolized sawdust conforming to SSDPWSF, Section 1007.04 Soil Amendment – one-half gallon bag, label source & content.
  - 2. Commercial Fertilizers as specified
  - 3. Mycorrhizal fertilizer packs
  - 4. Earthfort Soil ProVide
  - 5. Soil ReVive
- C. Test Reports: Submit the results of the following tests to the City Representative:
  - 1. Existing Site Soil: Provide test A05 at the beginning of the project for water meter service requirements; Test A05, for agricultural suitability, fertility, particle size analysis; including recommendations for soil amendment and fertilization during the maintenance period. Provide a minimum of four tests as directed by Engineer.
  - 2. Existing Site Soil: Provide a mycorrhizal soil analysis.
  - 3. Imported Soil: Provide test A05, for agricultural suitability, fertility, particle size analysis; including recommendations for soil amendment and fertilization during the maintenance period. Submit test reports of representative sample(s) for approval prior to delivery and for every 100 yards delivered to the site.
  - 4. Imported Top Soil: Provide a mycorrhizal soil analysis.
  - 5. Organic Compost: Provide test A09, organic amendment evaluation or equivalent for US Composting Council seal of testing assurance.
  - 6. Organic Compost: Provide a mycorrhizal soil analysis.
  - 7. Submit the specification section 32 91 19 to soil laboratory for amendment consideration.
  - 8. Nitrolized Fir Bark: Provide test A08 for organic amendment evaluation and standards as specified herein. Conform to DPWSS, Section 1007.

#### 1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Fertilizers and Amendments: Store fertilizers and amendments, bark mulch, soil mix, and other materials which could stain concrete and similar surfaces in such a manner that staining does not occur.
- B. Deliver, store, protect and handle products to site under Section 1007 Planting, SSDPWSF.
- C. Deliver fertilizer and other bulk products in waterproof bags showing date, weight, chemical analysis and name of manufacturer.

## PART 2 - PRODUCTS

### 2.01 SOILS

- A. General: All soils and recommended amendments for planting areas shall be free of rocks over 1/2-inch in diameter and free of foreign debris. Soils shall be free from sub-soil, refuse, plants or roots, clods, weeds, viable weed seeds, sticks, solvents, petroleum products, concrete, base rock, or other deleterious or extraneous material. Soils, sand and soil mix shall be free of soil-borne diseases and capable of sustaining healthy plant life.
- B. Imported Topsoil: As supplied by American Soil Products Inc., Richmond, CA, 1-510-292-3000; The Soil Farm, Half Moon Bay, CA 1-650-726-0100; or Lyngso Garden Materials, Inc., 19 Seaport, Redwood City, CA, 1-415-364-1730 or approved equal.
  - 1. Topsoil shall be fertile, friable soil of loamy character, containing an amount of organic matter normal to the region. All imported topsoil used on the job shall be from the same source.
    - a. Must have pH factor between 6.0 and 7.2 (reaction of paste during soils testing).
    - b. Salinity of less than 2.0 (Electrical conductivity in mmho/cm).
    - c. Sodium absorption ration (SAR) of less than 6.0
    - d. Sodium: Less than 5.0 mill equivalents per liter or 150 ppm.
    - e. Chloride: Less than 5.0 mill equivalents per liter or 150 ppm.
    - f. Boron content less than one part per million.
    - g. Organic matter content less than 5%.
  - 2. Make all arrangements for obtaining and testing imported topsoil. Submit test results of a representative sample of the proposed supply for approval by the City Representative well in advance of its scheduled delivery to the site. The approved sample will establish the standards to which all imported topsoil used on the job must conform.
  - 3. Do all work necessary to bring imported topsoil to standards specified above.
  - 4. Transport imported topsoil directly from source to final position. If stockpiling is required, locations and amounts of stockpiles will be designated by the City Representative.
  - 5. The City Representative reserves the right to take additional samples of imported topsoil at the site. If subsequent testing proves material to be at variance with the approved sample, remove rejected soil from the site and replace immediately, at no additional cost to the City.

- C. Submittal: submit for approval a 1-quart sample of proposed import soil, together with a standard soil analysis report by an accredited soils analyst showing chemical analysis stating source, fertility, agricultural suitability and particle size distribution of the soil. Deliver the sample to the Landscape Architect minimum two weeks before starting the contemplated hauling of the soil.

## 2.02 SOIL AMENDMENTS

- A. General: Refer to DPWSS, Section 1007.04 - Soil Amendment.
- B. All soil amendments and mulches shall be organic, OMRI (Organic Materials Review Institute) Certified.
- C. Microbial Amendment: Treat prepared soil, after placement and finish grading, with Earth *Soil ProVide* & *Soil ReVive*, or approved equal. Recommended application rate per manufacturer's recommendations. Available from Marin Soil Solutions, San Rafael, CA. Ph: 415-456-3300; or approved equal, no known equal.
- D. Nitrogen Stabilized Fir Bark:
1. Particle Size (dry weight basis); 0-1/8"
  2. Organic Content: Determined by ash analysis. Minimum 92 percent based on dry weight.
  3. Nitrogen: Minimum 0.8% nitrogen based on dry weight.
  4. Iron: Minimum 0.08 percent dilute acid soluble iron based dry weight, if iron treated.
  5. Salinity: Maximum saturation extract conductivity 3.5 millimole per cm at 25 degrees centigrade.
  6. Bulk Density: 450-580 pounds per cubic yard.
- E. Endo-Mycorrhizal Inoculant: Granular Endo Mycorrhizae blend consisting of four species of spores per pound. Manufacturer: Mycorrhizal Applications, Inc., by Rocky Mountain Bio Products, Denver, Co., Ph: (888) 696-8960; or approved equal, no known equal. Available through:
1. Pacific Coast Seed, Inc., Livermore, CA. Ph: 1(800) 733-3462.
  2. S&S Seeds, Inc., Carpinteria, CA. (805) 684-0436
- F. Organic Compost:
1. General: Compost shall be a well decomposed, stable and weed free. It shall be derived from one or more locally sourced organic materials such as: food waste or urban plant debris, agricultural crop residue or herbivore animal manures with a preference for urban plant debris and food waste. It shall not contain mixed solid waste. The product shall contain no substances toxic to plants, will possess no objectionable odors and shall not resemble the feedstock (the original material from which it was derived).
  2. Testing: Compost shall be tested through the US Composting Councils USCC Seal of Testing Assurance Program (STA). A lab analysis shall be performed by a STA certified laboratory using the test methods used in the Seal of Testing Assurance program found in the Test Methods for Examination of Compost and Composting Manual (TMECC). Verifying current participation in the STA program can be confirmed by logging onto the USCC website at [www.compostingcouncil.org](http://www.compostingcouncil.org). The compost lab analysis shall be submitted as part of the organic compost submittal



before delivery of compost. The compost laboratory report shall confirm the following compost parameters:

Parameters	Reported as (units of measure)	General Range
Plant Nutrients: Nitrogen Phosphorus Calcium Total NPK Sodium	Total N % P% Ca% Sum % Na%	0.9 < 0.6 <3.5 >2.0 <0.5
Moisture Content	% wet weight basis	>35
Organic Matter Content	% by dry weight basis	>35
pH	pH units	6.5-8.5
Soluble Salt Concentration (electrical conductivity)	dS/m (mmhos/cm)	<12
Particle Size or Sieve Size	% pass in a select mesh size, dry weight basis	95% < 1/2" or smaller
Stability Carbon Dioxide Evolution Rate	Mg CO2-C/g OM per day	<8
Maturity ( Bioassay) Seed Emergence and Seed Vigor	%, relative to positive control %, relative to positive control	Minimum 80% Minimum 80%
Select Pathogens Fecal Coliform Bacteria  Salmonella	MPN per gram per dry weight  MPN per 4 grams per dry weight	Fecal Coliform <1000 MPN/gram of total solids.  Salmonella <3 MPN/4grams of total solids
Trace Metals Chemical Contaminants	mg/kg (ppm)	Arsenic <16 Cadmium <8 Chromium < 100 Copper <400 Lead <100, Mercury <4 Molybdenum <75ppm Nickel <80 Selenium <5 Zinc <500
Trace Metals Chemical Contaminants	mg/kg (ppm)	Arsenic <16 Cadmium <8 Chromium < 100 Copper <400 Lead <100, Mercury <4 Molybdenum <75ppm Nickel <80

		Selenium <5 Zinc <500
Carbon Nitrogen Ratio	ratio of Carbon to nitrogen	≤25:1
Physical Contaminants (inerts)	% dry weight basis	<1
Ammonium-N	ppm	<450
<b>Nitrate-N</b>	<b>Ppm</b>	<b>&gt; 10</b>
Soluble Sodium	% of ECE	<40
Soluble Chloride	% of ECE	< 50
Bulk Density	dry lbs/cubic yard	>500 and <1,100
Boron	Ppm	Soluble shall be <2.5 total shall be <80
Organics Clyopyralid Organochlorine Pesticides Organophosphates Pesticides Chlorinated Herbicides Chlorinated Hydrocarbons		Pass plant test Non Detect Non Detect Non Detect Non Detect

(Table modified from the US Composting Council Landscape Architectural Specifications)

2.03 FERTILIZERS

- A. Utilize in each planting pit, Mycorrhizal fertilizer packs in quantity appropriate and recommended by manufacturer for plant size and type. Available as: Green Diamond biological feeder packs 4-2-2 and Green Diamond Tree pack 10-2-4 , or approved equal. Available from: Marin Soil Solutions, San Rafael, CA. Ph: 415-456-3300.
- B. Slow Release Fertilizer:
  - 1. Granular slow release all natural organic fertilizer with no chemical content, NPK 7-2-1, 96% fungal and bacterial biomass, 4% water, sterile and free of weed seeds. Fungal biomass to be obtained by fermentation on raw materials such as cottonseed meal, soybean meal, sucrose, lactose, trace elements, and vitamins, under constant sterile conditions. Fertilizer nutrients shall not be derived from any animal waste, animal by-products, or sewage material. Guaranteed sterilized and free of weed seeds. **Biosol Forte** fertilizer, by Rocky Mountain Bio Products, Denver, Co., Ph: (888) 696-8960; or equal, no known equal.
    - Available through:
      - a. Pacific Coast Seed, Inc., Livermore, CA. Ph: 1(800) 733-3462.
      - b. S&S Seeds, Inc., Carpinteria, CA. (805) 684-0436
  - 2. Nutrient Constituents: Organic Matter: >85%; Carbon/Nitrogen ratio: 5:1; Nitrogen (total) >7%. Nitrogen (water-soluble) <0.5%; Phosphorous (P205) 2-4%; Potassium (K20) 1%; pH level range: 6.5-7.5
  - 3. Application: 1,300 lbs/acre, and per manufacturer’s recommendations and site soil test and soil laboratory recommendations in accordance with Section 32-91-19.
- C. As subject to soil report recommendation in consideration of specified amendments and fertilizers noted in 2.03A & 2.03 B:

1. Ammonium Sulfate: 21-0-0, Caution: Ammonium sulfate fertilizer will burn leaves if applied to wet foliage. Immediately following the application, water the material thoroughly.
2. Iron Sulfate: Ferric sulfate, containing minimum 18-20 percent iron expressed as an elemental. Caution: Iron sulfate will stain concrete, stucco and tile surfaces. Avoid contact with these surfaces. After iron sulfate application, clean all such surfaces before any water application, including rains.
3. Calcium Carbonate Lime: Ground oyster shell type.
4. Cottonseed meal
5. Bone meal
6. Peat Moss
7. Perlite

#### 2.04 WEED BARRIER (RECYCLED CARDBOARD)

##### A. Recycled Cardboard Roll

Available from:  
Bee Green Recycling  
725 Julie Ann Way  
Oakland, CA 94621  
Phone: 510-635-1779

#### 2.05 ROOT BARRIER

##### A. 24" WIDE ROOT BARRIER PANELS

Available from:  
DeepRoot Green Infrastructure, LLC  
1032 Irving Street, #614, San Francisco, CA 94122-220  
[info@deeproot.com](mailto:info@deeproot.com)

Tel: 415 781 9700  
Toll Free: 800 458 7668

#### 2.06 MULCH- See Section 32 90 00 Planting

### PART 3 - EXECUTION

#### 3.01 FINISH GRADING

- A. General: All areas to be planted shall be free of rocks over one-half inch in diameter and free of foreign debris, subsoil, refuse, plants or roots, clods, weeds, sticks, solvents, petroleum products, concrete, base rock, or other deleterious or extraneous material.

Areas to be planted shall be free of soil-borne diseases and capable of sustaining healthy plant life. Do all work necessary to bring site soil, imported soil and planter backfill to compliance with these requirements.

1. Verify with the City Representative that all filter fabric covering Subsoil drains are securely in place. Do not proceed with backfilling until said conditions are completed and approved.
  2. Verify positive drainage rate in tree pits, planting areas and elsewhere as directed by City Representative. See Section 32 90 00 Planting.
- F. Surface Drainage: Contractor is responsible for proper surface drainage of planted areas. Report in writing to the City Representative any discrepancies in the Contract Documents, obstructions on the site, or any other conditions, which prevents establishing proper drainage. Contractor shall proceed with the work under the direction of the City Representative.
- C. Final Contouring:
1. Handle and place the soil and amended backfill to required depths as shown on Drawings.
    - a. Deposit amended backfill in horizontal lifts not exceeding 12 inches. Moisten to settle. Compact or roll each lift to 85 percent relative compaction.
  2. Work soil and amended backfill sufficiently so that after rolling, and after full settlement has occurred, the site will be graded to within +0.10 of a foot from the lines, grades, and elevations shown, and as may be directed by the City Representative. Finished surface shall be smooth and uniform, and shall be free of depressions that retain standing water, or any surface irregularities that would impede proper drainage.
  3. Unless otherwise noted, finish grade for all planting areas and tree pits shall allow for a three inch mulch layer, set 1/2 inch below top of adjacent walks, pavement, curbs, and walls.

### 3.02 PLANTING SOIL PLACEMENT

- A. Planting Soil Placement:
1. Inspect planting areas and remove all base rock and other foreign material. Verify placement of planting soil within dripline of trees with City Representative. Except within tree driplines, rip all planting areas in two directions full depth of compacted fill (to a minimum of 12 inches) into undisturbed native soil prior to backfilling. Scarification of any planting area which cannot be accomplished with a tractor shall be accomplished by an alternative method approved by the City Representative to the specified depth to ensure proper percolation/drainage.
  2. Prior to placing planting soil secure the City Representative's acceptance of the planting areas subgrade condition. Test depth of loose soil with hand shovel in presence of City Representative in several locations as directed. After acceptance of the planting areas subgrade condition, uniformly distribute and spread planting soil backfill over scarified subgrade in planting areas as specified and compact to a maximum of 85% relative compaction.
  3. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.
  4. Water settling, puddling, and jetting of fill and backfill materials as a compaction method is not acceptable.
  5. Provide a depth in planting area as shown on the plans
- B. Planting Soil Placement in Planting Islands and Adjacent to Pavement Areas:
1. Provide planting soil as a final lift in all planting areas within and adjacent to paved areas and other construction where native site soil has been covered by engineered fill

and/or base rock. Remove all engineered fill, base rock and compacted subgrade full depth of compaction and replace with approved planting soil, a minimum lift as shown on the plans. Unless shown otherwise, finish grade in planting islands shall be crowned with a minimum 2% pitch to the edges.

- C. All planting areas soil shall be loose and friable prior to planting. Rip any overly compacted and re-compacted planting areas in two directions full depth of compacted soil prior to planting.
- D. Planting operations shall be performed only during periods when beneficial results can be obtained. When excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped until conditions are satisfactory.
- E. Thoroughly wet down the planting areas to settle the soil and confirm irrigation coverage and operation. Allow soil to dry so as to be workable as described herein.
- F. Drag to a smooth, even surface. Grade to form all swales. Pitch grade with uniform slope to catch basins, streets, curb, etc., to ensure uniform surface drainage. Areas requiring grading include adjacent transition areas that shall be uniformly sloped between finish elevations. Slope surface away from walls so water will not stand against walls or buildings. Control surface water to avoid damage to adjoining properties or to finished work on the site. Take required remedial measures to prevent erosion of freshly graded areas and until such time as permanent drainage and erosion control features have been installed. Refer to Erosion Control Netting below for treatment of slopes 3:1 and steeper.
- G. Finish Grade: Hold finish grade and/or mulch surface in planting areas 1/2-inch below adjacent pavement surfaces, tops of curbs, manholes, etc. The subgrade of the mulch in mulched planting areas shall be a minus 2 inches for a distance of 12 to 18 inch from the edge of pavement. The remainder of the planting area shall be graded to receive the required 3 inch layer of mulch.
- H. In Situ Soil Preparation:
  - 1. Spread organic amendment, iron and Type A fertilizer evenly over installed and rough graded on-site topsoil in all planting areas including turf, ground cover and shrub areas at the following rates:
    - a. Organic Amendment: 6 cubic yards per 1,000 square feet
    - b. Fertilizer: Type-A (6-20-20) at 20 lbs. per 1,000 square feet.
    - c. Iron Sulfate: 10 lbs. per 1,000 square feet
  - 2. In the case of a contradiction between the quantity of organic amendment required by the Contractor-obtained soils laboratory analysis and the specified quantity shown above, the greater of the two quantities shall take precedence.
  - 3. Rototill above additives into soil 6 to 8 inches deep. Keep iron sulfate off pavement and other surfaces to prevent rust staining. Correct all rust damage to work.
  - 4. Planting soil shall have a pH range of 6.5 to 7.5.
- I. After the rototill work, float areas to a smooth, uniform grade as indicated on the drawings. Slope all planting areas to drain. Roll, scarify, rake and level as necessary to obtain true, even planting surfaces. Remove rocks, sticks and debris 1 inch and larger in size in turf areas and 2 inches or larger in shrub and ground cover areas. Secure approval of the grade by the Landscape Architect before any planting.

### 3.02 PREPARATION OF PLANTING HOLES

- A. Dig pits as indicated on drawings.

- B. Scarify bottom of planting pit to a depth of 3 inches. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted subsoil.
- C. Test drainage as specified in Section 32 90 00 Planting 1.09C.

3.03 SOIL AMENDMENT

A. Planting Areas

- 1. After finish grading operations in planting areas are completed, rototill in at least 2 perpendicular directions and with soil at the proper moisture content, so that all clods greater than 3/4" diameter will be broken up resulting in a homogenous blend of amended soil.
- 2. The following recommendations are to be used for bidding purposes only; final amendment procedures shall be in accordance with recommendations based on soil testing at no extra cost to the City.

Provide 18 inches amended backfill for planting areas. Amended backfill mix per 1000 square feet:

<u>Amount</u>	<u>Ingredient</u>
6 cubic yards	Organic compost
35 pounds	Organic Fertilizer
15 pound	Iron Sulfate (20% Fe)
15 pound	Soil Sulfur
0.5 pound	Endo mycorrhizal inoculant

B. Planting Pit Backfill

- 1 Backfill at full depth of plant container plus 8 inches deeper in tree pits.
- 2 The following recommendations are to be used for bidding purposes only; final amendment procedures shall be in accordance with recommendations based on soil testing at no extra cost to the City.

<u>Amount</u>	<u>Ingredient</u>
3 cubic yards	Imported Topsoil
1 cubic yard	Organic compost
3 pounds	Organic Fertilizer
1 pound	Iron Sulfate (20% Fe)
1 pound	Soil Sulfur
4 per 24"box and 2 per 1-15 gallon container	Mycorrhizal Fertilizer Packs

- C. Additional Amendments: Soil amendment recommendations may vary for planting areas. Provide additional amendments as required by soil testing and as directed by the City Representative at no extra cost to the City.
- D. Apply fertilizer in amounts appropriate to growing season as directed by manufacturer, unless otherwise directed by the City Representative.

- E. Replenish amended soil throughout the Contract Landscape Maintenance Period as soil settles from erosion, compaction and watering.
- F. Apply a minimum three-inch organic mulch layer, approximately two weeks following planting when amended backfill has settled as noted on drawings.

#### 3.04 PLACEMENT OF PLANTING BACKFILL

- A. General: Place planting backfill mix to the depths specified to obtain finish grades shown on the Drawings. Soil mix shall be handled in a manner so as to prevent segregation of ingredients.

Thoroughly water planting backfill mix after placement to compact and settle mix.

- B. Place planting backfill in one-foot lifts to specified compaction rate.

END OF SECTION





## SECTION 33 01 30.63

## SEWERAGE SYSTEM MORTAR REHABILITATION

## PART 1 – GENERAL

## 1.01 CALCIUM ALUMINATE CEMENTITIOUS STRUCTURAL REHABILITATION COATING

This specification defines the method and material for the rehabilitation of sanitary manhole and brick sewers utilizing a spray applied, fiber reinforced, calcium aluminate cementitious (CAC) structural rehabilitation system. The purpose of this work is to obtain a dense and durable concrete mortaring that is resistant to biosulfuric acid attack and meets the strength requirements described elsewhere in this specification.

## 1.02 DESCRIPTION

A. The work specified in this Section shall include:

1. Eliminating voids in walls.
2. Properly preparing interior to produce a surface suitable for application and adhesion of the specified coating system.
3. Bypassing main sewer flow as necessary.
4. Rehabilitate all interior surfaces of manholes and sewers in accordance with specifications.
5. Testing of CAC mortar material.
6. Furnishing all labor, equipment, materials, and supervision necessary to accomplish the rehabilitation as specified.

## 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Other contract documents, including Drawings, Relevant Sections of the SFDPW Standard Specifications and these Specifications apply to work specified herein.
- B. Division 1, General Requirements.
- C. Section 33 33 00.

## 1.04 REFERENCES

- A. Department of Public Works Standard Specifications. (Latest Edition).
- B. Standard Specifications for Public Works Construction - "Green Book". (Latest Edition)
- C. American Society of Testing and Materials (ASTM) Standards. (Latest Edition).

## 1.05 SUBMITTALS

A. The Contractor shall provide six (6) copies of the following:

1. Manufacturer's product data, including physical properties, surface preparation,

- repairs, application and curing instructions, Material Safety Data Sheets (MSDS/SDS), and field quality control.
- 2. Manufacturer’s product data and MSDS/SDS for repair, resurfacing and infiltration control materials, if necessary, and proof of compatibility of the materials.
- 3. Independent laboratory reports proving performance properties of mortar material. Test shall be performed within 10 years of the bid date of the contract.
- 4. Manufacturer’s warranty and warranty application procedures.
- 5. Nozzle men and applicator’s certification from the coating manufacturer, applicator and foreman reference and contact information on recently completed manhole rehabilitation using this coating within the last three (3) years.

PART 2 – PRODUCTS

2.01 MATERIALS FOR CAC MORTAR

A. Mortar material furnished under this specification shall be a prepackaged mortar mix, including all cement, aggregates, and any required additives. It is the intent of this specification that the Contractor only be required to add the proper amount of potable water so as to produce concrete suitable for spray application. Do not add portland cement, other aggregates, or any admixtures whatsoever to mortar material. Typical package weights shall not be less than 50 lbs and shall be identical for all material furnished on this project.

B. The properties of the mortar mix shall meet the following requirements:

<u>Property</u>	<u>ASTM Test</u>	<u>Result</u>
Compressive Strength	ASTM C109	
1 Day		>5,500 psi
7 Days		>6,000 psi
28 Days		>7,000 psi
Flexural Strength	ASTM C293/ C348	
1 Day		>900 psi
7 Days		>1,100 psi
28 Days		>1,300 psi
Slant Shear Bond Strength	ASTM C882	
7 Days		>2,400 psi
28 Days		>2,400 psi
Splitting Tensile Strength	ASTM C496	
1 Day		>550 psi
7 Days		>600 psi
28 Days		>700 psi
Shrinkage at 28 days	ASTM C596/ C157	<0.07% cured @ 90% relative humidity (Rh)

C. Mortar mix shall have at least seven (7) years of successful performance in similar

applications and be supplied by an ISO 9001 certified manufacturer.

- D. Mortar mix shall be designed to withstand long-term exposure to a bacterially corrosive hydrogen sulfide environment that may be expected to produce a pH range of 3.5 to 12 on normal Portland cement based concrete or typical brick and mortar surfaces.
- E. Water used in mixing shall be fresh, clean, potable water, free from injurious amounts of oil, acid, alkali, vegetable, sewage and/or organic matter.

2.02 MATERIALS FOR REPAIR AND INFILTRATION CONTROL

- A. A rapid setting crystalline enhanced hydraulic cement product specifically formulated for infiltration control shall be used to stop minor infiltration flows in accordance with the manufacturer's recommendations. The material shall meet the following strength requirements:

Compressive Strength (ASTM C109)	> 600 psi	(1 day)
	> 1,000 psi	(7 days)
Bond Strength (ASTM C882)	> 30 psi	(1 hour)
	> 80 psi	(1 day)

- B. All materials, labor, equipment, and incidentals required to correct inflow and infiltration conditions will be considered incidental to rehabilitation.

PART 3 – EXECUTION

3.01 SAMPLING AND TESTING

- A. The Contractor will retain a Testing and Inspection Agency to provide the testing and inspection of the material used on this project. Contractor shall provide all of its testing and inspection results to the City Representative for review and approval.
- B. Four (4) two-inch cubes of CAC mortar shall be cast each day from each of two (2) pallets as selected by the City Representative and shall be tested for compressive strength per ASTM C109. One (1) of these samples shall be tested at 24 hours and the remaining 3 samples shall be tested at 28 days. The CAC mortar shall meet the compressive strength as defined in section 2.01.
- C. Other testing required showing conformance with these specifications shall be the responsibility of the Contractor. Certified test reports and certificates, when so directed, shall be submitted to the City Representative.
- D. City retains right to sample and test proposed material. City retains the right to direct the Contractor's Testing Agency to perform additional sampling and testing, at no additional cost to the City.

3.02 QUALIFICATIONS

- A. The applicator shall be certified by the CAC coating system manufacturer.
- B. The nozzle operator and foreman shall have a minimum of three (3) years' experience each installing the coating system for similar work and project conditions.
- C. Either the foreman or nozzle operator shall be on-site during all preparation and installation activities.

### 3.03 EQUIPMENT

Equipment shall be of spray type and approved by the material manufacturer. Alternate equipment may be utilized provided the end product utilizing the alternate equipment meets the performance requirements of the specification, and as approved by the City Representative. All equipment shall be kept in operating condition and good repair.

### 3.04 SURFACE PREPARATION

- A. Prior to the installation of the mortar coating, the host sewer surfaces shall be prepared to produce a surface suitable for application and adhesion of the CAC mortar material. Contractor shall ensure the surfaces are clean and free of laitance, loose material, residue and all existing coating and mortaring materials. The Contractor shall thoroughly clean all the surfaces to be coated to remove grease, sludge, dirt, magnesium hydroxide, other foreign deposits, and all deleterious materials that may affect the bonding of the mortar. Roots shall be removed.
- B. Cleaning and surface preparation shall include the inspection of the existing structure for damage and infiltration. The Contractor shall protect the host structure from damage due to cleaning, and any damage shall be repaired prior to installation of CAC mortar coating.
- C. Prior to coating installation, patching, localized repairs, and resurfacing shall be performed in accordance with the coating manufacturer's recommendations. Repair, resurfacing and material to eliminate active infiltration shall be compatible with the CAC mortar material and shall meet specifications as specified in section 2.02.
- D. Sub-surfaces shall be thoroughly saturated with water prior to the application of the mortar materials. In no instance shall shotcrete be applied in an area where running water exists.

### 3.05 INSTALLATION

- A. The coating shall be installed in accordance with the manufacturer's recommendations.
- B. The Contractor shall provide all equipment necessary to individually gauge, control, and monitor the actual amounts of all component materials necessary to complete the mortar installation.
- C. All CAC mortar materials shall be thoroughly mixed by mechanical means to ensure all agglomerated particles are reduced to original size or removed prior to placement into the application equipment (i.e. the hopper). Each batch of material should be entirely discharged before recharging with fresh material. Mixing equipment shall be cleaned at regular intervals to remove all adherent materials.
- D. The addition of water to the mix shall be in strict accordance with the Manufacturer's recommendations.
- E. Re-mixing or tempering shall not be permitted. Rebound materials shall not be reused.
- F. CAC mortar material shall not be applied to a frozen surface or to a surface that may freeze within 12 hours of application. Frozen conditions shall be defined as ambient temperatures of 40 degrees Fahrenheit or below.
- G. Sequence of application may be from bottom to top or vice versa if rebound is properly removed.
- H. Application shall be from an angle as nearly perpendicular to the surface as practicable, with the nozzle held at least 1 foot from the working sub-surface (except in confined control). If the flow of material at the nozzle is not uniform and slugs, sand spots, or wet sloughs result, the nozzle operator shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses.

Application shall be suspended if:

1. Air velocity separates the cement from the aggregate at the nozzle.
  2. Ambient temperature approaches freezing, and the newly placed material cannot be protected and insulated.
- I. The time interval between successive layers of material application shall be sufficient to allow "tackiness" to develop but not final set.
  - J. Construction joints within a manhole shall be avoided. In the event a construction joint is necessary and approved by the City Representative, it shall be sloped off to a thin, clean, regular edge, at a 45-degree angle. Prior to placement of the adjoining materials, the sloped portion and adjacent applied material shall be thoroughly cleaned as necessary, then moistened and scoured with an air jet.
  - K. Nozzle operator shall bring the material to an even plane and to well-formed corners.
  - L. After the body coat has been placed, the surface shall be trued with a thin-edge screed to remove high areas and expose low areas. Low areas shall be properly filled with additional material to insure a true, flat surface.
  - M. The minimum thickness of CAC mortar shall be 1-inch cover over all surfaces including the invert of the brick sewer and manhole. Refer to Section 3.08 for thickness verification.
  - N. At the sewer interface with the manhole, the CAC shall be placed up to the leading edge of the sewer and flush with the inside diameter of the sewer surface.
  - O. When mortaring manhole only, CAC shall not be sprayed into any existing sewers. If CAC does enter a sewer, the Contractor shall remove all CAC from the sewer.
  - P. CAC coating shall be tapered as to not create an abrupt angle, where applicable.

### 3.06 CURING

- A. If the material has been applied and furnished in accordance to the specifications, and it has been determined that the environment is not moist enough for natural curing, the contractor will be required to apply a curing compound to all coated surfaces. Curing compound shall meet the requirements of ASTM C309 and have the approval of the CAC material Manufacturer and the City Representative prior to use.
- B. Moist curing may also be used in lieu of curing compound. If moist curing is selected, it should be implemented just after the notice of uniform heat generation of the installed mortar. Moist curing can consist of the use of soaker hoses, water sprinklers, or vapor/misting machines. Regardless of delivery method, moist curing should continue for a minimum of 18 hours.

### 3.07 PROTECTION OF ADJACENT SURFACES

- A. During progress of the work, adjacent areas or grounds which may be permanently discolored, stained, or otherwise damaged by dust and rebound material, shall be adequately protected and, if contacted, shall be cleaned by early scraping, brushing, or washing as the surroundings permit.

### 3.08 THICKNESS VERIFICATION

- A. In order to verify that the dry coating thickness meets the minimum requirement, the Contractor shall core the CAC coating at three (3) locations at each manhole or at each sewer segment at locations selected by and as directed by the City Representative. The

testing locations shall be determined by the City Representative after rehabilitation work is complete. The core holes shall be repaired in accordance with the manufacturer's recommendations. The average thickness of the three (3) samples shall be equal to or greater than the minimum coating thickness as specified, and if it is not, then the manhole shall have the surface prepared per the manufacturer's recommendation and additional coating shall be applied, at no additional cost to the City. If this thickness test fails, then core samples and repair may be required at additional locations to verify coating thickness.

3.09 CLEAN UP

- A. Upon completion of the installation work and after required testing indicates the manhole is acceptable, Contractor shall restore the project area affected by his operation.

3.010 CORRECTION OF DEFECTS IN SEWER CONSTRUCTED IN THIS CONTRACT

- A. The City will inspect the work prior to expiration of the three year post-construction period, following the date of acceptance of the work.
- B. All defects shall be corrected by the Contractor at no expense to the City.

END OF SECTION

## SECTION 33 11 00

## WATER UTILITY DISTRIBUTION PIPING

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. Work under this Section includes installation of all necessary components complete in place to provide a functional potable water distribution system, in accordance with all the requirements as specified herein and as shown in the contract plans, including, but not limited to the following:
- B. Furnishing and installation of 4-, 6- and 8-inch Tyton joint ductile iron pipe and fittings with Field Lok gaskets
- C. Furnishing and installation of 16-inch restrained push-on joint ductile iron pipe and fittings with rubber restraint gaskets.
- D. Furnishing and installation of flanged joint ductile iron pipe and fittings.
- E. Furnishing and installation of mechanical joint ductile iron fittings with EBAA Megalug mechanical joint restraints.
- F. Furnishing and installation of 4-, 6-, 8- and 12-inch gate valves with gaskets. See Section 33 12 16.12 – Gate Valves.
- G. Furnishing and installation of 16-inch mechanical joint gate valves with EBAA Megalug mechanical joint restraints. See Section 33 12 16.12 – Gate Valves.
- H. Furnishing and installation of 2-inch air and blow off valves and copper and bronze fittings with gaskets.
- I. Furnishing and installation of valve boxes.
- J. Installation of base plates and valve box covers.
- K. Temporary and permanent piping support and bracing systems including thrust blocks.
- L. Cleaning and hydrostatic testing of ductile iron pipe, including furnishing and installation of caps with blow offs and flushing assemblies.
- M. Coordinating and providing support for SFPUC-CDD work.
- N. Tracking and maintaining a log/inventory of all contractor-furnished materials received, stored, used, and installed to monitor changes and provide a basis of payment.

## 1.02 RELATED SECTIONS

- A. Section 01 35 55 – Sanitary Work Practices, Disinfection, and Other Regulatory Requirements
- B. Section 31 23 36 – Excavation and Backfill for Water Work

- C. Section 33 11 41 – V-Bio Polyethylene Encasement of Ductile Iron Pipe
- D. Section 33 12 16.12 – Gate Valves

### 1.03 REFERENCES

- A. ANSI/ASME B 16.1 – Gray Iron Pipe Flanges and Flanged Fittings
- B. ANSI/ASME B 16.5– Pipe Flanges and Flanged Fittings
- C. ANSI/ASME B 18.2.1 – Square and Hex Bolts and Screws; and Hex Cap Screws and lag Screws
- D. ANSI/ASME B 18.2.2 – Square and Hex Bolts (Inch Series)
- E. ANSI/ASME B 1.1 – Unified Inch Screw Threads
- F. ANSI/NSF-61 – Drinking Water System Components
- G. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- H. ASTM A194 – Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- I. ASTM A536 – Standard Specifications for Ductile Iron Castings
- J. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
- K. AWWA C110 – Ductile-Iron and Gray-Iron Fittings
- L. AWWA C111– Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- M. AWWA C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- N. AWWA C150 – Thickness Design of Ductile-Iron Pipe
- O. AWWA C 151– Ductile-Iron Pipe, Centrifugally Cast
- P. AWWA C153 – Ductile-Iron Compact Fittings
- Q. AWWA C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
- R. ISO 8179-2 – Ductile Iron Pipes, Fittings, Accessories and their Joints – External Zinc-Based Coating
- S. SFPW Standard Specifications (latest version)
- T. SFPUC CDD Standard Plans (<http://sfpuc.org/documents/cdd-standard-plans>)
- U. California Code of Regulations, Title 22, CA DPH



#### 1.04 HANDLING, DELIVERY, AND STORAGE OF MATERIALS

- A. The Contractor shall provide all labor, equipment and transportation means required to load City-furnished material stored at SFPUC-CDD Corporation Yard (1990 Newcomb Avenue, San Francisco, CA 94124) and University Mound Reservoir Pipe Yard (800 Bacon Street, San Francisco, CA 94134) and haul such materials to the jobsite. Piping materials and appurtenances shall be stored in a manner safe to the public and in accordance with the local agency requirements.
- B. The Contractor shall be responsible for all labor, equipment and transportation means required to receive and store Contractor-furnished materials. Piping materials and appurtenances shall be stored in a manner safe to the public and in accordance with the local agency requirements, and in accordance with manufacturer's recommendations.
- C. During loading, transportation and unloading, every precaution shall be taken to prevent damage to the material. Under no circumstances shall the pipe, fittings and appurtenances be dropped or skidded against each other. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.
- D. Repair damaged coating and/or cement mortar lining to match quality, thickness and bonding of original in accordance with manufacturer's requirement and AWWA standards. When coating and/or lining cannot be repaired or repairs are defective, replace piping material with undamaged one. The entire cost to repair or replace these materials shall be borne by the Contractor.
- E. The Contractor shall store pipe, fittings, and other accessories such that they do not accumulate and hold rainwater, dirt and debris. Gaskets shall be protected from long term exposure to sunlight. Openings in pipes shall be capped or plugged with removable plastic plugs or caps to prevent dirt and other foreign matter from entering the system. Plugs of rags, wood, cotton, waste or similar materials shall not be used. Pipe and fittings shall be stored at a minimum of six inches above the ground and away from standing water. The City Representative reserves the right to reject any contaminated pipes and fittings not stored properly on site. The cost of replacing such materials shall be borne by the Contractor.
- F. The Contractor shall be responsible for all labor, equipment and transportation means required to return unused City-furnished materials to the SFPUC-CDD Corporation Yard (1990 Newcomb Avenue, San Francisco, CA 94124) and University Mound Reservoir Pipe Yard (800 Bacon Street, San Francisco, CA 94134).

#### 1.05 SUBMITTALS

- A. Pipe Shop Drawings
  - 1. Contractor shall survey street grade and excavate test holes to locate existing underground utilities. The new ductile iron pipe alignment shall be developed based on this information. Contractor shall be responsible for developing the alignment of the new pipeline with the incorporation of information found from the field survey and potholing.
  - 2. Shop drawings shall show the pipe stationing and invert elevations at all changes in grade and horizontal alignment

3. Shop drawings shall include each pipe piece, fitting, valve, connection to existing pipes and other appurtenances.
  4. Contractor shall submit the shop drawings and detailed installation drawings for approval prior to installing. The approval of shop drawings does not relieve the Contractor from the responsibility to furnish and install appropriate pipe pieces, fittings and appurtenances to successfully install the potable water distribution system. There will be no time extension for ordering and procuring materials.
- B. Contractor shall maintain a tracking log/inventory of all contractor-furnished materials received, stored, used, and installed and shall be used to monitor changes and payment against the material tracking log. This log shall be submitted with monthly payment applications and shall be made available to the City Representative upon their request.
- C. Catalog cut sheets of all materials to be furnished by the Contractor.
- D. Written certification that all Contractor-furnished pipe and fittings, and valves meet or exceed all ANSI/AWWA requirements and any other requirements as specified herein.
- E. ANSI/NSF 61 certification for all applicable Contractor-furnished materials in accordance with Section 01 35 55 – Sanitary Work Practices, Disinfection, and Other Regulatory Requirements
- F. Manufacturer’s approved installation instruction including field cut joint assembly procedures.
- G. Hydrostatic Test Plan
- H. Schedule
1. The contract time allowance includes the time for the San Francisco Water Department (SFPUC-CDD) personnel to complete their work as specified herein after. The Contractor shall incorporate the SFPUC-CDD required times in his/her schedule. The Contractor shall confer with the City Representative in the preparation of the schedule that needs to satisfy the water distribution operation and minimize disruption of the services. No construction for water work shall be started until the City Representative approves the schedule.
  2. The time required by SFPUC-CDD to complete each type of work is listed below per pipe segment.
    - a. Request for pipeline connection measurement:
      - 1) Main connections and services larger than 2-inch diameter pipe require SFPUC-CDD to perform measurements for pipeline fabrication prior to any main connection or service change over.
      - 2) Contractor is required to complete the required excavation and shoring prior to SFPUC-CDD performing the requested connection measurement. In the event the excavation size does not conform to paragraph 31 23 36 3.12.G or as directed by the City Representative or the excavation is not adequately shored, the Contractor will be required to perform the requested corrections prior to submitting a new request for measurement. The Contractor shall be responsible for any delays associated with performing the subject corrective work and additional connection measurements. The Contractor will be

- back charged all labor, equipment, and materials associated with SFWD mobilizing more than two times for same connection request.
- 3) 2 working days from the time connection measurement is requested by Contractor through the City Representative to completion of measurement by SFPUC-CDD.
  - 4) For 12-inch and smaller pipes, up to four measurements per request can be submitted, provided that measurements are:
    - A) All are either for services larger than 2-inch diameter pipe (excluding services with manifold meters) or for main connections, and
    - B) All within the same pipe segment, and
    - C) All within the same main shutdown.
  - 5) For 16- and 24-inch pipes, up to two measurements can be requested provided that measurements are:
    - A) All main connections, and
    - B) All within the same pipe segment, and
    - C) All within the same main shutdown.
- b. Connection to an active main:
- 1) Flushing and Chlorinating connection (the first connection of a segment of pipe).
    - A) 15 working days from the time SFPUC-CDD completes connection measurements (for 12-inch or smaller diameter pipe).
    - B) 20 working days from the time SFPUC-CDD completes connection measurements (for 16-inch or larger diameter pipe).
  - 2) Main connection:
    - A) 15 working days from the time SFPUC-CDD completes all connection measurements for a main connection request up to four connections or 20 working days for up to eight connections (for 12-inch and smaller diameter pipe within the same pipe segment).
    - B) 20 working days from the time SFPUC-CDD completes connection measurements for up to two main connections (for 16-inch or larger diameter pipe within the same pipe segment).  
Note: When a request involves multiple connections within the same main shutdown, SFPUC-CDD will not make any connection to an active main until all connection measurements in that request are completed.
- c. Chlorination including sampling and laboratory testing
- 1) 5 working days from the time the flushing and chlorinating connection is made.
  - 2) Chlorination is required for the first main connection (flushing and chlorinating connection) of each segment. The remaining main connections in a chlorinated segment do not require chlorination.
- d. Service change over and hydrant set request:
- 1) Service connections and hydrant set shall only be made to an approved chlorinated segment of pipe that has passed required water quality testing by SFPUC-CDD. Hydrant set can be requested independently from service change over. However, if a hydrant lateral is required to be connected to a chlorinated segment of pipe, a

- request shall be made as large service change over per subparagraph 5.C). (Service larger than 2 inches in diameter).
- 2) Contractor shall only request the same service change over type for each working day per the above schedule. Requests for a combination of service change over types for the same working day shall be subject to approval by the City Representative.
  - 3) The Contractor shall provide all required labor, equipment, and materials to support service renewals including completing required excavation and shoring along with providing required traffic control and materials to perform the work. The above working durations are based on the Contractor completing the required advance preparation work along with providing adequate support.
  - 4) All services shall be changed over before remaining main connections (non-flushing and chlorinating connections) can be made within the same pipe segment. Service change over and main connections will not be installed simultaneously.
  - 5) Service Renew or Retap
    - A) 1-inch services.
      - 1) 1 working day for up to 8 retap (RT) services.
      - 2) 1 working day for up to 8 short renew (RN) services.
      - 3) 1 working day for up to 4 long renew (RN).
    - B) 2-inch services.
      - 1) 1 working day for up to 4 retap (RT) services.
      - 2) 1 working day for up to 3 short renew (RN) services.
      - 3) 1 working day for up to 2 long renew (RN) services.
    - C) Services larger than 2 inches in diameter
      - 1) 10 working days from the time SFPUC-CDD completes measurements for each replacement of a manifold meter.
      - 2) 10 working days from the time SFPUC-CDD completes measurements for up to four services or 15 working days for up to eight services (without replacement of manifold meters) within the same pipe segment.
3. The Contractor shall notify the City Representative in writing three weeks before any work by SFPUC-CDD is required and confirm with the City Representative 3 working days before the actual work is required in the field. The Contractor shall complete the excavation of the water main connection pit and install appropriate shoring to the satisfaction of the City Representative before SFPUC-CDD personnel can do any work including measurements and connections.
  4. Extension of time will only be granted for delay that is on critical path and effectively delays the progress of the construction as stipulated in these specifications. Such delays shall be considered non-compensable and require the Contractor to submit a time impact analysis and associated support documents to the satisfaction of the designated City Representative for any request for time extension due to delay caused by SFPUC-CDD personnel.
  5. Contractor shall use the table below to identify pipe segments and develop the construction schedule for approval.

Segment	Main Segment Size	Street (Side of Street)	From	To	Main Conn. And Disconn.	Services (> 2")	Services (1" and 2")
1	16"	Amador St (S)	Illinois St	429 Amador St	4	2	4

I. Field Welding

1. If field welds are required during construction, the Contractor shall submit the following:
  - a. Manufacturer Welding Procedure Specification (WPS), which shall address the equipment, materials and instructions how the work shall be performed;
  - b. Welder Performance Qualification for each welder, which shall demonstrate that the welder has satisfactorily performed work regarding the specific materials, welding process, test position, etc. listed under the Welding Procedure Specification (WPS).
  - c. Certified Welding Inspector (CWI) Certification from the American Welding Society (AWS) for each welding inspector indicating that the welder to perform the work is accredited by national standards.

1.06 SUPPORT WORK

- A. The Contractor shall provide traffic control, removal and resetting of steel plates and general housekeeping as requested by the City Representative for all main connection measurements, disinfections, main connection operations and service connections by SFPUC-CDD. This will be considered incidental work and no additional payment will be made therefore except for traffic control, which shall be paid through the Bid Item for Traffic Control.
- B. City Representative may request support work at night. The Contractor's additional costs associated with the difference in standard and overtime for support work associated with SFPUC-CDD activities outside of normal working hours shall be paid through the Allowance Bid Item for Working Outside Normal Work Hours. Additional requests for support work at night at the same location will be compensated as time and material.
- C. Night Noise Permit
  1. If SFPUC night work is required, the Contractor shall obtain the night noise permit on behalf of SFPUC-CDD. SFPUC-CDD will provide the affidavit, mailing list and flyer for the permit application.
  2. The durations set forth in Part 1 of this specification section does not include time to obtain night noise permits. No additional time will be given to obtain night noise permits.

1.07 QUALITY CONTROL

- A. The Contractor's quality control is the means by which it ensures that construction is performed according to the Contract Drawings and Specifications, including that of Subcontractors and Suppliers.
- B. The Contractor is responsible for quality control and shall establish, document, implement and maintain an effective contractor quality control system.

- C. The Contractor shall perform specified and required quality control activities including inspections and tests by qualified personnel to verify that it is conformed to contract requirements. Upon request, the Contractor shall furnish to the City Representative duplicate samples of test specimens for possible testing by the City.

#### 1.08 QUALITY ASSURANCE

- A. All work including but not limited to materials, workmanship, testing and manufacture and fabrication of components shall be subject to inspection and testing by the City or by other authorized personnel designated by the City. Such inspection or test is for the sole benefit of the City and shall not relieve the Contractor of the responsibility for providing quality control measures to assure the work strictly complies with the Contract requirements. No inspection, test, surveillance or audit by the City shall be construed as constituting or implying acceptance. Inspection, test, surveillances or audits by the City shall not relieve the Contractor of the responsibility for damage to or loss of material prior to acceptance, nor in any way affect the continuing rights of the City after acceptance of the completed work.
- B. Installation of all piping materials and appurtenances shall be subject to inspection by the City Representative, in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. Inspection of pipe materials and appurtenances will be made by the City Representative after delivery. All materials and their installation shall be subject to rejection at any time on account of failure to meet any of the specified requirements.

#### 1.09 WARRANTY

- A. The Contractor shall furnish a three (3) year warranty for all work covered by this Section beginning on the date that the Substantial Completion certificate is issued by the City.

### PART 2 – PRODUCTS

#### 2.01 CONTRACTOR-FURNISHED MATERIALS

- A. Contractor shall provide at no additional cost to the City materials not listed in the Contract Documents and not specified as provided by the City but are required for a complete and operating water distribution system.
- B. The Contractor shall field verify the lengths at the time of construction, and furnish all the necessary pipe pieces, pipe appurtenances and material to complete the installation.
- C. The Contractor is advised to thoroughly inspect all materials supplied by the manufacturer prior to acceptance of such materials. Materials found to be damaged shall be repaired or replaced as directed by the City Representative. The entire cost to repair or replace these materials shall be borne by the Contractor.
- D. Field-Cut Pipe
  - 1. The Contractor shall furnish all material needed when field cutting restrained push-on joint pipe. These materials shall be approved for use by the pipe Manufacturer.
- E. Flanged Pipe, Flanged Fittings, Nuts, Bolts and Washers

1. Ductile iron flanged pipe thread-fabrication shall be Special Thickness Class 53 and shall be in accordance with AWWA C115/A21.15. (Bolt circle and bolt holes shall match those of ANSI B16.1 class 125 and ANSI B16.5 class 150 flanges). The flanges shall be rated for at least 250 psi working pressure. The threaded flanges shall be individually fitted and machine tightened on the pipe ends at the factory. Flange facing shall be smooth or with shallow serration per AWWA C115. All ductile iron flanged pipe shall be in compliance NSF/ANSI 61 requirements.
  2. Flanged fittings shall be manufactured to ANSI/AWWA C110/A21/10 or to ANSI B16.1 class 125 standard. Elbows, bends (straight sizes), tees, crosses, concentric reducers, base elbows and bottom base tees are manufactured to ANSI/AWWA C110/A21.20 standard. These fittings have identical face to face and center to face dimensions and the same flange drilling as ANSI B16.1 fittings, but differ slightly in wall thickness. Ductile iron C110/A21.10 flanged fittings are rated for at least 250 psi water working pressure. All ductile iron flanged fittings shall be in compliance NSF/ANSI 61 requirements.
  3. Flange gaskets
    - a. All flange gaskets shall be new, type "E", 1/8 inch thick, and in compliance with ANSI/NSF-61 requirements. Sealing element placement shall accommodate flat faced flanges. The quad-ring seals shall be pressure energized. The G-10 retainer shall have a 550 volts/mil dielectric strength and a minimum 50,000 psi compressive strength. The flange gasket shall be one of the following:
      - 1) Quad-seal, pyrox G-10 material, as manufactured by Advance Products & System, Inc.
      - 2) One full faced isolating and sealing gasket, Linebacker G-10 retainer containing precision tapered grooves to accommodate the controlled compression of EPDM quad-ring sealing elements. Four grooves per gasket.
      - 3) Garlock Multi-Swell 3760U.
    - b. Outside/inside diameter of the gasket shall be equal to the outside/inside diameter of the flange. Before installation, all gaskets shall require inspection for adherence to the specifications by the City Representative.
  4. Nuts, bolts and washers for ductile iron flanges: bolts and nuts for flanged joints shall be stainless steel Type 316.
  5. Contractor shall furnish all flange gaskets, nuts, bolts, and washers necessary to install fittings and pipe.
- F. 4-inch through 16-inch Ductile Iron Push-On Joint Pipe
1. General
    - a. The Contractor shall furnish a written certification that all pipe has been manufactured in accordance with the latest revisions of all applicable ANSI/AWWA standards as specified herein. As required, certifications shall verify that all pipe meet the minimum requirement for tensile strength, yield strength, elongation and charpy impact strength.

- b. Ductile iron pipe sizes 4-inch through 12-inch shall be listed by Underwriters Laboratories and approved by Factory Mutual.
- 2. Pipe Class
  - a. All ductile iron pipe shall be Special Thickness Class 53 as shown in Table 15 of ANSI/AWWA C150/A21.50.
- 3. Pipe Properties
  - a. All ductile iron pipe shall be manufactured in accordance with and meet all requirements of ANSI/AWWA C151/A21.51. Ductile iron shall have 60,000 psi minimum tensile strength, 42,000 psi minimum yield strength, 10% elongation and minimum 7 ft/lb Charpy test value.
  - b. Pipe barrels shall maintain the dimensional tolerances as specified for full-length pipe spigots as specified in Table 1 of ANSI/AWWA C151/A21.51. All pipe barrels shall be 100% gauged for the entire pipe length so that pipe diameter and roundness shall not impede assembly into adjoining pipe, fitting or valve bell regardless of what section of the barrel is used. Gauged pipe shall be identified with a ½" green stripe painted around the circumference of the pipe near the spigot end.
- 4. Pipe Lay Length
  - a. All ductile iron pipes shall be manufactured in 18-foot or 20-foot nominal lengths.
- 5. Coating and Lining
  - a. All ductile iron pipe shall be cement-mortar lined, double the standard thickness, and seal coated in accordance with the latest revision of ANSI/AWWA C104/A21.4 and in accordance with the requirements of NSF/ANSI 61.
  - b. The exterior of ductile iron pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179-1 "Ductile Iron Pipes – External Zinc-Based Coating – Part 1: Metallic zinc with finishing layer".
  - c. The zinc coating materials shall be metallic zinc with a zinc content of at least 99.99% by mass and the mass of zinc applied shall be a minimum of 200 g/m<sup>2</sup> of pipe exterior surface area. A finishing layer of bituminous paint or synthetic resin compatible with the zinc coating shall be applied over the zinc rich paint coating.
- 6. Marking Pipe
  - a. Pipe markings shall conform to applicable requirements of ANSI/AWWA C151 and shall include the word "Zinc" in the pipe markings or label. The face of the bell end shall be painted with silver color to identify pipes are coated with zinc.
- 7. Gaskets
  - a. Gaskets shall be rated for 350 psi working pressure with a 2 to 1 safety factor in sizes 4" through 16".
  - b. Gaskets shall be EPDM and in compliance with ANSI/AWWA C111/A21.11.



- c. Gaskets shall be NSF/ANSI 61 certified.
  - d. All gasket sizes 4" through 16" shall be listed by Underwriters Laboratories and approved by Factory Mutual.
8. 4-, 6-, and 8-Inch Ductile Iron Pipe
- a. Joints
    - 1) All 4-inch through 8-inch ductile iron pipe shall be provided with push-on joints in accordance with the latest revision of ANSI/AWWA C111/A21.11 unless otherwise specified herein. Ductile iron pipe shall have TYTON Joint and be designed to be joined and sealed with FIELD LOK 350 restrained gasket as manufactured by U.S. Pipe and Foundry Company.
  - b. Bell
    - 1) All 4-inch through 8-inch pipe bells shall be designed to allow joint deflection after assembly. Joint Deflection shall be as follows:

Pipe Size	Allowable Deflection
4" – 8"	5 degrees
    - 2) Pipe bells shall be TYTON type restrained joint system designed with a gasket retaining bead around the inside of the socket to accommodate FIELD LOK 350 restraint joint gasket by U.S. Pipe and Foundry Company. The assembled joint shall be capable of deflection after assembly. The joint shall be rated for a minimum of 350-psi working pressure.
    - 3) All bells shall be manufactured under the certified manufacturing license for TYTON joint bells by U.S. Pipe.
9. 12- and 16-Inch Ductile Iron Pipe
- a. Joints
    - 1) All 12-inch and 16-inch ductile iron pipe shall be provided with push-on restrained joints in accordance with the latest revision of ANSI/AWWA C111/A21.11 unless otherwise specified herein. 12-inch through 16-inch ductile iron pipe shall have TR FLEX Joint designed to be joined and sealed with TYTON gasket or Flex-Ring joint designed to be joined and sealed with Fastite gasket, or approved equal.
    - 2) TR FLEX pipe shall be manufactured by U.S. Pipe and Foundry Company or under the certified manufacturing license by U.S. Pipe or AMERICAN Flex-Ring pipe manufacturing license by American Ductile Iron Pipe, or approved equal.
    - 3) The pipe spigot end shall be provided with two painted gauge white lines per U.S. Pipe's TR FLEX, one white/yellow line per Flex-Ring joint requirements for assembly stripe locations, or per an approved equal Manufacturer's standard assembly stripe location.
  - b. Bell
    - 1) All 12-inch and 16-inch pipe bells shall be designed to allow joint deflection after assembly. Joint deflection shall be as follows:

Pipe Size	Allowable Deflection
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12"	5 degrees
-----	-----------

16"	3 ¼ degrees
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- 2) The assembled joint shall be capable of deflection after assembly. The joint shall be rated for a minimum working pressure of 350-psi.
- 3) All bells shall be manufactured under the certified manufacturing license of TR FLEX joint bells by U.S. Pipe and Foundry Company or AMERICAN Flex-Ring joint bells by American Ductile Iron Pipe, or approved equal.

G. 4-inch through 16-inch ductile iron push-on joint and mechanical joint fittings

1. General

- a. The Contractor shall furnish a written certification that all fittings provided meet or exceed all ANSI/AWWA requirements and any other requirements as specified herein. Ductile iron pipe fittings sizes 4-inch through 12-inch shall be listed by Underwriters Laboratories and approved by Factory Mutual.
- b. Ductile Iron Compact Push-on joint and Mechanical Joint Compact Fittings
- c. All ductile iron compact push-on joint, restrained push-on joint, and mechanical joint compact fittings furnished under these specifications shall conform to all applicable requirements and the latest revisions of ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/A21.11 at the time of contract advertisement date, unless otherwise specified herein.

2. Pressure Rating

- a. All push-on fittings, restrained push-on fittings, and mechanical joint fittings shall be rated for 350 psi working pressure. All fittings shall have a 2 to 1 safety factor over their specified working pressure rating.

3. Coating and Lining

- a. All ductile iron fittings shall be double the standard thickness cement-mortar lined conforming to ANSI/ASTM C104/A21 and NSF/ANSI 61 certified.
- b. The exterior of ductile iron fittings shall be coated with zinc rich paint coating per ISO 8179-2 "Ductile Iron Pipes – External Zinc Coating – Part 2: Zinc rich paint with finishing layer".
- c. The coating materials for ductile iron fittings shall be a zinc-rich paint with inorganic binder and a zinc content of at least 85% by weight in the dry film and a finishing layer of bituminous paint or synthetic resin compatible with the zinc rich paint. The zinc rich paint coating shall be applied to a dry film thickness (DFT) of between 2.3 to 3.5 mils (.0020" to 0.0035").

4. Dimensions

- a. The size, dimensions, shape, weight, wall thickness and allowable variations thereto shall conform to all applicable requirements of ANSI/AWWA C153/A21.53, except as noted herein.

- b. Fittings with mechanical joints shall conform to the dimensions, weights and laying lengths shown in Tables 1 through 8 of ANSI/AWWA C153/A21.53. Laying lengths shown in this standard are required as minimum values. The dimensions of the mechanical joint bell and socket and the diameter and location of the bolt holes shall be gauged to ensure compliance with applicable requirements of ANSI/AWWA C111/A21.11.
5. Markings on Fittings
- a. Markings on fittings shall conform to applicable requirements of ANSI/AWWA C153/A21 or ANSI/AWWA C110/A21 and the face of each bell shall be painted with silver color to identify fittings are coated with zinc.
6. Ductile Iron Tyton Joint Fittings
- a. Joints
- 1) Ductile iron push-on compact fittings shall have TYTON® type joints in dimensional compliance with and approved by U.S. Pipe. All 4-inch through 8-inch push-on type fittings bells shall be designed with a gasket retaining bead around the inside of the socket to accommodate a FIELD LOK 350® Gasket from U.S. Pipe.
- b. Bell
- 1) All 4-inch through 8-inch fitting bells shall be designed to allow joint deflection after assembly. Joint deflection shall be as follows:
- | Pipe Size | Allowable Deflection |
|-----------|----------------------|
| 4" – 8"   | 5 degrees            |
- 2) The fitting bells shall be TYTON® type restrained joint system designed with a gasket retaining bead around the inside of the socket to accommodate FIELD LOK 350® restraint joint gasket by U.S. Pipe and Foundry Company. The assembled joint shall be capable of deflection after assembly. The joint shall be rated for a minimum of 350-psi working pressure.
- 3) All bells shall be manufactured under the certified manufacturing license of TYTON® joint bells, by U.S. Pipe and shall be required to have the product trademark name on the bells
7. Ductile Iron Restrained Push-On Joint Fittings
- a. Joints
- 1) Ductile iron restrained push-on fittings shall have TR FLEX Joint designed to be joined and sealed with TYTON joint gasket as manufactured by U.S. Pipe and Foundry Company or under the certified manufacturing license by U.S. Pipe; or Flex-Ring® joint as manufactured by American Ductile Iron Pipe designed to be joined and sealed with Fastite joint gasket; or approved equal.
- b. Bell
- 1) All 12-inch through 16-inch pipe bells shall be designed to allow joint deflection after assembly. Joint deflection shall be as follows:
- | Pipe Size | Allowable Deflection |
|-----------|----------------------|
| 12"       | 5 degrees            |

16"            3 ¼ degrees

- 2) The assembled joint shall be capable of deflection after assembly. The joint shall be rated for a minimum working pressure of 350-psi.
- 3) All bells shall be manufactured under the certified manufacturing license of U.S. Pipe for TR FLEX joint bells by U.S. Pipe and Foundry or under the certified manufacturing license by U.S. Pipe joint or Flex-Ring joint bells as manufactured by American Ductile Iron Pipe, or approved equal.

8. Mechanical Joint Fittings

a. Joints

- 1) Ductile iron mechanical joint compact fittings shall be compatible with wedge action gland body restraint with individual actuated wedges MEGALUG® Series 1100 from EBAA Iron Inc.

b. Bell

- 1) The mechanical-joint fitting bells shall be mechanical joint type restrained with MEGALUG® gland restrained joint system. The assembled restrained joints shall be rated for a minimum of 350 psi working pressure and capable of deflection after assembly with restraint mechanical joint gland as follows:

Fitting Size	Allowable Deflection
--------------	----------------------

4" – 12"	3 degrees
----------	-----------

16"	2 degrees
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H. 4-Inch through 16-Inch Mechanical Joint Restraints and Restraints for Ductile Iron Pipe

1. Reference Standards

- a. Restraints shall meet applicable requirements of ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53 ductile iron fittings
- b. Restraints shall be manufactured of ductile iron conforming to ASTM A536.

2. Restraints shall consist of the following:

- a. Mechanical joint restraints shall consist of a wedge action gland body with torque limiting twist-off nuts. A 5/8" hex head shall remain after the torque limiting twist off nut is removed during installation to allow for disassembly. Torque limiting twist off nuts shall not have any individual turning limitations during the installation procedure.
- b. The gland body shall have individually actuated wedges that increase their resistance to pull-out as pressure or external forces increases.
- c. Restraints may come in split design for installation for existing ductile iron pipe bells. Split restraint rings/glands shall have individually-actuating wedges/gripping surfaces, which will be used to grip the pipe. These wedges increase their resistance to pull-out as pressure or external forces increases. Tie rods shall be used to connect each split restraint ring/gland (spigot end) to an opposing split ring (bell end).

- d. Restraints may come in as a style of harness for push on joints for ductile iron pipe. Restraint harness for push on joints shall include a restraint ring/gland (spigot end) to an opposing split ring (bell end).
  - e. Restraints for push on bells with restraint ears shall consist of a split serrated ring that is equipped with inserts that grip onto ductile iron pipe. The split serrated ring shall connect to the pipe restraint ears and joint.
  - f. Restraints used at push-on bell ends (without restraint ears) on existing ductile iron pipe shall come in split serrated rings that are equipped with inserts that grip ductile iron pipe, connecting with one another on opposing sides of the bell.
  - g. Mechanical joint restraint shall allow installer to use impact wrench to install the restraint.
  - h. All necessary anti-rotation T-head bolts, washer and nuts for San Francisco Public Utilities Commission ("SFPUC") to install the restraint.
  - i. Listed by Underwriters Laboratories (4-inch through 16-inch sizes) and approved by Factory Mutual (4-inch through 12-inch sizes) at the time of bid submittal.
  - j. A minimum pressure rating of 350 psi.
  - k. Mechanical joint restraint devices shall be MEGALUG® by EBAA Iron Inc or City approved equal.
  - l. Bell restraint devices shall be Tru-Dual® by EBAA Iron Inc or City approved equal.
3. Safety Factor: Ductile iron mechanical restraints must have a minimum safety factor of 2.0.
  4. Coating: Unless specified otherwise, coating for restraints shall consist of the following:
    - a. Wedge Assemblies and related parts including nuts for T-head bolts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a metallic base coat followed by an adhesion coat, then a heat cured fluoropolymer topcoat containing PTFE (Polytetrafluoroethylene) to seal the two under coatings.
    - b. Casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder.
    - c. T-head bolts and washers shall be made of 316 stainless steel.
  5. Traceability: Identification number consisting of plant designation shall be cast into each gland body. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. These Material Traceability Records are to be made available, in hard copy or email if requested, within two (2) working days to SFPUC as requested. Production pieces that are too small to accommodate individual numbering, such as fasteners and wedges, shall be controlled in segregate inventory until such time as all quality control tests are passed. These component parts may then be released to a general inventory for final assembly and packaging.

6. All mechanical joint fittings shall be bid inclusive of joint lubricant, but exclusive of gaskets, mechanical joint gland or mechanical joint restraints and nuts and bolts. Restraint device kits shall include all gaskets, nuts and bolts, and assembly pieces.
- I. Screw Taps, Saddles, and Air Valves
    1. Bolts and Nuts for Service and Air Valve Installation:
      - a. Bolt and nuts shall be 304 or 316 stainless steel.
    2. Copper and Bronze Valves and Fittings
      - a. Material: All copper pipes & fittings, bronze valves and fittings shall be "lead free" as defined in State of California Health and Safety Code Section 116875 Section 2. ("lead free" means not more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent when used with respect to the wetted surfaces of pipes and pipe fittings, plumbing fittings, and fixtures.)
      - b. Workmanship: All castings shall be cast and machined in a workmanlike manner by competent mechanics working with modern equipment and under conditions that will permit them to produce a finished product of uniform texture, properly machined and without flaws.
      - c. Standards:
        - 1) All bronze used in the manufacture of the valves and fittings shall conform to the grade as specified in American Society for Testing Materials, ASTM B62, and latest revision.
        - 2) All valves and fittings shall be tested in accordance with AWWA C800 and as specified hereinafter.
        - 3) All materials shall be in compliance with NSF/ANSI 61.
      - d. Interchangeability: All similar parts of each fitting shall be interchangeable with similar fittings. The various parts of each fitting shall be selected at random when assembling the said fitting. Special markings on any castings or finished part designating special assembly of any or all fittings will be considered as sufficient evidence for the rejection of said fitting.
      - e. Working Pressure: All valves and fittings to be furnished under these specifications shall be designed for cold water and for an unbalanced pressure of one hundred and fifty (150) pounds per square inch (psi) water working pressure.
      - f. Hydrostatic Test:
        - 1) All screw type taps (corporation stop valves) shall be tested by the Manufacturer in his shop and at his own expense. These valves shall be tested with cold water at a pressure of not less than two hundred twenty-five (225) pounds per square inch (psi), both in the open and closed position.
        - 2) The Manufacturer shall furnish the City an affidavit stating that the said fittings have been tested as specified.
    3. Compression Fittings:

- a. Compression fittings shall be of the stab type with no flaring or soldering necessary to complete connection with Type K copper tubing.
- b. The interior surface of the coupling nut, including threads, shall have baked-on fluorocarbon coating to reduce assembly friction and prevent the gasket from turning and twisting during tightening. The nut shall bottom on a machined shoulder on the body when properly assembled. This design shall provide a visual check to assure connection is properly assembled
- c. The sealing gasket shall be of molded synthetic rubber (EPDM) with molded in place bronze spring (ASTM A-1334 Alloy No. 6) to assure electrical continuity and to eliminate the possible cold flow of the gasket between the pipe and fitting.
- d. A gripper band of hardened stainless steel (ANSI Type 410) shall be fitted into the gasket. When the gasket is compressed, it will cause the gripper ring to distort the pipe giving the fitting a high resistance to pull out. The gripper band shall overlap itself to prevent cold flow of the gasket into the cavity under the band.
- e. The minimum pull out load for the fitting when used with Type K copper tubing shall be as follows for each given size:

SIZE	MINIMUM PULL OUT (FT. LBS.)
3/4"	2,000
1"	3,000
1-1/2"	3,500
2"	4,000

- 4. Gasket: Gaskets, o-rings and all other seals that will be in contact with water shall be made of ethylene-propylene-diene (EPDM) elastomer materials, and shall be in compliance with NSF Standard 61, "Drinking Water System Components-Health Effects". The elastomers shall be fully cured and rinsed in clean water before assembly and shall be proven resistance to chloramines attack and not impact the taste and odor when placed in service.
  - a. 2-inch meter gaskets shall have a minimum pressure rating of 225 psi.
- 5. Plugs: Plugs shall be 2-inch brass square head plugs, and shall not be tapered.
- 6. Inspection:
  - a. Inspection and acceptance for full compliance will be made by the City Representative at any time during the term of contract.
  - b. Any material that is found unsatisfactory on inspection shall be removed by the Contractor and promptly replaced by him at his expense, with new valves or fittings satisfactory to the City Representative.
- J. Polyethylene encasement shall be V-Bio Enhanced Polyethylene Encasement. See Specification section 33 11 41 V-Bio Polyethylene Encasement of Ductile Iron Pipe.
- K. White marking paint.

## 2.02 CITY FURNISHED MATERIALS TO BE INSTALLED BY THE CONTRACTOR

- A. The Water Department will furnish the following material:
  - 1. 6-inch hydrants, Tyton joint hydrant buries, and riser with breakaway groove
  - 2. Valve box covers.
  - 3. Base plates.
- B. The City will not provide any ductile iron flange pipe, flange fittings, flange gaskets, flange bolts, nuts and polyethylene encasement of ductile iron pipe.
- C. The City will not provide Flex-Ring groove-on rings and grooving machine.
- D. The Water Department will furnish and Contractor shall install valve covers and steel base plates. The Contractor shall furnish and install valve boxes for gate valves and 2" air valves/blow offs.
- E. The Contractor is advised to thoroughly inspect all materials supplied by the Water Department prior to acceptance of such materials. Materials found to be damaged in loading, transportation and unloading following acceptance of materials by the Contractor shall be repaired or replaced as directed by the City Representative. The entire cost to repair or replace these materials shall be borne by the Contractor.
- F. The Contractor shall be liable for all damaged and lost surplus materials and shall compensate costs of such materials to the satisfaction of the City.
- G. The Contractor shall notify the City Representative immediately upon determination of the amount and type of materials required from the Water Department. No materials will be issued to the Contractor without a requisition itemizing such materials and signed by the City Representative. The Contractor shall give three (3) working days of advance notice to the City Representative prior to loading and unloading of materials at the storage area.
- H. The Contractor shall not subject any materials supplied by the San Francisco Water Department to any unnecessary jars or shocks during the progress of the work. The Contractor shall be responsible for all said materials and such materials lost or damaged by the Contractor shall be replaced at his/her own expense.

## PART 3 – EXECUTION

### 3.01 INSTALLATION OF DUCTILE IRON PIPE AND FITINGS

- A. Before any pipe may be installed, the grade of the trench bottom shall be approved by the City Representative. Immediately prior to installing the pipe, the Contractor shall remove all loose rocks and other objectionable material from the bottoms of the trench and bell holes. When the trench is properly prepared, the pipe shall be lowered therein, singly, without jarring or strain and joined to each adjoining pipe section in accordance with the manufacturer's recommendations.
- B. Pipe trench widths and trench depths shall be as specified in SFPUC CDD Standard Plans, latest revision. Variances in maximum cover shall be permitted and approved by the City Representative.



- C. The City requires that water mains with less than the minimum cover have a protecting slab or other structural protective measures. In addition, such alternate design shall require approval, on a case-by-case basis by the City Representative.
- D. Where water mains are to be installed with less than the minimum horizontal clear distance of 10-feet to the sewer main, an additional layer of V-Bio polyethylene wrap shall be installed. Refer to Section 33 11 11 V-Bio Polyethylene Encasement of Ductile Iron Pipe.
- E. Restrained joints for ductile iron pipe and fittings shall be assembled per manufacturer's written installation instructions. The deflection at joints shall not exceed 2 degrees or 40 percent of maximum allowable deflection permitted by the manufacturer, whichever is less, and the bending radius shall be 300 feet minimum. Joint restraint devices shall be per SFPUC CDD standard plans, except that bolts, nuts, and tie-rods shall be stainless steel type 316.
- F. Restrainers and tie-rod joint restraints shall be installed at specified locations in accordance with SFPUC CDD Standard Plan CDD-LP-006 and as required by the City Representative if deemed necessary. Installation of restrainers and tie-rod joint restraints shall be considered as incidental work and no direct payment will be made therefore.
- G. The assembly for cut pipe to bell shall be completed as described for full-length pipe. Care should be taken to ensure that all corners are rounded and no sharp edges remain that might damage or dislodge the gasket. Any damage to the lining or coating shall be repaired to the satisfaction of the City Representative.
- H. If the joint assembly is not accomplished with the application of reasonable force, the plain end of the pipe should be removed to check the proper position of the gasket. Care shall be exercised to protect the pipe laid from any foreign materials or obstructions entering the pipe. At the end of each day, the Contractor shall, to the satisfaction of the City Representative, plug or cover the open end of the pipe laid.
- I. As the pipe is being installed a minimum of 75 feet shall be maintained between the end of the new pipeline and the end of the trench being excavated (except where trenching reached the end of the design alignment) or from any visible obstructions. The purpose of this stipulation is to permit the City Representative to see in advance whether any horizontal or vertical adjustments in the pipe alignment will be required to avoid conflicts.
- J. Temporary Blowoffs and Flushing Assemblies
1. Contractor shall coordinate with the City Representative prior to the installation of temporary blowoffs or the flushing assembly in a segment. One flushing assembly is required at the end of each segment as shown in the drawings and temporary blowoffs are required at all remaining open ends of the segment. Flushing assemblies may be required at more than 1 location if so determined by the City Representative.
  2. Flushing assembly shall be installed in accordance with SFPUC CDD Standard Plan CDD-LP-005.
- K. Tyton Joint
1. Tyton joints for ductile iron pipe and gate valves shall be restrained by use of US Pipe FIELD LOK gaskets unless otherwise directed by the City Representative.

2. Any foreign matter in the socket shall be removed prior to installing the gasket; the gasket seat shall be thoroughly inspected to be certain it is clean. The gasket shall be wiped clean, flexed and then placed in the socket with the large round end entering first so that the gasket is seated evenly around the inside of the socket with the heel of the FIELD LOK gasket or other approved gaskets fitting snugly in the retainer seat. Looping the gasket will facilitate inserting the gasket. A thin film of lubricant shall be applied with a paintbrush to the exposed surface of the gasket. The last 6 or 8 inches of the pipe shall be thoroughly cleaned before applying a thin film of lubricant to the outside of the plain spigot to a line about one inch back from the end. The pipe spigot shall not be allowed to touch the ground or trench side after it is lubricated. Lubricant other than that furnished with the pipe shall be used. The spigot end of the pipe shall be aligned and carefully started into the socket until it just makes contact with the gasket. Joint assembly shall then be completed by forcing the spigot end of the pipe past the gasket until the inside edge of the first painted strip or the spigot end of full-length pipe is approximately flush with the bell face. The deflection of the joint shall be done after this. The pipe shall then be moved in the opposite direction to lock the joint.
  
3. When Tyton joint pipe is cut in the field, the outside of the duct end shall be beveled about one-quarter inch at an angle of about 30 degrees and the leading edge founded. The prepared cut end shall be marked in accordance with the dimensions specified by the manufacturer for FIELD LOK gaskets.

Pipe Size	Location of Assembly Mark
4"	2-3/4"
6"	2-15/16"
8"	3-1/4"
12"	3-5/16"
16"	4-1/2"

L. Flex-Ring Joint Pipe

1. Flex-Ring Joint piping materials with Fastite gaskets shall be installed per manufacturer's instructions.
  
2. Field Cut Pipe

The installation of a 16-inch Field Flex-Ring is not the same as installation of Field-Flex Rings 12 inches and smaller. Contractor shall be familiar with the difference in installation methods and follow the Field Flex-Ring assembly instructions from American Ductile Iron Pipe Company.

- a. Pipe sizes 12 inches and smaller: Field Flex-Ring shall be installed with a groove on the spigot end of the field cut pipe
  - 1) For Flex-Ring joint 12 inches and smaller in diameter, Field Flex-Rings shall be used to restrain a Flex-Ring bell with a field-cut spigot in lieu of a standard Flex-Ring joint spigot manufacturing welded-on retainer ring. Installation of Field-Flex Rings on pipe diameters up to 12 inches requires the use of a pipe grooving machine.

- 2) Contractor shall be responsible for following the grooving instructions from American Cast Iron Pipe Company.
  - 3) Dimensions of the groove shall be in strict conformance with the groove dimensions and tolerances from American Ductile Iron Pipe Company.
  - 4) The Contractor shall provide access for the City Representative to inspect all field cut grooves. The Contractor shall be required to measure and record all field cut grooves to demonstrate that the field cut grooves are within the manufacturer's specified tolerances.
  - 5) Any grooves which are determined by the City Representative to not be within the manufacturer's specified tolerances shall be redone on a new piece of pipe. Contractor shall be responsible for all labor, material, and equipment costs, including the material cost of the new pipe, along with project delays related to reinstalling the groove.
- b. Pipe sizes equal to 16 inches
- 1) For pipe diameters 16 inches and larger, Field Flex-Rings shall be used to restrain a bell joint with a field cut pipe in lieu of a standard Flex-Ring joint spigot with a manufacturing welded-on ring.
- c. When Flex-Ring joint pipe is cut in the field, the outside of the plain end shall be beveled about 3/8" to 5/8" long at an angle of about 30 to 40 degrees with the axis of the pipe. All sharp corners or rough edges that might damage or dislodge the Fastite gasket or Field Flex-Ring should be removed from the beveled pipe end. The prepared cut end shall be marked in accordance with the dimensions specified by the manufacturer for Fastite gaskets.
3. If welding, all welds must be inspected and approved by a Contractor-furnished certified welding inspector (CWI). Any welds deemed not suitable for use by the CWI shall be redone on a new piece of pipe. Contractor shall be responsible for all costs related to rewelding of failed welds.
  4. Flex-Ring Pipe and Fitting sockets allow a small amount of axial movement which provides substantial flexibility after installation. Unwanted expansion shall be prevented by manually pulling the pipe to full extension after installing the locking ring and prior to setting the joint deflection to minimize joint take-up in test or service conditions. In any application where axial or lateral movement may be undesirable, such as certain bridge crossings, certain exposed or unburied piping applications, or certain connections of restrained pipe sections to rigid piping, special provisions, including effective joint extension, may be necessary to control unacceptable pipeline movement.
  5. When the distance between two fittings is greater than the lay length of one uncut pipe, Contractor shall use an uncut Flex-Ring spigot end with factory weld ring and a standard locking ring in one of the fitting sockets rather than using a field-cut plain end. For 16" Flex-Ring, a Field Flex-Ring and cut pipe can then be used in the next pipe socket.
  6. The correct positioning of the yellow Flex-Ring or yellow restraining segments (if pipe diameter larger than 12 inches) in the socket locking groove shall be verified by visual or physical inspection.

7. For field-cut Flex-Ring pipe, spigot assembly stripes shall be located as shown in the table below. The dimensions in the table are not to be confused with the dimensions for grooving a Field Flex-Ring.

Pipe Size	Location of Assembly Mark
4"	5.49"
6"	5.49"
8"	5.61"
12"	6.59"
16"	7.25"

M. TR FLEX Joint Pipe or Approved Equal

1. TR FLEX Joint Pipe or approved equal shall be installed per the Manufacturer's procedures.
2. TR-Flex Gripper Rings shall not be installed with TR-Flex fittings
3. If welding, all welds must be inspected and approved by a Contractor-furnished certified welding inspector (CWI). Any welds deemed not suitable for use by the CWI shall be redone on a new piece of pipe. Contractor shall be responsible for all costs related to rewelding of failed welds.

3.02 FLANGED JOINTS

A. Before installing gaskets in flanged joints, the faces of the flanges shall be power-brushed to the satisfaction of the City Representative.

1. Bolts for flanged joints shall be of sufficient length to give a full nut engagement plus three full threads when the joint is made up.
2. When bolting up flanges, the bolts shall be tightened in such a way that the flanges in the completed joint will be parallel and free from unequal stresses.
3. Care shall be taken to prevent damage to the bolt heads, nut and threads.
4. All damaged material shall be replaced.
5. Flanged joints showing leaks will not be acceptable.
6. Leaks shall be stopped by one or all of the following methods, cleaning flange face; replacement of gaskets, and adjustment of tension on bolts. No other method will be permitted.
7. Where, in the opinion of the City Representative, conditions prevent the use of hex head bolts, stud bolts of the proper size shall be substituted.

### 3.03 THRUST BLOCKS

- A. Thrust blocks shall be installed at hydrant and hydrant laterals, blow offs and other locations as shown on the Contract Drawings or per SFPUC CDD Standard Plans.
- B. Thrust blocks shall also be installed at main connections as directed by the City Representative.
- C. Thrust blocks shall provide a minimum bearing surface area of 18 inches by 18 inches against the soil to prevent any pipe movement.
- D. The concrete shall be poured against a satisfactory bearing surface and be of sufficient size to prevent any movement of the pipeline when subjected to the hydrostatic test pressure. Installation of thrust blocks shall be considered as incidental work and no direct or additional payment will be made thereof.

### 3.04 INSTALLATION OF HYDRANTS

- A. Location of fire hydrants shall be as required by SFFD.
- B. Hydrants shall be installed near the street curb, and shall be accessible to fire trucks, and protected from traffic.
- C. Hydrants shall be installed in accordance with SFPUC CDD Standard Plan CDD-LP-004A

### 3.05 INSTALLATION OF VALVES AND VALVE BOXES

- A. Gate Valves
  - 1. Gate valves shall be located on all branches of the main including services that are 4 inches or larger. Each fire hydrant shall be provided with an isolating valve. An additional gate valve shall be installed next to the main if the hydrant lateral is longer than 20 feet. On long distribution mains, valves shall be installed at every 500 feet in commercial areas and no more than one block apart or within an interval of 800 feet in other areas. Dead ends for future expansion shall be provided with a valve and a blow-off valve. All taps to existing mains shall be provided with valves.
  - 2. Valves on service pipes 2-inch or less shall be "corporation stop" type and buried.
- B. Air Release and Blow-Off Valves
  - 1. Air release valves shall be installed next to a shut-off valve and at the high points in the distribution system isolated by two gate valves.
  - 2. Blow-offs shall be installed at dead ends and at low points in the distribution system isolated by two gate valves.
  - 3. Center to center spacing between the air release valve and blow-off valve to the gate valve shall be 3 feet. The first air release valve/blow-off valve shall not be more than 3 feet behind the property line.

4. The air release valve/blow-off valve and gate valve shall not be under sidewalks, reinforced concrete bus pads, bulb-outs or concrete gutters and crosswalk areas.

C. Valve Boxes & Covers

1. Over each buried valve, or other similar appurtenance, a piece of ductile iron pipe of such size shall be placed vertically to form a valve box. A suitable cover shall be placed on top of the pipe or box. The bottom of the box shall rest on a steel plate furnished by SFPUC-CDD so placed as to prevent the box from bearing on the buried devices. Steel plates supporting boxes, over valves shall be set on an asphalt bed. Contractor shall cut the box to such lengths that the top of the gate cover will be flush with the surface of the finished pavement or as shown on the Contract Drawings. Valves boxes for gate valves and 2-inch air valves/blow offs shall be furnished and installed by the Contractor.

3.06 PIPE MARKING

- A. The Contractor shall provide and install buried non-detectable warning tape in trench, continuously over the centerline of the pipe, as per Section 31 23 36 – Excavation and Backfill for Water Work and SFPUC CDD Standard Plans.

3.07 IDENTIFICATION OF RESTRAINED GASKET JOINTS

- A. The Contractor shall identify all joints by spraying white marking paint on top of each bell. The Contractor shall provide the paint.

3.08 CLOSING OF UNINSPECTED WORK

- A. The Contractor shall not cover, or allow to be covered, any of the work installed under this Contract before it has been inspected and approved by the City Representative. Should any of the work be covered prior to such approval, the City Representative shall have the authority to require the work to be uncovered for inspection and approval, recovered, and all resultant damage required, all at the Contractor's expense (also refer to Article 8 of the General Conditions).

3.09 HYDROSTATIC TEST IN THE FIELD

- A. When the pipeline or portion of the pipeline laid under this contract is completed, the Contractor shall test the line as a complete system, as directed by the City Representative, to a hydrostatic pressure as specified below. The pressure test shall be maintained for not less than 2 hours during which time no additional water shall be added to the line under test. All screw taps or valves at service outlets shall be closed before the pipe line may be tested. All in-line gate valves shall be open during the test.
- B. The Contractor shall furnish all necessary labor, material and equipment, such as caps, blow offs, flushing assemblies, pumps, piping, connections, pressure gauges, etc., for the test. The Contractor shall also submit for approval, furnish and install necessary temporary restraints including but not limited to anchorage and blocking to prevent movement of the pipe line under test. Furnishing and installation of materials required for hydrostatic testing shall be considered as incidental work and no direct payment will be made therefore.
- C. During the installation

1. Contractor shall examine City-provided pipes, fittings and gaskets for any visible defect. This should be done before trench backfill. Contractor shall be responsible for all costs related to retest even if the leak is due to visible defect of City-provided materials.

D. Before the Test

1. Before performing the hydrostatic test, Contractor shall make sure that:
  - a. Restrained gaskets such as FIELD LOK or equivalent have been installed at every push-on joint. Ensure every joint is pulled to confirm FIELD LOK gaskets are positively engaged prior to testing.
  - b. Flex-Ring or TR-Flex joints including field-cut joints are properly installed and the joint has been manually pulled to full extension to eliminate any expansion slack in the joint.
  - c. Joints have been restrained with restrainers and tie-rods per SFPUC CDD Standard Plan CDD-LP-006.
  - d. Every open end of the line subject to the test is terminated with an end cap or a blind flange. Every end cap must have been restrained to the line with tie-rods or restrainers. A mechanical joint with FIELD LOK gasket is not allowed to restrain an end cap to the line. A 2" screw tap and blow off valve shall be installed on each cap. Opened-end cap or blind flange shall be exposed for the test. No external restraint shall be used to prevent possible axial pipe movement at any end cap or blind flange such as lumber between the cap or blind flange and end of trench.
  - e. Flushing assemblies are installed in accordance with SFPUC-CDD Standard Plan CDD-LP-005 at the locations shown on the drawings, or as specified by the City Representative.
  - f. Contractor shall completely fill the main for a minimum of 24 hours prior to the pressure test.

E. Test Pressure

1. Test pressure shall be 150% of the maximum operating pressure or 225 psi, whichever is greater, or as specified or as determined by the City Representative.
2. No pressure drop is allowed during the 2 hours minimum test time during which no additional water shall be added to the line under test.

F. Backfill and hydrostatic test

1. Contractor may backfill the new installation (except open ends) prior to hydrostatic test. If the test fails, it is the contractor's responsibility to locate the leak, fix the leak and retest at no cost to the City, except that the leak was caused by invisible defect from City provided materials.

### 3.10 DISINFECTION

- A. Upon completion of satisfactory hydrostatic test, the Contractor shall excavate an initial connection hole for measurement and connection. SFPUC-CDD will make the

connection to flush, disinfect, chlorinate and take bacteriological water samples from the new water main.

- B. The estimated time required for disinfecting each pipeline segment may be up to 5 working days. Depending on the size and length of the pipe, the actual time required for the completion of disinfection and bacteriological testing may vary depending on site conditions. It is the Contractor's responsibility to plan ahead of the construction schedule and coordinate with the City Representative to allow sufficient time for SFPUC-CDD to complete the disinfection work.
- C. During the disinfection of the new pipeline segment, the Contractor is advised not to excavate other main connection holes within the segment. This is to allow access to the blow off valves for collecting water samples. If the Contractor chooses to excavate the other connection holes prior to completion of disinfection work, Contractor shall be responsible for providing full access to the blow off valves when requested by the City Representative. Providing access to the blow off valves will be incidental and no payment will be made thereof. Measurements for the other main connections will not be made until disinfection for the segment is passed.

### 3.11 WATER MAIN ABANDONMENT

- A. For existing 8-inch diameter or smaller mains that are to be abandoned in place, the ends shall be plugged with grout and sealed with plastic to prevent future connection.
- B. For pipes larger than 8-inches diameter to be abandoned in place, the entire pipe length shall be filled with slurry.

END OF SECTION



## SECTION 33 11 41

## V-BIO POLYETHYLENE ENCASUREMENT OF DUCTILE IRON PIPE

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. Work under this Section includes furnishing and installing polyethylene encasement tube over all pipe, fittings, and appurtenances installed by the contractor and SFWD personnel including service bronze valves and fittings, service lateral copper pipe and water main connections.

## 1.02 RELATED SECTIONS

- A. Section 33 11 00 – Water Utility Distribution Piping

## 1.03 CITED REFERENCES

- A. Contractor shall install the polyethylene encasement in strict conformance with the latest edition of the AWWA C105 Standard.

## 1.04 QUALITY CONTROL

- A. All work shall be accomplished by experienced personnel working under competent supervision.
- B. All materials shall be new and of the highest quality and shall be supplied by a vendor who is regularly engaged in procurement of polyethylene encasement products for water pipes.
- C. For work to be accepted by the City Representative, there shall be no pinholes, no tear in the polyethylene encasement, and no water collected inside the polyethylene encasement.

## 1.05 SUBMITTALS

- A. Contractor shall submit the following:
  - 1. Polyethylene encasement product data sheet, dimensions, thickness.
  - 2. Installation procedures: including spacing of adhesive tapes on pipe barrels, Encasement of pipes installed by SFWD, termination of encasement at epoxy coated appurtenances, installation of adhesive tape at corporation stops, and repair details of the polyethylene encasement.

## PART 2 – PRODUCTS

### 2.01 MATERIAL

- A. The polyethylene encasement shall consist of three layers of co-extruded linear low density polyethylene (LLDPE), fused into a single thickness of not less than 8 mils.
- B. The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of anti-microbial biocide to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion.
- C. The polyethylene encasement shall meet AWWA C105 Standard and shall be furnished by one of the manufacturers specified in 2.01.D or approved equal.
- D. V-Bio polyethylene encasement manufactured by DIPRA and sold through US Pipe and American Ductile Iron Pipe Company.
- E. The tape shall be blue polyethylene adhesive tape or approved equal.

## PART 3 – EXECUTION

### 3.01 EXECUTION OF WORK

- A. Install polyethylene encasement tubing as per the approved procedures. Any deviation from the approved procedures shall be re-evaluated and approved by the City Representative before proceeding. Installation “Method A” from AWWA C105 is included herewith for information only.
- B. Each polyethylene encasement tube shall have sufficient length to cover one pipe segment and overlap the pipe joints one foot minimum at both ends of the segment.
- C. The intervals of the adhesive tape shall not exceed the intervals that have been approved. Install additional tape as required to ensure good quality of the pipe Encasement. Any wrap at tap locations shall be taped tightly prior to tapping and inspected for any needed repairs following the tap.
- D. For pipes installed by SFWD, the Contractor shall install sufficient extra polyethylene encasement at the end of the pipe installed by him/her to encase the connecting pipe and fittings after these are installed by SFWD personnel.
- E. The Contractor shall remove any sharp edges or materials, which can penetrate or create cuts in the polyethylene encasement when the pipe is lowered into the trench.
- F. At 1-inch and 2-inch service connections to the new main, the Contractor shall install adhesive tape over the polyethylene encasement on the entire circumference of the pipe before performing the tapping for corporation stop.
- G. Polyethylene encasement shall be installed over all pipe and fittings installed by the contractor and SFWD personnel including service laterals and water main connections.
- H. Where water mains are to be installed with less than the minimum horizontal clear distance of 10 feet to the sewer main, an additional layer of V-Bio polyethylene wrap shall be installed.

1. The second layer shall be installed in a similar manner although separate from the first layer.
2. The two layers shall overlap so that, neither end of the second layer shall be within 2 feet of the either end of the first layer.
3. Each layer shall be taped individually.

### 3.02 ACCEPTANCE OF WORK

- A. Work will be accepted only if there is no tear or pinhole in the polyethylene encasement.
- B. During the water pressure test, if any leaks exist, Contractor shall remove the polyethylene encasement; fix the leaks; allow all water to escape; and retape the polyethylene encasement with the tape per the approved repair procedures.

END OF SECTION

INSTALLATION OF POLYETHYLENE ENCASEMENT (AWWA C105)  
 (Not part of the specifications, for information only)

*Method A  
 for Normal Dry Trench Conditions*



**Step 1.**  
 Cut a section of polyethylene tube approximately two feet longer than the pipe section. Remove all lumps of clay, mud, cinders, or other material that might have accumulated on the pipe surface during storage. Slip the polyethylene tube around the pipe, starting at the spigot end. Bunch the tube accordion-fashion on the end of the pipe. Pull back the overhanging end of the tube until it clears the pipe end.



**Step 5.**  
 Overlap the secured tube end with the tube end of the new pipe section. Secure the new tube end in place.



**Step 2.**  
 Dig a shallow bell hole in the trench bottom at the joint location to facilitate installation of the polyethylene tube. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe.



**Step 6.**  
 Take up slack in the tube along the barrel of the pipe to make a snug, but not tight, fit. Fold excess polyethylene back over the top of the pipe.



**Step 3.**  
 Move the cable to the bell end of the pipe and lift the pipe slightly to provide enough clearance to easily slide the tube. Spread the tube over the entire barrel of the pipe. Note: Make sure that no dirt or other bedding material becomes trapped between the wrap and the pipe.

**Step 7.**  
 Secure the fold at several locations along the pipe barrel (approximately every three feet).



**Step 4.**  
 Make the overlap of the polyethylene tube by pulling back the bunched polyethylene from the preceding length of pipe and securing it in place. Note: The polyethylene may be secured in place by using tape, string, plastic tie straps, or any other material capable of holding the polyethylene encasement snugly against the pipe.

**Step 8.**  
 Repair all small rips, tears, or other tube damage with adhesive tape. If the polyethylene is badly damaged, repair the damaged area with a sheet of polyethylene and seal the edges of the repair with adhesive tape.



**Step 9.**  
 Carefully backfill the pipe according to the AWWA C600 standard for backfill procedure. To prevent damage during backfilling, allow adequate slack in the tube at the joint. Backfill should be free of cinders, rocks, boulders, nails, sticks, or other materials that might damage the polyethylene. Avoid damaging the polyethylene when using tamping devices.

## SECTION 33 11 43

## REMOVAL OF SFWD-OWNED VALVE BOX AND COVER

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. Work under this Section includes saw cutting, excavating, removing and disposing of pavement, excavating the hole to the dimensions as specified by the City Representative, removing all existing SFWD valve boxes and valve covers to be abandoned or as indicated by the City Representative.
- B. This work also includes providing traffic control and routing; furnishing and placing sand backfill; restoring pavement, sidewalk, and other roadway structures that have been removed during the progress of the work, unless otherwise specified herein and clean the site of the work together with other work necessary or incidental thereto.
- C. The Contractor shall dispose of the boxes as the Contractor's property and return all box covers to the SFWD Corporation yard at 1990 Newcomb Avenue, or at the location indicated by the City Representative.

## 1.02 RELATED SECTIONS

- A. The latest version of SFPW Standard Specifications
- B. Section 31 23 36 – Excavation and Backfill for Water Work

## PART 2 – PRODUCTS

- A. Not Used.

## PART 3 – EXECUTION

## 3.01 REMOVAL OF VALVE BOX AND COVER

- A. The Contractor shall notify the City Representative in writing 7 calendar days prior to scheduling the removal of abandoned valve boxes and valve covers. The City Representative shall identify the abandoned valve boxes and covers that are to be removed by marking them on the field. This removal work shall be completed before the final pavement restoration, as applicable.
- B. The Contractor shall saw cut 2' x 2' square minimum the pavement around the valve cover and remove the valve box at least 18 inches below the roadway surface. The removal of the plate under the valve box is optional.
- C. The hole shall be backfilled in accordance with the provisions of Section 31 23 36 - Excavation and Backfill for Water Work.

- D. The concrete base and pavement removed shall be restored to match the existing in accordance with the provisions of Section 32 10 00 - Pavement Restoration for Water Work.

END OF SECTION

## SECTION 33 12 13

## INSTALLATION OF SCREW TAPS, SADDLES, SERVICE PIPE AND FITTINGS

## PART 1 – GENERAL

## 1.01 WORK INCLUDED

- A. Work under this Section includes
  - 1. Excavation of 1- and 2-inch water service trenches.
  - 2. Excavation of 1- and 2-inch service connection holes.
  - 3. Drilling tapping and installing screw taps
  - 4. Trenchless installation of 1-inch service pipe.
- B. The service list included in this contract is subject to field change as directed by the City Representative.
- C. Provide support for SFWD to perform service connections, which includes traffic control and removal and replacing steel plates. This support work shall be considered as incidental.
- D. Wrap service pipe and fittings between the water main and water meter with V-Bio Polyethylene Encasement.

## 1.02 RELATED SECTIONS

- A. Section 31 23 36 – Excavation and Backfill for Water Work
- B. Section 33 11 00 – Water Utility Distribution Piping
- C. Section 33 11 41 – V-Bio Polyethylene Encasement of Ductile Iron Pipe

## PART 2 – PRODUCTS

## 2.01 MATERIALS

- A. Service Fittings
  - 1. Service fittings shall be made of bronze or brass, in conformance with AWWA C-800.
- B. Service Pipes
  - 1. Service pipe materials shall be supplied by the City.
  - 2. Service pipe larger than two inches shall be ductile iron pipe.

## PART 3 – EXECUTION

## 3.01 INSTALLATION OF SCREW TAPS AND SERVICE SADDLES

- A. Drill, tap and install screw taps as shown on the drawings or as required by the City Representative. Any screw tap not satisfactorily installed in the opinion of the City Representative shall be removed and replaced at the expense of the Contractor. Where the screw tap installation is unsatisfactory, it shall be removed and replaced with a brass saddle and brass plug at no cost to the City. Where there are more than 2 unsatisfactory screw taps installed in a full length of the new pipe, the Contractor shall remove and replace that pipe and the cost for the labor and material shall be borne by the Contractor. The City Representative shall determine the location of the relocated screw taps and approve the replacement.
- B. The UNK acronym shown in the drawings indicate unknown size and/or material information on the existing service. The Contractor shall pothole these services to verify the size of the service.
- C. Where there is a bank of 3 or more services, contractor shall install screw taps spaced apart horizontally 6 inches on center and 6 inches vertically from the horizontal plane.
- D. The Contractor shall not leave any “coin” cut out from the main for the installation of screw taps. The Contractor shall provide all “coin for 2” screw taps to the City Representative. It is the Contractor’s responsibility to remove any object left inside the newly installed pipe.
- E. Install saddles furnished by the City for 2-inch services and 2-inch air valves on mains 8 inches or smaller per the manufacturer’s recommendations.
- F. Drill, direct tap and install 2-inch air valves on mains 12 inches and larger without saddles.
- G. Service pipes larger than 2 inches will require coordination with SFWD to schedule for measurements and connections. The coordination and scheduling shall be in accordance with Section 33 11 00 Water Utility Distribution Piping

## 3.02 SERVICE TRENCH EXCAVATION AND BACKFILL

- A. Service trench excavation and backfill shall be in accordance with Section 31 23 36 - Excavation and Backfill for Water Work.
- B. The service trench shall be of sufficient width to properly install the service pipe and have a flat bottom two feet below the final gutter grade. The gutter grade shall be defined as the existing gutter grade or six inches below the official grade (grade at top of curb as established by the San Francisco Board of Supervisors) whichever is lower.
- C. The bottom of the trench shall slope uniformly to the main from a point approximately ten feet from the main.
- D. Service trench pavement restoration shall be performed in accordance with the provisions of Section 32 10 00 - Pavement Restoration for Water Work of the Specifications



- E. Excavation and backfill for service connection and disconnection holes at the mains shall be paid for under the bid item for Additional Excavation and Backfill.
- F. Excavation and backfill for services larger than 2 inches shall be paid for under the bid item for Excavation and Backfill for 4-, 6- and 8-Inch Pipe Trench.

### 3.03 INSTALLATION OF SCREW TAPS AND SERVICE PIPE

- A. The Contractor shall install screw taps for 1- and 2-inch services as directed by the City Representative. SFWD will perform the service changeover to the new main. Contractor shall excavate connection/disconnection pits and service pipe trench prior to scheduling SFWD work. The Contractor shall not disturb newly paved concrete pavement slabs.
- B. For existing 1-inch plastic services where the service pipes are connected on the opposite side of the street, the Contractor shall install new 1-inch service pipe using trenchless methods as directed by the City Representative. Contractor shall renew 1-inch plastic service pipes by pulling the new 1-inch copper through the existing 1-inch plastic service pipe at the same location instead of excavating a trench for the service pipe. This will be paid for under the Bid Item for Renewal of 1-inch Plastic Service Pipe – Trenchless Installation. The service meter will be installed and connected to the service line by the Water Department. The Contractor shall not disturb newly paved concrete pavement slabs.
- C. The Contractor shall dig trench under the curb, gutter, sidewalk and parking strip to the meter box as shown in the CDD Standard Plans. If the Contractor wants to use any other method other than open trenching, prior approval by the City Representative is required. The City Representative's approval does not relieve the Contractor from the responsibility and liability of properly protecting underground facilities.
- D. Should the meters be located inside sub-sidewalk basements, the Contractor shall, as incidental work, make openings in basement walls for service renewal installations. Basement walls are located at or just behind the curb line. The size of the opening shall be sufficient to accommodate the service being installed, with the maximum service size being 8-inches. The Contractor shall maintain the opening in such a way that the basements remain free from flooding with water from outside through this opening during and after the installation of service pipe. After the installation the Contractor shall dry-pack with non-shrink grout the annular gap to prevent water from leaking into the basement or as directed by the City Representative.
- E. When the installation of the pipe through the basement wall is part of the service change over and is done by SFWD personnel, Contractor shall maintain the annular gap between the pipe and the wall opening. The Contractor shall install a permanent plug after SFWD completes the work. The permanent plug shall be approved by the City Representative prior to backfilling the hole.
- F. All service trench pavement restoration shall be performed in accordance with the provisions of Specifications Section 32 10 00 - Pavement Restoration for Water Work of these Specifications.
- G. All installation of 2-inch service pipe and installation of 1-inch service pipe in open trench excavations will be performed by SFWD.

SERVICE LIST

Address		Existing Service				New Service		
		Tap Directions	Size	Mat.	Size	Mat.	Work Required*	
WD-2905								
435	Amador St	20' WE PL Pier 92	13' SS PL Amador St	6"	C	6"	C	D-RENEW, S
488	Amador St	8' SN PL Amador St	38' WW PL Bldg 429	4"	D	4"	D	D-RENEW, S
500	Amador St	46' NS PL Amador St	505' WW PL #429 Amador St	4"	D	4"	D	D-RENEW, S
699	Amador St	12' NS CU Amador St	462' EE CU Cargo Way	1"	P	1"	C	D-RENEW, S
90	Pier	26' NS PL Amador St	322' WW PL Shed Office	1"	UNK	1"	C	D-RENEW, S
701	Amador St	12' NS CU Amador St	310' EE PL Cargo Way	2"	C	2"	C	D-RENEW, S

SERVICE TYPE:

C-COMBINATION D-DOMESTIC F-FIRE I-IRRIGATION S-SHORT L-LONG

SERVICE MATERIAL:

C-COPPER P-PLASTIC I-CAST IRON D-DUCTILE IRON W-WROUGHT IRON G-GALVANIZED UNK-UNKNOWN UD-UNDETERMINED

\*WORK REQUIRED SUBJECT TO FIELD CHANGES

END OF SECTION

## SECTION 33 12 16.12

## GATE VALVES

## PART 1 – GENERAL

## 1.01 SCOPE OF WORK

- A. Furnish all materials, equipment and incidentals required and install, complete for operation, all gate valves, actuators, appurtenances and miscellaneous items as shown on the Drawings and/or specified herein.

## 1.02 RELATED WORK

- A. Section 01 11 00: Summary of Work
- B. Section 33 11 00: Water Utility Distribution Piping
- C. Section 01 35 55: Sanitary Work Practices, Disinfection, and Other Regulatory Requirements

## 1.03 REFERENCES

- A. ANSI/ASME B 16.1– Gray Iron Pipe Flanges and Flanged Fittings
- B. ANSI/NSF 61 – Drinking Water System Components
- C. ANSI/AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- D. ANSI/AWWA – C509-15 Resilient-Seated Gate Valves for Water Supply Service
- E. ANSI/AWWA – C515-15 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
- F. AWWA C550 – Protective Interior Coatings for Valves and Hydrants
- G. SFPUC CDD Standard Plans (<https://sfpuc.org/construction-contracts/design-guidelines-standards/water-main-installation>)

## 1.04 DESCRIPTION OF SYSTEM

- A. The items specified under this Section shall be new resilient-seated gate valves. The valves shall be installed substantially as shown on the Drawings so as to form complete workable systems.
- B. The Contract drawings indicate new gate valves in various sizes. This includes 4", 6", 8", 12" and 16" gate valves shown in the drawings.
- C. All gate valves shall **open clockwise (open right). Counter-Clockwise to close.**

**1.05 QUALIFICATIONS/RESPONSIBILITIES**

- A. The equipment specified under this Section shall be furnished by manufacturers who are fully experienced, reputable, qualified and regularly engaged in the manufacture of the equipment to be furnished, and shall have a minimum of five (5) years experience in the manufacture of specified equipment for valves.

**1.06 SUBMITTALS, OPERATION AND MAINTENANCE INSTRUCTIONS**

- A. Submit to the City Representative within seven calendar days after the Notice to Proceed, a list of materials to be furnished and the date of delivery of materials to the job site.
- B. Submit to the City Representative for review as provided in Section 01 33 00 – Submittal Procedures, complete shop drawings and pertinent information relating to the installation of the valve. The submitted information shall include, but not limited to:
  - 1. Literature and drawings, describing the valve in sufficient detail, including catalog cuts, material parts list, dimensions and weights of materials, and details of construction and installation.
  - 2. All valves will be direct buried and manually operated. Typical catalog drawings will not be acceptable.
  - 3. A metal plate will be set around the nut with a cut piece of ductile iron pipe riser to the surface.
  - 4. Detailed manufacturing schedule with a list of materials to be furnished and date of delivery to the job site.
  - 5. Factory Testing: Procedures shall be submitted with the valve submittal and certified test report shall be submitted following factory shop testing. See article 3.01.
- C. Following installation and startup, Submit O & M Manual data and contents.
- D. Submit certifications per Section 01 35 55 – Sanitary Work Practices, Disinfection, and Other Regulatory Requirements
- E. Certificate of Compliance or complete list of all deviations from the drawings and specifications.

**1.07 QUALITY CONTROL**

- A. The manufacturers shall be required to furnish the City Representative with a certified statement that all the requirements of the Specifications referred to herein have been complied with.
- B. Inspection of the units shall be made by the City representative of the City after delivery. The equipment shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though submittal data may have been accepted previously.

### 1.08 HANDLING, DELIVERY, AND STORAGE OF MATERIALS

- A. Contractor shall maintain a tracking log/inventory of all contractor-furnished materials received, stored, used, and installed and shall be used to monitor changes and payment against the Bill of Materials. This log will be made available to the City Representative upon their request.
- B. The Contractor shall be responsible for all labor, equipment and transportation means required to receive and store Contractor-furnished materials. Piping materials and appurtenances shall be stored in a manner safe to the public and in accordance with the local agency requirements.

### 1.09 TOOLS AND SPARE PARTS

- A. The manufacturer's recommended complement of spare parts, including a full set of gaskets and seals, shall be provided. Special tools, if required for normal operation and maintenance shall also be provided.

### 1.10 WARRANTY

- A. Unless otherwise noted herein, the contractor shall furnish a warranty of a minimum of three (3) years from the date of substantial completion for all work covered by this Section. See Section 01 78 36 - Warranties.

## PART 2 – PRODUCTS

### 2.01 GATE VALVES – 4 INCH, 6 INCH, 8 INCH, 12 INCH AND 16 INCH

- A. 4-, 6-, 8-, 12-, and 16-inch ductile iron Tyton joint (TYT), mechanical joint (MJ) and flange joint (FL) gate valves.
  - 1. General:
    - a. All valves shall fully comply with the latest revision of AWWA C509-2015 or C515-2020. Testing and inspection for valves shall be done in accordance with latest version of AWWA C509 or C515. Contractor shall submit manufacturer certification stating valves have been tested and inspected in accordance with AWWA C509 or C515. The leakage test shall be 1,000 complete cycles instead of 500 complete cycles as specified in AWWA C509 and C515 and certified by an independent testing lab as applicable.
    - b. The valve shall be rated for 250 psig working pressure.
  - 2. Reference Standards
    - a. Valves shall be manufactured and tested to AWWA C509 or C515 standards with a minimum design working pressure of 250 psi.
    - b. Valves and components shall be in full compliance with the latest revision of AWWA/ASTM/NSF 61, and also be UL Listed and FM approved (except as modified herein) for all water system requirements. Valves shall be UL listed at a minimum of 250 psi. Valves shall be tested and certified to ANSI/NSF 61.
    - c. Bronze valve components shall not contain more than 16% zinc and 0.25% lead nor exceed the limit set in any applicable codes or standards.

3. Coating: Unless specified otherwise, coating shall consist of the following:
  - a. Prior to coating valves, surfaces shall receive a surface preparation according to the requirements of AWWA C509 or C515.
  - b. The body, bonnet, and O-ring plate shall be fusion-bonded epoxy coated, both interior and exterior on body and bonnet. Epoxy shall be applied in accordance with AWWA C550 and be NSF 61 certified.
  - c. The minimum nominal dry film thickness of the coating shall be at least 10 mils excluding flange faces. Coating thickness shall not exceed 16 mils or maximum recommended by the coating manufacturer, whichever is less.
  - d. Internal coatings shall be free of holidays and pinholes, and shall be tested in accordance with ASTM G62 Method A or B. Internal coatings shall be tested and Contractor shall confirm testing method certification on all wetted surfaces.
  - e. Materials and coating shall be suitable for soft water (less than 50 ppm total dissolved solids) with pH from 7.0 to 9.5 and chloramines residual of up to 4.0 ppm.
4. Traceability: All bodies of valve bonnets shall have cast-on raised letters indicating the manufacturer's name, valve size, and design working pressure.
5. Operating Requirements: **Valves shall open clockwise (open right)**. Operating nuts shall be painted red for right turn open valves. Operating nuts shall be painted black for left turn open valves and valves with bevel gears (if shown).
6. Valve Body and Bonnet:
  - a. Valve bodies and bonnets shall be made of ductile iron and thickness of body and bonnet components of valves shall conform to Table 3, Section 4.4 of AWWA C509 or C515.
  - b. All parts of the valve shall fit snugly without binding. All threads shall fit "hand tight". All bolt holes shall have sufficient clearance for the inserting of the required bolt without driving.
  - c. All valves 4-inch through 16-inch shall be of the same manufacturer.
  - d. All valves shall have a smooth, unobstructed waterway free of pockets and depressions.
7. Valve Ends:
  - a. Push-On Joint Valves: Valve end configuration shall be furnished with Tyton by Tyton push-on joints. Joint ends shall also be in accordance to ANSI/AWWA C111/A21.11.
  - b. Mechanical Joint Valves: Valve ends configuration shall consist of mechanical joints. Mechanical joint ends shall be manufactured in accordance to ANSI/AWWA C111/A21.11. Mechanical joint valves shall be compatible with wedge action gland body restraints with individual actuated wedges that increase resistance to pull-out of mechanical joints. Fasteners and accessories do not need to be provided with mechanical joint valves.
  - c. Flange Joint Valves: Flanged end drilling pattern shall be ANSI B16.1 Class 125.

8. Valve Disc:
  - a. Valve disc shall be made of ASTM A536 ductile iron. Fabricated steel disc is not acceptable.
  - b. Valve discs and guidelugs shall be fully encapsulated with EPDM and shall comply with ASTM D429 and have a peel strength no less than 75 pounds per inch. Elastomer shall be securely bonded to the gate body, including the part which houses the stem nut.
  - c. Valve discs shall be equipped with guide caps made of thermoplastic or other polymer materials to maintain optimum alignment with the body throughout the disc travel and to reduce operation torque and prevent abrasion of rubber coated gate and fusion epoxy interior coating.
  - d. Sealing rubber shall be permanently bonded to the wedge per ASTM D429 per AWWA C509 or C515.
  
9. Stems and Stem Nuts:
  - a. The valve stem shall be made of ASTM B138 C67600 or ASTM B763 C86700. The bronze stem shall have at least two (2) "O" ring stem seals above the thrust collar and one (1) "O" ring below the thrust collar. The "O" ring stem seal(s) shall be replaceable with the valve under pressure in the full open position. Valves without at least three (3) "O" rings are unacceptable.
  - b. The disc shall have cast ASTM B763 C86700 or ASTM B584 bronze stem nut to prevent twisting or angling of the stem. Designs with loose stem nuts are unacceptable.
  - c. Valve type shall be NRS (non-rising stem).
  - d. Torque Minimum Values from UL262 shall apply to all NRS valve stems. Torque values from this table shall be met without stem failure. Valves without a stuffing box are unacceptable.
  - e. To allow identification of stem material by City inspection personnel, the manufacturer must provide identification of stem material. Identification may be via permanent stamping on the stem above the packing gland and below the wrench nut, or through stamping on a metal nameplate/tag affixed to the stem/operating nut with stainless steel braided cable.
  - f. The valve stem shall have at least one (1) "anti-friction" thrust washer above and below the stem collar to reduce operating torque. Valves with two-piece stem collars are unacceptable.
  
10. Operating Nut:
  - a. Operating nuts shall be made of ductile iron. Valves shall be fitted with one (1) 2-inch square skirted operating nut. The engagement between the operating nut and the stem shall be either lugged or pinned. For the lugged engagement system, the operating nut shall be fastened to the valve stem by a bolt or a nut if the bolt is an integral part of the stem.
  - b. Operating nuts shall have an arrow cast showing the opening direction as specified.
  - c. Operating nuts shall be painted red.
  - d. **Valves shall open clockwise (open right).**

- 11. Gearing
  - a. Furnish gearing, if any, as shown in the Contract documents including reference details.
- 12. Elastomers and Gaskets:
  - a. Elastomers shall be constructed of EPDM and shall be in compliance with NSF 61 standard. Elastomers shall be fully cured and rinsed in clean water before assembly into valve and shall be proven resistance to chloramines attack and not impact the taste and odor when placed in service.
  - b. Gaskets, "O" rings and all other seals shall be made of EPDM elastomer materials and shall be in compliance with NSF 61 as specified above.
- 13. Fasteners and Hardware:
  - a. Fasteners and hardware such as nuts and bolts shall be made of 316 stainless steel. All bolts, nuts and threads shall be standard sizes. Cap screws shall be provided with hexagonal heads.
- 14. Bill of Materials

The Contractor shall furnish all gate valves as necessary as shown in the Contract. The following table below presents the minimum (size and quantity) of gate valves the Contractor shall furnish and install. Should there be a difference, the larger quantity shall be used as the basis of bid.

Valve	Quantity
VALVE, GATE TYTxTYT 6in	5
VALVE, GATE MJxMJ, 16in	2

- B. See also Specification Section - 33 11 00 Water Utility Distribution Piping for additional requirements. Accessories such as valve boxes shall be per standard detail CDD-LP-250 and furnished by the Contractor. The valve box covers and steel base plates, however, shall be City Furnished.
- C. Gate valves shall be:
  - 1. Model A-2362 for 12 inch and smaller gate valves and A-2361 for 16 inch gate valves manufactured by Mueller Company, or
  - 2. Approved equal.

**PART 3 – EXECUTION**

**3.01 SHOP TESTING**

- A. Prior to shipment, all valves shall be subjected to hydrostatic, leakage, and performance tests as specified in AWWA Standards C509 (Section 5.1) or AWWA Standard C515. Certification of tests and copies of the test reports shall be furnished.



- B. There shall be no evidence of wear at any friction point, or failure, distortion or other evidence of weakness of any part, nor excessive noise or looseness of moving parts during any portion of the testing as specified below.

### 3.02 PROTECTIVE COATING AND LINING

- A. The coating shall be applied in strict accordance with manufacturer's direction and as specified herein. The coating and lining shall be free of holidays. Appropriate "return" shall be incorporated at all juncture lines of coated and uncoated surface such as valve bore to valve flange to prevent lifting of the coating. NOTE: Drawings submitted for design approval must describe these "return" and the surfaces to be coated.
- B. Upon delivery, valves may be inspected or tested by the City Representative for compliance with these Specifications. Any valve found not to comply will not be accepted until deficiencies are corrected by the Contractor at no cost to the City. Failure by the City Representative to inspect or witness tests at the manufacturer's plant shall not be construed as waiving inspection upon delivery or testing.

### 3.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall furnish the services of the manufacturer's representative to verify proper installation of gate valves upon City request. The services of the representative shall not be construed as relieving the Contractor of his/her responsibility for furnishing qualified supervisors and mechanics to properly perform the installation.

### 3.04 INSTALLATION OF VALVES

- A. All valves shall be installed as shown, on the Drawings true to alignment and supported. Contractor shall furnish and install all necessary hardware for a complete installation of the valves. Any damage to the valves shall be repaired to the City representative's satisfaction before they are installed. All items shall be installed in accordance with the Manufacturer's recommendations.
- B. Install the valves as shown on the Drawings. The Contractor shall check all plans and figures, which have a direct bearing on their location, and he/she shall be responsible for the proper location of these valves. Installation shall be in accordance with AWWA C509 or C515, Appendix A, Section A.5.
- C. Flanged joints shall show no visible leakage under test. Repair joints that show signs of leakage prior to final acceptance by the City. Valves shall be stored indoors at an offsite location approved by City representative at no additional cost to the City.
- D. See Specification Section - 33 11 00 Water Utility Distribution Piping for additional installation requirements.

### 3.05 FIELD TESTING

- A. The Contractor shall exercise due care in loading, unloading, and handling of the valves. The Contractor shall be solely responsible for any damage to the valves and shall repair any valves damaged in handling to the satisfaction of the City Representative at no cost to the City.
- B. Contractor shall field test the valves after installation by operating one full cycle per each valve. Contractor shall leave the valves in the open position after testing.

- C. See also Specification Section - 33 11 00 Water Utility Distribution Piping for additional testing requirements.

END OF SECTION

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## SECTION 33 13 00

## SANITARY WORK PRACTICES AND DISINFECTION OF WATER UTILITY DISTRIBUTION

## PART 1 – GENERAL

## 1.01 SUMMARY

- A. This Specification Section: summarizes requirements for cleaning, draining, dechlorination, disinfection and testing of drinking water components and facilities associated with the construction of these facilities or impacts to existing facilities as a result of construction.

## 1.02 SCOPE OF WORK

- A. All construction tasks to add or modify drinking water facilities must be implemented using sanitary protocols to prevent or remove contaminants prior to facility startup. Contaminants include, but are not limited to, fuels, hazardous materials, chemicals and solvents, radioactive materials, construction materials and debris, dirt, microorganisms, surface water runoff, groundwater, rodents, vectors, birds and other animals that may degrade drinking water quality.
- B. The Contractor shall be responsible for sanitary work practices and the cleanup of all drinking water components and facilities affected by the work, before they are put into operation.
- C. The Contractor shall post a sign that would be visible for everyone who are within the work perimeter to implement the Sanitary Practice Protocol.
- D. The Contractor shall be responsible for draining and dechlorination of any water following initial limited gravity draining performed by the City. Water may be a result of leaks, intrusion and other sources from components and facilities affected by the work. The Contractor shall be responsible for compliance with all regulations related to the discharge of water, including obtaining and adhering to all necessary permits and keeping all correspondence and records available to the City Representative.
- E. Unless otherwise specified, City will perform initial gravity draining, soak testing, disinfection, dechlorination, flushing, sample collection and water quality testing of all pipelines 24 inches in diameter and smaller and water storage facilities affected by the work. The City Representative will contact regulatory agencies for discharges related to initial draining, flushing and disinfection.
- F. With respect to projects within the City of San Francisco, the Contractor shall be responsible for draining, disinfection and dechlorination of all pipelines greater than 24 inches in diameter, fittings, appurtenances and other components that are used for conveyance of drinking water.

## 1.03 REFERENCES

The Contractor shall use the latest edition of the following references:

- A. American National Standard Institute (ANSI) / National Sanitation Foundation International (NSF) Standard 60 and 61 for Drinking Water System.

- B. American Water Works Association (AWWA) Standards:
1. C651 (Disinfecting Water Mains)
  2. C652 (Disinfection of Water-Storage Facilities)
  3. C653 (Disinfection of Water Treatment Plants)
  4. C654 (Disinfection of Wells)
- C. Title 22 of California Code of Regulations (Title 22), including California Waterworks Standards (Division 4, Chapter 16).
- D. Standard Methods for the Examination of Water and Wastewater, 20<sup>th</sup> Edition, as published by the American Public Health Association.
- E. Other standards as directed by City Representative.

#### 1.04 SUBMITTALS

- A. Not less than 60 days prior to the commencement of work on any facilities, the Contractor shall submit to the City Representative proof of ANSI/NSF Standard 60 certification for all chemicals or products added to drinking water and meet "Direct Additives" requirements under Article 7 of Title 22 California Waterworks Standards. The Contractor shall not use any chemicals or products that are not NSF60 approved without written permission from the City Representative. Testing and certification is required to be from one of the ANSI accredited organizations. The direct additives must be used within their specific ANSI/NSF60 certification requirements.
- B. Not less than 60 days prior to the commencement of work on any facilities, the Contractor shall submit to the City Representative proof of ANSI/NSF Standard 61 certification for materials, lubricants and products that will result in its contact with the drinking water per Article 2.3 and meet "Indirect Additives" requirements under Article 7 of Title 22 California Waterworks Standards. Testing and certification is required to be from one of the ANSI accredited organizations. The indirect additives must be used within their specific ANSI/NSF61 certification requirements.
- C. Not less than 60 days prior to the commencement of work on any facilities, the Contractor shall submit to the City Representative a "Sanitary Work Practices Plan" describing the procedures for work involving components, equipment, tools, structures and work areas with the potential for direct contact with drinking water. The Sanitary Work Practices Plan shall describe the Contractor's plan to minimize contamination of the components and facilities during transportation, storage and construction. The Sanitary Work Practices Plan shall address the following requirements:
1. Minimizing physical contamination of the internal surfaces of the existing and newly installed drinking water system components.
  2. Preventing chemical and biological contamination (e.g. oil, grease, residual lubricants, dirt, cross contamination, wastewater, etc.).
  3. Preventing the introduction and loss of foreign materials (construction debris, dirt, garbage, construction material, tools, etc.) into the drinking water system.
  4. Preventing the ingress of vandals or wildlife (birds, rodents, animals, insects etc.) into the drinking water system.

5. Preventing the intrusion of non-drinking water into the pipelines, tanks and appurtenances. Non-drinking water sources include, but are not limited to, surface water runoff, rain water, contaminated drinking water, groundwater, etc.
  6. Post-construction cleanup that may include localized spray or swab disinfection of the components and facilities upon completion of work.
  7. Cleanup and disinfection of the components as a preventive measure as directed by the City Representative. If disinfection of the facility is to be performed by the Contractor, the Contractor's plan shall include:
    - (a) Disinfectant name and concentration
    - (b) Proposed disinfection method.
    - (c) A diagram showing all pipes including the length, valves and appurtenances to be disinfected, as well as the sampling, monitoring and chemical injection locations.
    - (d) Flushing velocity and flow calculations.
    - (e) Calculations for disinfectant quantity to be used.
    - (f) Sampling Plan
    - (g) Material Safety Data Sheets (MSDS) for the disinfectant to be used.
  8. Description of sanitary controls established by the Contractor in accordance with AWWA Standards.
- D. Not less than 60 days prior to the commencement of dechlorination, the Contractor shall submit to the City Representative a "Draining, Dechlorination and Monitoring Plan" for compliance with regulatory requirements.
1. The Plan shall include information on personnel, equipment, instruments, chemicals, sampling locations, and procedures related to the calibration of instruments, monitoring, notification and recordkeeping.
  2. The Contractor shall also provide the City Representative with an estimate of the water volume and time period for the discharge.
  3. Refer to Article 3.2 for draining and dechlorination.
- E. Not less than 60 days prior to the commencement of hot tapping, the Contractor shall submit to the City Representative a "Hot Tap Plan" as described in Article 3.1.
- E. The Contractor shall show timelines on the project schedule for all cleaning, draining, hot tapping, dechlorination and disinfection activities.
- F. Dechlorination monitoring records as described in Article 3.2, or as directed by the City Representative.
- G. If disinfection is required to be performed by the Contractor, the Contractor shall submit disinfection monitoring records including location, chemical name, concentration, dosage, contact time, and other records as directed by the City Representative.
- H. Communications, permits, and records with Regulatory Agencies.

## PART 2 – PRODUCTS

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## 2.01 COMPONENTS

- A. All chemicals, materials, and/or products that are used in construction/ installation and that will be in contact with drinking water are collectively described as drinking water system components (hereinafter the component or components). These include, but are not limited to, process media, protective coating and lining materials, sealants, lubricants and adhesive compounds.

## 2.02 FACILITIES

- A. All equipment, pipelines, valves, fittings, pumps, wells, mechanical devices, and storage tanks that are used for treatment, conveyance, and/or storage of drinking water are collectively described as drinking water system facilities (hereinafter the facility or facilities).

## 2.03 INDIRECT ADDITIVES

- A. All components and facilities that are supplied by the Contractor such as materials, lubricants, and products (e.g. valves, pumps, fittings) in the production, treatment or distribution of drinking water that will result in its contact with the drinking water are required to be certified as meeting the specifications of ANSI/NSF61 and meet California Waterworks Standards. It includes, but is not limited to, process media (carbon, sand), protective materials (coatings, linings, liners), joining and sealing materials (solvent cements, welding materials, gaskets, lubricating oils), pipes and related products (pipes, tanks, fittings), and mechanical devices used in treatment/ transmission/ distribution systems (pumps, valves, chlorinators, separation membranes).

There are three ways to comply with the California Waterworks Standards for Indirect Additives. They are listed below in the preferred order:

1. All Components: The entire material, lubricant, or product is certified as meeting the specifications of ANSI/NSF61. The Contractor shall submit proof of ANSI/NSF61 certification for the entire material, lubricant, or product to the City Representative for acceptance.
2. All Wetted Components: If the entire material, lubricant, or product is NOT certified as meeting the specifications of ANSI/NSF61, then all wetted components that may result in its contact with drinking water are required to be ANSI/NSF61 certified. The Contractor shall submit a list of all wetted components, manufacturers of the components, materials of construction, and proof of ANSI/NSF61 certification for the components to the City Representative for review and acceptance. The contractor shall collect data for each wetted component and associated certification in a timely manner taking into account that information gathering for each component may be a time consuming process.
3. Some or No Components/Waiver: If ANSI/NSF61 certified materials cannot be used or if there are no certified alternatives, then the Contractor shall submit justification with supporting information that demonstrates equivalent public health protection for use of the proposed product to the City Representative for review and waiver by SFPUC and California Department of Public Health (CDPH). In order to demonstrate the same level of public health protection, CDPH may require leach tests or other criteria on a case-by-case basis for the material or product, which can be a complex and time consuming process that should be accounted



for by the Contractor. CDPH will need 30 days to review justification package; however, CDPH regulatory review timelines can be unpredictable at the time of submittal and there are risks that CDPH may deny the approval request.

- B. “All Components” compliance method for the entire material, lubricant, or product (valves, pumps etc.) provides clear regulatory compliance and is the best option as it eliminates chances of delay (some of which may be classified as Avoidable Delay) associated with further reviews and CDPH approval.
- C. The Contractor shall comply with ANSI/NSF61 regulatory requirements as specified in Articles 1.3 and 2.3, obtain complete ANSI/NSF61 certification documentation, and provide timely submittals to the City Representative for acceptance not less than 60 days prior to the commencement of work on any facilities to avoid any schedule delays. If ANSI/NSF61 certified materials are available, but the Contractor fails to procure and install ANSI/NSF61 certified materials, or fails to provide complete NSF61 certification documentation, then the Contractor shall be responsible for schedule delays and related overhead expenses associated with corrective actions and with any necessary regulatory approvals. Such schedule delays will be classified as Avoidable Delays under the Contract Documents.
- D. If ANSI/NSF61 certified materials are not feasible or if certified materials do not exist, then the contractor shall provide timely submittals with workable alternative solutions to the City Representative for review and acceptance not less than 60 days prior to the commencement of work on any facilities to avoid any schedule delays. This will also require review and approval by CDPH as specified in Article 2.3 (A) (3). The Contractor shall implement mitigation measures and meet regulatory requirements as directed by the City Representative. The Contractor shall be responsible for the cost of any extended overhead as a result of non-compensable schedule extension. In no event will delays associated with review and approval by CDPH entitle Contractor to a compensable time extension.

### PART 3 – EXECUTION

#### 3.01 SANITARY WORK PRACTICES

- A. The Contractor shall exercise due care and implement sanitary work practices as described hereunder to prevent physical, chemical, biological and animal contamination of all components and facilities.
- B. The Contractor shall establish sanitary controls in accordance with AWWA Standards C651 (most recent edition) Section on “PREVENTIVE AND CORRECTIVE MEASURES DURING CONSTRUCTION.”
- C. The Contractor shall be responsible for implementation of its Sanitary Work Practices Plan at all times.
- D. All materials stored on site shall be kept in a clean and undamaged condition. Hazardous materials shall be stored at least 25 feet away, or as directed by the City Representative, from all drinking water facilities (in service or out of service), on grounds where surface drainage slopes away from drinking water facilities and away from areas of standing water. All temporary human waste collection systems (i.e. “Portapotties”, or holding tanks) shall be kept a minimum of 25 feet away, or as directed by the City Representative, from any drinking water storage or conveyance system, and will be placed in a manner that will prevent any leakage from contaminating any part of the components/facilities storage or conveyance system.

Pipelines, valves and other appurtenances shall be kept capped, wrapped or housed to prevent unsanitary conditions, rust, animal nesting and other contamination hazards. Plugs of rags, wood, cotton, or similar materials are not acceptable.

- E. Prior to installation of any facilities and/or components, all plugs, caps, dirt, debris, grease, and foreign material shall be removed. If dirt has entered a pipeline, or disinfection of the components (e.g. valves, small pipe sections, taps etc.) is required prior to installation, the Contractor shall spray or swab the interior surface using a nominal 1% sodium hypochlorite solution as the disinfectant as directed by the City Representative. The solution should have at least 10,000 milligrams per liter (mg/L) chlorine concentration. For the purpose of preventing corrosion by the disinfectant, and upon request by the City Representative, the Contractor may need to rinse the interior surface with drinking water to remove the disinfectant after the disinfectant has been in contact with the surface for at least five (5) minutes.
- F. Once cleaned, all components and facilities shall be stored under controlled conditions to prevent re-contamination. If the City Representative finds unacceptable care or cleanliness of the components and facilities prior to installation or being put into service, the Contractor will be required to clean the components and facilities to the satisfaction of the City Representative. The Contractor shall be solely responsible for the cost of the required cleaning.
- G. If the Contractor is required to enter the interior of any in-service facility, all tools, equipment and boots shall be washed and cleaned to remove dirt, and disinfected with a nominal 200 mg/L sodium hypochlorite solution prior to entering the facility, or as directed by the City Representative. Material and tools may be rinsed with drinking water to remove residual disinfectant after 15 minutes of contact time, or as directed by the City Representative.
- H. The Contractor shall remove all dirt, dust, oil and foreign materials from all components and facilities after their installation and prior to the disinfection to the satisfaction of the City Representative.
- I. The Contractor shall be responsible to take all safety and precautionary measures, including safe handling of chemicals, safe operation of equipment/tools, and the use of appropriate personal protective equipment during and at the end of construction. The Contractor shall provide the City Representative with Material Safety Datasheets (MSDS) of all chemicals and other hazardous materials used by the Contractor at the site. The MSDS of all chemicals shall be kept on-site at all times for City Representative review.
- J. The Contractor shall notify the City Representative immediately of any suspected vandalism, chemical spill or construction activity that could cause contamination or otherwise compromise the integrity of the facilities.
- K. Hot Tap Practices
  - 1. For any occasion when the Contractor will tap into an active drinking water storage or conveyance, the Contractor shall submit a Hot Tap Plan and schedule to the City Representative not less than four weeks in advance of the procedure. The Contractor shall confirm the time of the hot tap with the City Representative in advance. The hot tap shall proceed only in the presence of the City Representative or other designated representative of the City.
  - 2. All materials, lubricants, sealants or other compounds used in the hot tap shall be

NSF 61 compliant. The Contractor shall submit product descriptions displaying NSF 61 compliance as part of the Hot Tap Plan.

3. All mechanical parts that have the potential to come into contact with drinking water shall be disinfected as specified in Article 3.3, prior to the hot tap and kept clean until use. These parts may include, but are not limited to, the drill bits, the housing, and the surface of the pipeline around and above the tap location. The subject parts and method of disinfection shall be described in the Hot Tap Plan and implemented to the satisfaction of the City Representative.
4. The area around the tap shall be secured from landslide, erosion, runoff, flooding or unauthorized entry prior to the hot tap work. Drainage from the tap shall be controlled and directed away from the tap. These precautions shall be described in the Hot Tap Plan and implemented to the satisfaction of the City Representative.
5. Any failure in the hot tap shall be immediately communicated to the City Representative, and the Contractor shall, at no cost to the City, take appropriate remedial measures, as determined by the City Representative.

### 3.02 DRAINING AND DECHLORINATION OF PIPELINES AND STORAGE FACILITIES

- A. Prior to construction, City personnel will perform initial gravity draining of the pipelines and storage facilities to the extent possible without pumping. The Contractor shall be responsible for draining and/or pumping water that remains in the facility as a result of leaks, intrusion, or other sources, to pursue the contract work. The Contractor shall dechlorinate any water drained or pumped from the components or facilities prior to discharging to surface water or storm drainage according to his submittal and as directed by the City Representative.
- B. The City drinking water typically contains detectable total chlorine residual up to 4 mg/L and has an elevated pH up to 9.5. The discharge of water to a surface stream or creek may also cause turbidity in the receiving water to increase. Prior to discharging water, the Contractor shall be responsible for dechlorinating all water that is drained/pumped out of the facility. The Contractor shall treat, monitor and record all water discharges into storm drains, surface streams, or other locations not connected to a sanitary sewer to ensure compliance with all applicable City, Regional Water Quality Control Board (RWQCB) and local regulatory requirements. In addition, the City Representative may require the Contractor to monitor these parameters at a different frequency during unusual water quality conditions.

The RWQCB requirements are as follows:

1. The discharged water shall have non-detectable chlorine residual (<0.05 mg/L). The frequency of monitoring in the effluent shall be every 60 minutes for the duration of the discharge.
2. The pH of the discharged water shall be in the range of 6.5 to 8.5. If the discharge fails to meet this limitation additional samples may be collected in the receiving water stream to verify compliance with the pH standard. If the pH standard cannot be met in the receiving water then sampling should be conducted 50 feet upstream and downstream of the discharge to determine if the ambient pH has not been changed by more than 0.5 pH unit. If the standard still cannot be attained then further treatment prior to discharge is necessary. The frequency of monitoring in

the effluent shall be every 60 minutes for the duration of the discharge.

3. To limit erosion when discharging to the receiving water a perforated pipe will be attached to the discharge line in the shape of a T (See SFPUC WS&TD SOP).
  4. The discharge shall not cause pollution, contamination, or nuisance. The discharge shall cause no scouring or erosion at the point where discharged water enters the receiving water.
- C. At no cost to the City, the Contractor shall provide all necessary equipment (for example tanks, pumps, valves, instruments, controls, chemicals) and qualified on-site personnel for managing and monitoring the water discharges. The Contractor shall notify the City Representative for inspection of the equipment set up prior to the commencement of draining and dechlorination.
  - D. Total Chlorine residual must be monitored using EPA approved test methods, which can be found in the latest edition of Standard Methods for the Examination of Water and Wastewater or at the EPA website. The City typically uses Hach Pocket Colorimeter (DPD Method) for total chlorine residual monitoring during dechlorination. The test kit is available from Hach ([www.hach.com](http://www.hach.com)). Note that total chlorine and free chlorine are measured using different test kits.
  - E. The Contractor shall, at no cost to the City, provide, configure and set up an appropriate dechlorination system using either a drip feed, or a metering pump feed of a nominal 25% sodium bisulfite solution, or other suitable chemicals approved by the City Representative.
  - F. The Contractor shall, at no cost to the City, maintain pH levels while complying with other parameters specified in Article 3.2.B, by adjusting the flow rate of dechlorination chemical, or by using acid and/or alkali. Note that sodium bisulfite has some pH depression capability.
  - G. The Contractor shall be responsible for all regulatory issues related to this discharge including obtaining, paying for, adhering to all permit terms and conditions and for keeping written records of any regulatory communication available for the City Representative. In the event of an accidental release of water discharges not meeting the RWQCB requirements specified in Article 3.2, the Contractor shall immediately notify the City Representative and take necessary actions to stop the discharge and correct the process to meet the discharge requirements. The Contractor shall provide relevant monitoring data and an estimate of the volume of water discharged that did not meet regulatory requirements.
  - H. During all periods of discharge, the Contractor shall monitor and maintain records for verification that the water has been dechlorinated and pH adjusted to meet the RWQCB requirements specified in Article 3.2. The Contractor shall prepare and maintain a daily log of the monitoring and sampling results, in addition to completing the Discharge Monitoring Form (DMF) provided in this Section as Appendix 'A' and provide records of both the daily log and the DMF to the City Representative. The Contractor shall monitor and record all such discharges at a frequency of not less than once per hour. The daily log, recorded in ink, shall include, but are not limited to: dates, time, sampler names, signatures, sample locations, discharge locations (including latitude and longitude), instrument and equipment calibration records, estimated discharge flow rates, chemical feed rates, total chlorine residuals and pH at upstream and downstream of the dechlorination points, turbidity and other parameters in accordance with Article 3.2. The Contractor shall also calculate the

total volume of water discharged and total quantity of chemicals used on a daily basis.

- I. The Contractor shall provide the original copies of the previous day's monitoring logs to the City Representative by 10:00 AM the following calendar day.
- J. Where the Contractor plans to use a sanitary sewer for the discharge, the Contractor shall submit the request to the City Representative for prior review and acceptance prior to initiating the discharge. The Contractor shall provide detailed information regarding the sewer location, approved backflow devices, anticipated dates of the discharge, and approximate flow rates and volumes. If permission to use the sewer is granted by the City Representative, the Contractor shall comply with all local agency requirements, including schedule submittals, notifications, flow rate limits, applicable water quality standards, monitoring and pre-treatment requirements. The Contractor shall be responsible for all sewer related permitting and discharge issues and costs.

### 3.03 DISINFECTION OF CONVEYANCE FACILITIES (PIPELINES AND ASSOCIATED APPURTENANCES)

- A. After installation of conveyance facilities and field tests by the Contractor, the City may perform a soak test if new coatings, linings, sealants, or other chemicals may have been introduced or used by the Contractor as part of the contract work. This soak test is for water quality testing that the Contractor's work must pass prior to disinfection. City personnel may also perform a localized preliminary disinfection inside the conveyance facilities prior to soak tests and full scale disinfection. The Contractor may also be required to perform a localized preliminary disinfection, if necessary, as instructed by the City Representative.
- B. In performing disinfection of a valve, City personnel may need access to both sides of the valve. The Contractor shall be responsible for keeping the valve open and the pipeline dry during the preliminary disinfection. This preliminary disinfection process is estimated to take about four (4) hours at each location. The City Representative will notify the Contractor at the completion of the preliminary disinfection process.
- C. Prior to putting these facilities into service, the City will perform a full-scale disinfection of the conveyance facilities in accordance with the AWWA Standards and the City's internal disinfection procedures.
- D. The Contractor shall notify the City Representative not less than **5 weeks** prior to a facility being ready for disinfection. The Contractor shall coordinate construction activities to facilitate the disinfection conducted by City personnel. The Contractor shall provide access, support and equipment, as needed, to assist City personnel in completing the disinfection.
- E. The Contractor shall plan the work schedule by taking into consideration the time required by City personnel for disinfection, which typically includes filling, disinfecting, flushing, dechlorinating, and taking water samples from the disinfected facilities for bacteriological analysis and residuals management. Although the estimated time required for disinfecting each pipeline segment may be up to **5 days**, depending upon size and length of pipe, the actual time required for the completion of disinfection and bacteriological testing may vary depending on site conditions. It is the Contractor's responsibility to plan ahead of construction schedule and coordinate with the City Representative to allow sufficient time for SFPUC personnel to complete the disinfection work.
- F. After completion of disinfection, the City Representative will arrange for City personnel to collect water samples for bacteriological analysis. The passing criteria for satisfactory disinfection of the components and facilities is that all water samples shall indicate the

absence of total coliform bacteria. Any sample result that shows positive for total coliform is considered a failed test.

- G. If the Contractor is required to perform the preliminary and final disinfection of the conveyance facilities as part of the Contract work, the Contractor shall follow the same procedures as described in Articles 3.3 above for the disinfection work performed by City personnel.
- H. The City Representative will be responsible for contacting the governing regulatory agencies on all matters related to the disinfections and related environmental discharges.

### 3.04 WATER QUALITY TESTS AND REMEDIAL MEASURES

- A. Water quality tests include soak tests and bacteriological tests. The Contractor may be required to perform these tests if directed by the City Representative. In that event, the Contractor shall be responsible for all the materials and labor to conduct these tests.
- B. The City is responsible for collecting appropriate water samples upon completion of soak tests and bacteriological tests. Samples will be analyzed for the appropriate contaminants and bacteriological parameters by the City.
- C. If any of the water quality tests fails, the Contractor shall, at no cost to the City, take appropriate remedial measures, as determined by the City Representative, to ensure that the components and facilities pass the specified water quality tests. These remedial measures may include, but are not limited to, aeration utilizing a compressor with an oil separator, draining/cleaning/refilling the component and/or facility, re-application of coating or sealant, or any combination of these and other remedial measures as determined by the City Representative. It is presumed that any failure to pass the specified water quality tests is due to foreign constituents introduced into the facility by the Contractor and/or by improper application of coating/sealing materials.
- D. Upon the Contractor's completion of all required remedial measures, the City Representative will reschedule disinfection of the facility, if necessary, and the specified water quality tests as described above.
- E. Disinfection and water quality testing of the components and facilities shall be repeated until all water samples pass the specified water quality tests. All costs and time associated with assuring that the facility passes the specified water quality tests are the sole responsibility of the Contractor.
- F. Facilities shall not be placed into service unless the required water quality tests pass to the satisfaction of the Water Quality Engineer.
- G. The City is not responsible for the Contractor's loss as a result of any delays in project completion due to the failure of the initial and repeat water quality tests.

### END OF SECTION

(See Appendix 'A' on following page)

**APPENDIX 'A'**

**REGIONAL TRANSMISSION SYSTEM  
DISCHARGE MONITORING FORM**

**Water Supply and Treatment Division**

<b>PROJECT INFORMATION</b>								
Project Name: _____								
SFPUC City Representative: _____								
Project Contractor: _____								
<b>DISCHARGE LOCATION DETAILS</b>								
City and Cross Street(s): _____								
Latitude and Longitude: _____ N _____ W								
Receiving Water Body: _____								
<b>DISCHARGE MONITORING DATA (attach additional sheets as necessary)</b>								
Date	Time (hr)	Discharge Flow Rate (gpm)	Raw Cl <sub>2</sub> Residual (mg/L)	Treated Cl <sub>2</sub> Residual (mg/L)	Dechlor Feed Rate (gph)	Dechlor Chemical Used	Treated pH (su)	Sampler Initials
<b>EROSION CONTROL MEASURES USED (describe)</b>								





SECTION 33 33 00  
SANITARY SEWERAGE UTILITIES

## PART 1—GENERAL

## 1.01 DESCRIPTION

- A. The work specified in this Section shall include:
1. Constructing 6-inch diameter HDPE SDR 17 with fused joints force main and fittings on crushed rock encasement wrapped in geotextile fabric;
  2. Constructing 6-inch diameter HDPE SDR 17 with fused joints force main in 10-inch diameter steel casing by pipe jacking method, and filling annular space with non-shrink grout.
  3. Constructing 16-inch diameter HDPE SDR 17 with fused joints on crushed rock encasement wrapped in geotextile fabric.
  4. Constructing 8-inch bell and spigot type extra strength vitrified clay pipe (VCP) sewer.
  5. Constructing 10-inch diameter VCP culverts.
  6. Constructing 10-inch diameter VCP culvert with concrete encasement.
  7. Constructing 12-inch and 15-inch diameter Class IV RCP on crushed rock bedding wrapped in geotextile fabric.
  8. Construction of concrete manholes with new frame and cover.
  9. Installing HDPE cleanouts and air valve assembly inside manholes.
  10. Installing Controlled Density Fill inside manholes.
  11. Furnishing and installing High Flow trash collection devices.
  12. Applying mortar to the interior of existing manholes including riser.
  13. Removing existing railroad track facilities within sewer and force main trench.
  14. Reinstating existing laterals, roof leaders and culverts as necessary and as per City Representative to construct force main and storm drain.
  15. Testing, handling, transportation and disposal of hazardous excavated materials and contaminated soils including all incidental work, if necessary.
  16. Plugging and filling existing force main, sewers and sewer structures.
  17. Furnishing and installing connections to and between sewers, structures and culverts.
  18. Furnishing and installing pipe to pipe connections using mechanical shear band repair couplings.
  19. Reconstructing pavement inside the sewer T-trench limit and outside of paving work limits under C-drawings with 10-inch thick concrete base.
  20. Reconstructing pavement as per excavation code or as shown in project plans.
  21. Potholing as directed by City Representative.
  22. At the conclusion of the Work, cleaning existing catch basins located within the limits of Work.
  23. Performing necessary Work due to unforeseen conditions related to sewer and drainage work.
- B. Earthwork and pavement restoration work required for the work of this Section shall be considered incidental work.

## 1.02 RELATED SECTIONS

- A. Section 31 23 33, Trenching and Backfilling
- B. Section 32 12 16, Asphalt Paving
- C. Section 33 01 30.63, Sewerage System Mortar Rehabilitation.
- D. Section 33 41 00.10, Reinforced Concrete Pipe

### 1.03 REFERENCES

- A. San Francisco Department of Public Works Standard Specifications, latest revision.
- B. DPW Standard Plans, latest revision.
- C. ANSI/ASTM C12, Practice for Installing Vitrified Clay Pipe (VCP) Lines.
- D. ANSI/ASTM C425, Compression Joints for Vitrified Clay Pipe (VCP) and Fittings.
- E. Material Designation - Plastic Pipe Institute/ASTM - PE3408.
- F. ASTM F2620, D1348, D2657, D3350 - Joints for HDPE and Fittings.
- G. Material Classification - ASTM D-1248 - Type III Class C.5.P34.
- H. ASTM F-714 - Standard Specification for Polyethylene Plastic Pipe Based on Outside Diameter.
- I. ANSI/AWWA – Standard Specifications for Ductile Iron Pipe (DIP).

### 1.04 SUBMITTALS

- A. The Contractor shall furnish six (6) copies of the following:
  - 1. Certified report of the actual test results for precast components of concrete manholes meeting the requirements of ASTM C478 for approval by City Representative in accordance with the requirements of Section 310 of the SFDPW Standard Specifications.
  - 2. Certified report of the actual test results for Class IV RCP pipes meeting the requirements of ASTM C76 for approval by City Representative in accordance with the requirements of Section 304.06 of the San Francisco Public Works Standard Specifications.
  - 3. Certified report for manhole frame and cover meeting the requirements of ASTM A-48 for approval by City Representative.
  - 4. Certified report for Geotextile fabric meeting the requirements of AASHTO M288 Class 2 non-woven.
  - 5. Steel casing pipe design and fabrication detail.
  - 6. Certified report for chemical resistant polymer epoxy coating for concrete manholes.
  - 7. Certified report of the actual test results for HDPE pipe meeting the requirements of ASTM D-3350 for approval by the City Representative.
  - 8. Written certification that the fusion technician has received training in the proper use of fusion equipment and manufacturer's recommended fusion procedures.
  - 9. 2-inch air valve and blow off assembly details.
  - 10. Manufacturer's product data sheets and installation instructions for wet spray mortar.
  - 11. Independent laboratory reports proving performance properties of wet spray applied mortar mix.
  - 12. Manufacturer's warranty and warranty application procedures.
  - 13. Nozzle men's certification.
  - 14. Detectable warning tape for sewer trench.
  - 15. Mechanical shear band repair coupling with external stainless-steel band to be used for all 6-inch, 8-inch, and 10-inch diameter VCP pipe to pipe connections and for larger VCP main sewer repairs.

16. High flow trash collection device, crosslinked high-density polyethylene and deflective separator with new concrete manhole.

## PART 2—PRODUCTS

### 2.01 MATERIALS

- A. VCP used in this Contract shall be in accordance with the applicable requirements of Section 305 and 306 of the SFDPW Standard Specifications.
- B. Mechanical shear band repair couplings with external stainless-steel bands used for VCP connections shall meet or exceed ASTM Specification C425. Pipe to pipe deflections cannot exceed allowable tolerances per manufacture recommendations to ensure watertight seal and achieve the required structural strength. Per SFDPW Standard Specifications, **no angled pipe cutting, or mitered joints** will be permitted for making VCP to VCP pipe connections. VCP elbows and fittings shall be utilized where directed in the contract documents, SFDPW Standard plans, or when directed by the City Representative.
- C. VCP main sewers and fittings for pipe diameter 12-inch and larger shall be of bell and spigot type unless directed by City Representative.
- D. RCP pipes used in this contract shall be constructed in accordance with Section 33 41 00.10-Reinforced Concrete Pipe and Section 304 of San Francisco Public Works Standard Specifications.
- E. Manholes shall be constructed of precast Concrete Sections in accordance with ASTM C 478 or cast in place in accordance with the applicable requirements of Section 303 of the SFDPW Standard Specifications and in accordance with SFDPW Standard Drawing 87,181 and as shown on the Contract Drawings. Manhole frame and cover shall be in accordance with SFDPW Standard Drawing 87,190 or as specified on the Contract Drawings. Manhole rungs and steps are deleted from the Contract.
- F. Crushed rock bedding shall comply with the requirements of Section 703.05 and 712 of SFDPW Standard Specifications.
- G. Geotextile fabric shall be AASHTO M288, Class 2, Non-Woven.
- H. Certified reports of 10-inch diameter steel casing with minimum 1/2-inch wall thickness.
- I. HDPE pipes shall conform to ASTM Standard D-3350 and shall have nominal diameter as indicated on the contract plans and with fused joints.
- J. Cast-iron water trap for catch basin shall be constructed in accordance with San Francisco Public Works Standard Drawing 87,194 meeting the requirements of ASTM A-48. Cleanout cap for cast iron water trap shall be “T” cone expandable cleanout plug S-802 of ETCO Specialty Products, Inc. from Groeniger and Co. or approved equivalent.
- K. Detectable warning tape shall be 6-inch wide 5-MIL thick green metallic warning tape with words “CAUTION: BURIED SEWER”.
- L. High flow removable trash collection device crosslinked high density polyethylene “Downstream Defender” by Hydro International, suitable for installation on concrete, conforming to the requirements in the Contract Plans, or approved equivalent.
- M. High flow removable trash collection device with new concrete manhole “JDS72-3636 Jensen Deflective Separator”, conforming to the requirements in the Contract Plans, or approved equivalent.
- N. Mortar Material shall be as specified in Section 33 01 30.63 of these Specifications.
- M. Hydraulic Cement shall be premixed Portland cement based hydraulic cement consisting of Portland cement, graded silica aggregates, special plasticizing and accelerating agents. It shall not contain chlorides, gypsum, plasters, iron particles or gas forming agents, or

promote the corrosion of steel it may come in contact with. It shall be formulated at the factory and supplied in factory sealed and labeled pre-measured containers, which shall contain the complete quantity of materials required for this work. Invert patch compound shall be used to fill minor voids and cracks, to bring substrates up to profile, to provide watertight seals at invert, lateral line and house connections. The fast setting hydraulic cement patch is designed to be troweled or knead applied and capable of providing a watertight seal when cured and shall conform to the following specifications:

<u>Property</u>	<u>ASTM Test</u>	<u>Result</u>
Set Time	ASTM C-191-92	3 – 5 min
Compressive Strength	ASTM C-109-91	
1 Hour		700 psi
1 Day		2,000 psi
28 Days		5,500 psi

**PART 3—EXECUTION**

**3.01 EXAMINATION**

- A. The Contractor shall verify that trench is ready to receive work and excavations, dimensions and elevations are as indicated on drawings.

**3.02 PREPARATION**

- A. Clean existing sewers to be replaced with high velocity hydrocleaning equipment before excavation, if required.
- B. All high-velocity sewers cleaning equipment shall be truck-mounted for ease of operation. The equipment shall have a minimum of 500 feet of 1-inch ID high-pressure hose with a selection of cleaning nozzles.
- C. The equipment shall have a minimum working pressure of 1,000 pounds per square inch. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned.
- D. All sludge and dirt shall be flushed downstream within the sewer system and shall not cause line stoppage due to heavy accumulation. If removal of debris is necessary to prevent stoppage in the sewer system downstream, Contractor shall notify the City Representative immediately. Sludge, dirt, sand, or other solids shall not be removed from the sewer system unless directed by the City Representative.
- E. The Contractor shall hand trim excavations to required elevations. Correct over-excavation with crushed rock.
- F. The Contractor shall remove large stones or other hard matter, which could damage piping or impede consistent backfilling or compaction.

**3.03 BEDDING**

- A. Bedding shall be crushed rock as specified in Section 31 23 33 of these specifications and shown in the contract plans.
- B. Bedding material shall be placed as shown on the contract plans. Care shall be taken to completely fill all spaces under the haunches.

### 3.04 MANHOLES AND STRUCTURES

- A. Manholes shall be constructed as detailed on the Contract Drawings and in accordance with SFDPW Standard Drawing 87,181, as shown and at the locations shown on the Contract Drawings.
- B. Construction of manholes shall be in accordance with Section 310 of the SFDPW Standard Specifications. Manholes elected by Contractor to be cast-in-place shall be constructed in accordance with the applicable requirements of Section 303 of the SFDPW Standard Specifications.
- C. Concrete base of new manholes shall have reinforcing steel, be allowed to set overnight, at the minimum time, and shall not be subjected to any load on the same day the concrete base was poured. No. 4 steel reinforcement is required in concrete base for Standard Drawing 87,181.
- D. All new or salvaged manhole frames and covers to be used on new manholes shall be in accordance with the SFDPW Standard Drawing 87,190, or as indicated in the Contract Drawings, or as directed by the City Representative.
- E. All manhole frames shall be set in cement mortar.
- F. Maximum distance between the pavement and top of the manhole cone shall be 15 inches or as directed by the City Representative.
- G. Side sewer connections to the manhole shall not be more than 12 inches higher than the manhole invert.
- H. Dimensions of manhole base shall be increased as necessary to accommodate connections to these manholes.
- I. Chemical resistant polymer epoxy coating shall be applied to the entire invert of the concrete manhole, where indicated on the Contract Drawings.

### 3.05 INSTALLATION OF MAIN SEWER

- A. The Contractor shall have available at all times either (1) a transit and rod or (2) a sewer laser beam instrument suitable for transferring elevations from established points to the sewer work. The spirit level, taut string, and/or straight edge will not be acceptable for sewer construction work.
- B. VCP main sewer and storm drain shall be installed in accordance with the requirements of Section 305.07 of the SFDPW Standard Specifications.
- C. HDPE main sewer shall be installed in accordance with the requirements of Section 322 of the SFDPW Standard Specifications.
- D. Lay pipe to slope gradients noted on the Contract Drawings, unless conform elevation conflicts with the slope, in which case, conformance to existing elevations takes precedence.
- E. The Contractor shall not use soil mounds or any blocking to bring the pipe to grade. The Contractor shall not apply pressure to the top of the pipe, such as with a backhoe bucket, to push the pipe down to grade.
- F. Refer to Section 31 23 33 for trenching, backfill, bedding and compaction requirements.
- G. Refer to Section 33 41 00.10 for further detail regarding RCP installation.
- H. Refer to SFDPW Standard Plan 87,195 for details on reinforced concrete encasement for vitrified clay pipe.
- I. The Contractor shall furnish and install detectable warning tape as indicated in detail on contract plans.

**3.06 MORTAR APPLICATION**

- A. Mortar shall be applied as to fully adhere while being free of voids and rebound.
- B. Finishing: Steel trowel to a hard, dense surface within twenty (20) minutes of the spray-on application and/or as directed by the City Representative.

**3.07 INSTALLATION OF 10-INCH DIAMETER STEEL CASING AND HDPE PIPE BY TRENCHLESS OPERATION**

- A. This is a system for installing underground pipe without excavation. All materials and equipment for this work shall be furnished by the Contractor. Contractor shall exercise extreme care not to cause damage to the existing structures. Any damage to existing structures because of work performed by the Contractor shall be fully repaired and restored and cleaned up to the satisfaction of the City Representative, at the Contractor's expense.
- B. Excavation and backfill of pits:
  - 1. The installation pits shall be adequately shored to safeguard the equipments and to ensure against ground movement. All pits shall at all times be adequately barricaded from public access and for the protection of workers.
  - 2. Insertion pits shall be efficiently located so that total number of pits is minimized and footage of liner pipe installed in a single pull is maximized. Where possible, use existing trench for insertion pits.
  - 3. Dimension of pits shall be of necessary size, shape and depth as required for sheeting and bracing and for proper performance of the work.
  - 4. Pits shall be dug with minimum length and width dimensions and to the depth necessary for installation of HDPE pipes. The pits shall be kept dry at all times. Where the bottom is not firm, a layer of crushed rock shall be placed on the bottom to provide working surface. Where a utility goes through a pit, it shall be adequately supported and protected.
  - 5. Backfill of pits shall be as specified for trenches.
  - 6. The pits shall be sheeted and dewatered at all times. The Contractor shall furnish and install equipment to keep the pit free of excess water. The Contractor shall also provide surface protection during the period of construction so that surface runoff does not enter the pit. The dewatering method used shall not cause damage to adjacent structures or property due to lowering of the water table and subsequent ground settlement. In the event any damage does occur, the Contractor shall be fully responsible for correction of damage and/or settlement of any claims arising from such damage.
- C. The steel casing pipe shall be 10-inch outside diameter. Contractor shall determine appropriate wall thickness, minimum 1/4-inch thick, of the steel casing pipe to accommodate the installation of the carrier pipe.
- D. HDPE Pipe Insertion
  - The installation forces on the pipe shall be kept to a minimum.
  - Where a continuous length of pipeline is butt fused prior to insertion, the length of insertion pipe shall be defined below:
    - 1. The bottom of the pit shall be horizontal and its length shall not be less than 12 times the diameter of the inserted pipe.
    - 2. The rear sloping face of the pit shall be not less than 30 time the diameter of the pipe.

3. The radius of curvature of the inserted pipe shall not be less than 30 times the diameter of the pipe.

Maximum force to be within stress limits of the pipes.

Where a device is employed to exert force on the rear of the inserted pipe lengths, the force applied to the inserted pipe shall be evenly distributed around the wall of the pipe.

Where lengths of pipe are jointed and a device is employed to exert force to the rear of the inserted pipe lengths, precautions will be taken by the Contractor to ensure that no buckling crushing or twisting of the pipe takes place.

Where lengths of HDPE pipe are pushed, there is no relaxation time required to allow pipe to return to its original length.

- E. Upstream and Downstream Manholes

At the upstream and downstream ends of the pipes, it shall be cut in an approved manner so that 2 inches of pipe protrudes into the manhole. The invert of the manhole shall be suitably prepared such that a smooth transition shall be made from the existing pipe work to the new pipe.

To seal the HDPE pipes in the manholes at the entry and exit points, the ends of the pipes are surrounded in concrete, which forms part of the manhole base. Additional methods, such as mechanical anchoring systems, may be employed for this operation.

- F. Contractor shall fill the annular space between casing and carrier pipe with slurry grout. Contractor shall prevent carrier pipe from floating when filling the annular space with slurry grout. Contractor shall provide end seals (caps) at the end of the steel casing.

- G. Testing

The new pipe shall be tested for acceptance following a 25 psi test procedure. Testing shall be in accordance with ASTM F2164 for hydrostatic pressure leak test of PE pressure piping systems, and as directed by City Representative.

### 3.08 SIDE SEWER (LATERAL) AND CULVERT T.V. INSPECTION AND ABANDONING INACTIVE SIDE SEWER (LATERAL) AND CULVERTS

- A. General

All existing active side sewers interiors and culverts shall be inspected by CCTV with high resolution camera (minimum 640x480 pixels) and delivered with original resolution in MPEG format on DVD media, prior to paving, to evaluate if their structural condition warrants replacement and ensure quality and craftsmanship of assets delivered, respectively. These side sewers shall be televised either from the side sewer air vent or inside open main sewer trench. As directed by the City Representative, Contractor may be asked to televise side sewers and culverts located outside the limits mentioned but within paving contract limit. The Contractor shall record the locations and the extent of pipe defects as to leakage, bad and offset joints, constricted inside diameter, sagging lines, obstruction due to roots intrusion, broken, cracked, and collapsed pipe of each active side sewer/culvert by video and voice recording. The number and locations of existing active side sewers, roof leaders and culverts as indicated on the sewer plan and to be televised are approximate only, and may be increased, decreased or deleted as directed by the City Representative. The Contractor shall provide and furnish the City with a copy of the "T.V. Inspection Log and DVD" to the Resident Engineer.

DVD submitted by the Contractor should have a typed label on the front of the DVD providing the following information:

1. Contract ID Number (#)
2. Street Names with Limits
3. Side Sewer TV Inspection

4. Contract Title
5. Date

Each individual side sewer video file shall include the street address for the address they are in front of (e.g. Noriega\_St\_1234\_SS) in the naming convention. If multiple side sewers serve the same property, letter modifiers will also be included in the file name in order to differentiate between each asset (e.g. Noriega\_St\_1234\_SS-A and Noriega\_St\_1234\_SS-B). Each individual culvert video file shall include the roadway names at the intersection and the corner location (e.g. 34<sup>th</sup>\_Ave\_Noriega\_St\_NE\_Culv). When a culvert is located away from the curb return, the individual culvert video file shall be labeled with the street address where the catch basin or storm water inlet is located (e.g. Noriega\_St\_101\_Culv). Similarly, if multiple culverts have the same address, letter modifiers will be appended to the file name to differentiate between assets. When letter modifiers(s) are included in the video file names, a pdf map with a legend and locations identifying these assets shall be provided as part of the submittal package.

**B. CONDITION ASSESSMENT FOR SIDE SEWER (LATERAL) AND CULVERT REPLACEMENT**

The Contractor shall perform the following for all side sewers and culverts:

1. Confirm connection points of active side sewers by dye-testing at sidewalk vents.
2. Investigate, locate, and confirm active side sewers not identified by sidewalk vents by dye-testing at building fixtures and/or rodding.

Side sewers rodded to show lengths short of one (1) foot behind the curb shall be considered as inactive. The Contractor shall abandon these side sewers by excavating at their end points and plugging as shown on SFDPW Standard Plan 87,198. Side sewers rodded to show lengths beyond one (1) foot behind the curb are to be assumed as active and shall be connected to the new sewer.

3. Prior to connecting existing side sewer to the new main, televise side sewer with a mini camera from the connection at the main sewer to the vent location on the sidewalk. If there is no vent or sidewalk, terminate side sewer television inspection at the property line. If desired these inspections can be performed in the opposite direction from the vent to the connection at the sewer main.
4. Television inspection of side sewers and culverts shall be performed by personnel who are trained to identify cracks and other defects in these pipes. The video equipment used to perform this inspection shall provide clear and well-focused video (minimum 640x480 resolution) along with footage counters to give accurate measurement of locations where defects are identified, and identify the street address of property or location of the intersection return. If Contractor encounters debris inside active side sewers and culverts, Contractor shall flush all debris out prior to re-televising in order to ensure a clear and complete television recording.
5. Record locations of active side sewers and culverts and their conditions shall be provided by the Contractor in the form of a log and drawing markup.

**C. POST CONSTRUCTION QUALITY ASSURANCE FOR ACCEPTANCE**

1. Televising of newly constructed side sewer shall be performed from the farthest practicable upstream location to the connection to the main sewer line. In no case may the television inspection exclude more than 10% of the expected finished pipe length; and as such, this exclusion will only be allowed from the uppermost portion of the run. Side sewer TV inspection shall be completed, submitted, and accepted prior to substantial completion. Side sewer inspection should be



performed after necessary back fill and compaction of 90% of lower lateral. **The inspection video shall show the backfilled lower lateral and a context shot of the surrounding landmarks (for a location reference) before the camera is inserted into the sewer lateral for the remainder of the inspection.**

2. Post construction video inspection will be reviewed by the City Representative to validate contractor workmanship of the new pipeline facilities, installed in place after necessary backfill and compaction of the trench excavation has been completed. Video inspections of newly laid pipeline facilities performed prior to necessary backfill and compaction of the trench excavation, or lacking evidence thereof, will not be accepted or used by the City Representative to validate contractor workmanship. Further, CCTV inspections shall include video of the surrounding landmarks for location reference and a shot proving the sewer lateral has been backfilled before the camera is inserted into the pipe; any inspection not showing the backfill at the time of inspection will be rejected. All subsequent CCTV inspection, repairs, and replacement shall be completed at no cost to the City.
3. Contractor shall furnish a copy of the side sewers and culvert DVD(s) and log(s), at the same time as the post construction main sewer DVD(s) are furnished, to the City Representative. If side sewer and culvert TV inspection DVD(s) and log(s) are not furnished, then the respective progress payment shall be withheld.
4. CCTV inspection camera quality shall be minimum 640x480 pixel resolution with adequate lighting to illuminate the sewer lateral interior wall 6 feet ahead of the camera. Inspection speed shall be reduced so that insertion of the camera does not exceed 1 foot per second.
5. All CCTV inspection videos shall be accurately reflected on construction drawings by the Contractor, certified by the City Representative.

### 3.09 SIDE SEWER CONNECTION

- A. The sewer plan indicates side sewer connections at all side sewer vent locations or at least one lateral for each property. The number and locations of these connections are approximate only.
- C. The Contractor shall confirm that each property has been provided with a satisfactory connection for all its side sewers and roof leaders per Section 316.06 of the San Francisco Public Works Standard Specifications.
- D. This item includes any necessary side sewer or roof leader extensions to make the proper connection.
- E. Side sewer connections at manholes shall not be higher than twelve (12) inches above manhole invert.

### 3.10 REPAIR OR REPLACEMENT OF 6 OR 8-INCH DIAMETER SIDE SEWER (LATERAL) AND CULVERT

- A. The Contractor is responsible to coordinate and make TV inspection DVD available to the City Representative for review as soon as possible after TV inspection has been performed, and obtain City Representative's approval prior to reconnecting the side sewer to the main.
- B. The City Representative shall review the television inspection of the each side sewer/roof leader/culvert, and evaluate its structural condition.

- C. If existing side sewer or culvert has defects stated in section "T.V. INSPECTION OF EXISTING SIDE SEWERS, ROOF LEADERS, AND CULVERTS AND ABANDONING INACTIVE SIDE SEWER", then side sewer, roof leader, or culvert shall be repaired or replaced as necessary by the Contractor with the City Representative's approval.
- D. All locations, invert elevations and slopes of side sewers shall be conformed unless otherwise directed by the City Representative.

### 3.11 INSTALLATION OF VCP CULVERTS

- A. VCP culverts shall be installed in accordance with the requirements of Section 306.06 of the San Francisco Public Works Standard Specifications.

### 3.12 CAST IRON WATER TRAP FOR CATCH BASIN

- A. After cleaning existing catch basins, the Contractor shall check the condition of existing water trap if one exists. If existing catch basin does not have cast iron water trap or existing water trap is not in good condition or according to our standards, the Contractor shall furnish and install new cast-iron water trap including cleanout cap per San Francisco Public Works Standard Plan 87,194.
- B. If existing water trap is in good condition but does not have a specified cleanout cap, the Contractor shall furnish and install cleanout cap including all incidental work at no cost to City. All work shall be done as directed by City Representative.

### 3.13 PRE AND POST CONSTRUCTION MAIN SEWER VIDEO INSPECTION

- A. CCTV-General

Existing main sewer and newly constructed storm sewer interiors shall be inspected by CCTV with a minimum 1080p resolution (1920x1080 pixels) camera delivered with original resolution in MPEG format on DVD media to detect active connections prior to plugging and filling the sewer and to evaluate the Contractor's quality of workmanship after constructing a new sewer facility.

All pipes shall be thoroughly cleaned prior to inspection, and inspections must be conducted in accordance with version 6 of National Association of Sewer Service Companies (NASSCO) Pipeline Assessment & Certification Program (PACP). **Personnel on the job are required to be trained and NASSCO PACP certified. Minimum PACP guidelines for any sewer main CCTV inspection will be enforced. Inspections shall not exceed 0.5 feet per second and shall stop, pan and zoom all around all joints, lateral connections, culvert connections, and any visible irregularities or defects. Video quality shall be minimum 1080p resolution (1920x1080 pixels) with adequate lighting to illuminate the pipe interior wall.**

The Contractor shall record by color video picture and voice recording, the main sewer and locations of the side sewer connections. **The video shall have the project name, limits of the sewer being televised, Maximo Asset ID, and the upstream and downstream manhole numbers (the Start\_Node and End\_Node fields from the pipe's GIS) superimposed on the beginning of each inspection.** The camera shall travel through the sewer at a speed of a half of a foot (0.5 feet) per second. A continuous counter in feet measurement shall be superimposed at the bottom of the screen to show the distance from the starting manhole or a reference point to an exit manhole or reference point. The date of the video recording shall be superimposed on the screen and/or audio recording. There shall be sufficient artificial light in the interior of the sewer to produce a clear and well focused picture and illuminate the pipe interior wall.

The DVD shall have a label with the project name, specification number and limits including the date of the television inspection. The Main Sewer TV Inspection Log shall have the locations measured in feet of the side sewer connections from the commencement point of the camera, a sketch showing the project limits and the direction the camera was run through the sewer. The Contractor shall provide and furnish the City with a copy of the "Main Sewer TV Inspection Log and TV DVD" to the Resident Engineer.

Within one week following the pre-construction meeting, the City Representative will provide the Contractor electronically the following files for performing main sewer inspections:

1. For pre-construction inspection, a shape file of existing sewer lines and nodes for manholes and non-manhole junctions with current asset ID's
2. For post-construction inspection, a shape file of newly constructed sewer lines and nodes with new asset ID's.
3. A shape file of City base map consisting of right-of-way/blocks and streets

Contractor will:

1. Import sewer line shape file to sewer inspection software such as Pipelogix, POSM, WinCan or others.
2. Select the corresponding pipe record to be inspected by identifying upstream manhole ID from pipe list. Enter the MXASSETNUM field from the pipe's GIS into the NASSCO Pipe\_Segment\_Reference field, use the Start\_node field from the pipe's GIS in the NASSCO Upstream\_MH field and the End\_Node field from the pipe's GIS for the Downstream\_MH field.
3. Begin inspection
4. Stop the tractor, pan and zoom at defects and irregularities in or on the pipe surface. Irregularities are defined as anything other than a uniform pipe wall material and includes scuffs, cobwebs, discoloration, or any NASSCO defined observation code.
5. Pause and turn camera view at each lateral/culvert connection point.
6. Code all observations such as defects, locations of lateral connections, change in pipe alignment, unusual conditions, and other discernible features, as defined in the NASSCO PACP defect codes.
7. End inspection at FINISH manhole or other non-manhole junction (connection to another main sewer or change in pipe size per sewer line shape file).
8. Prepare one video file for each individual inspection from manhole to manhole or node.
9. Export inspections to NASSCO Exchange Database format for delivery to the City.

If counts or locations of main sewer assets (pipes and manholes) built differ from plan drawings then the contractor shall communicate these changes to the City immediately so that the City can provide new asset ID's and GIS maps before CCTV inspection begins. All assets shall have city provided ID's before CCTV inspection begins. The Contractor should expect a **minimum** of one full workday for the City to provide new/updated asset ID's and GIS maps.

Database file, DVD & Log:

Contractor shall submit database files, video files in MPEG format with minimum 1080p resolution (1920x1080 pixels) on DVDs, and digital inspection logs in PDF format. All main sewer inspection data will be standardized per PACP guidelines and in NASSCO Exchange Database format.

DVD submitted by the Contractor should have a typed label on the front of the DVD providing the following information:

1. Contract ID Number (WW #)
2. Street Names with Limits
3. Main Sewer Post-Construction TV (or Pre-Construction)
4. Contract Title
5. Date

The Contractor shall submit the post-construction main sewer video DVDs within five (5) calendar days after the completion of the sewer work at each location for review. Post construction video inspection will be reviewed by the City Representative to validate contractor workmanship of the newly constructed main sewer facilities, installed in place after necessary backfill and compaction of the trench excavation has been performed. Video inspections of newly constructed main sewer facilities performed prior to necessary backfill and compaction of the trench excavation will not be accepted or used by the City Representative to validate contractor workmanship. If post-construction main sewer TV inspection DVDs are not furnished, the respective progress payment shall be withheld.

### 3.14 HIGH FLOW REMOVABLE TRASH COLLECTION DEVICE

- A. Trash capture devices shall be for partially or totally submerged saltwater applications, be saltwater-resistant, and be constructed of rust-preventative materials.
- B. Contractor shall verify exact diameter of existing pipe connections and dimensions of existing manholes prior to ordering the new trash collection devices.
- C. Installation of all parts shall be done by the contractor in a workmanlike manner and in accordance with the manufacturer's instructions. It shall be the contractor's responsibility to handle, store and install the trash collection devices in strict accord with the manufacturer's drawings and recommendations.
- D. Trash collection device work will be impacted by tide levels. The Contractor shall review San Francisco Tide Chart prior to performing the work, and shall plan and adjust the work schedule accordingly.

- E. Incidental work shall include, but not limited to, inspection of existing manhole structures, and cleaning of existing storm drain pipe pre- and post- trash collection device installation. Cutting of protruding pipe flush inside existing manholes prior to trash collection device installation shall be considered as incidental work.

### 3.15 CORRECTION OF DEFECTS IN SEWER FACILITIES CONSTRUCTED IN THIS CONTRACT

- A. The Contractor will provide warranty of three (3) year period, following the date of acceptance of the work, for all the sewer and drainage facilities constructed under this contract.
- B. The City will inspect the sewer interior by television prior to expiration of the 3-year post-construction period, following the date of acceptance of the work.
- C. Adjacent pipes at each joint shall be concentric. Maximum allowable eccentricity is 1 percent of pipe I.D. or 3/16 inch, whichever is greater. Greater eccentricity shall be corrected.
- D. Any defects shall be corrected by the Contractor at no expense to the City. Representative.

### 3.16 DRAINAGE MAINTANANCE

- A. Contractor shall be responsible for maintaining and keeping in operation all storm water inlets and catch basins throughout the entire project site, both inside and outside the phased construction work area, for the duration of the project, including during the performance of the punch list, until Final Acceptance.
- B. Contractor shall check and remove all debris from the storm water inlets and catch basins prior to the rainy season and clear clogged inlets and catch basins during the rainy season.
- C. Prior to the final inspection and acceptance, the Contractor shall check the storm water inlets and catch basins for debris and remove debris.
- D. Contractor is advised that during rainy weather the sewer system may flow full or overflowing. Therefore, Contractor shall schedule, sequence and protect its work accordingly. If Contractor plans to perform sewer work during rainy seasons, Contractor shall submit construction procedure for approval. The submittal shall include description of work to be done, proposed schedule and mitigation measures to keep the sewer functioning during rainy weather, and to minimize impacts to the public.

### 3.17 SEWAGE SYSTEM MAINTENANCE

- A. Contractor shall take adequate measures to prevent the impairment of the operation of the sewer system. It shall prevent construction material, pavement, concrete, earth, or other debris from entering a sewer, sewer structure, catch basin, or storm water inlet.

### 3.18 UNDERGROUND UTILITIES

- A. To safeguard existing underground utilities, Contractor shall notify Underground Service Alert (U.S.A.), so that utility companies and City Departments having underground utilities in the area may be advised of the work and may field mark or otherwise protect and warn the Contractor of their utility lines; (U.S.A.), 4090 Nelson Avenue, Suite A, Pleasant Hill, CA 94520, 800-227-2600.
- B. Contractor shall notify the San Francisco Fire Department, 2245 Jerrold Avenue, San Francisco, CA 94124, (415) 558-3557, Attention Mr. Bill Gunn, Facsimile (415) 647-8502, to have their facilities field marked.
- C. Contractor shall notify the San Francisco Street Lighting Department, Attention Mr. Herb Meier at (415) 554-1844, to have its facilities field marked.
- D. Contractor shall perform all work, including dewatering operations, in such a manner as to avoid damage to existing fire hydrants, power poles, railroad tracks, lighting standards, and

all other existing utilities, facilities and structures, public or private. Contractor will be held responsible for damage due to its failure to exercise due care.

- E. All broken concrete and debris shall be immediately removed from the project site as the Contractor's property and shall be disposed of in a legal manner.
- F. The Contractor shall exercise due care to avoid damage to existing pipe and coating, wrapping, sewers, conduit, or other existing facilities and structures. Should the Contractor damage or displace any of the above, Contractor shall repair same to the satisfaction of the City Representative, and all expenses in connection therewith shall be borne solely by the Contractor.

### 3.19 RECORD DRAWINGS

- A. Prior to acceptance of the work for warranty, the Contractor shall furnish the City Representative one neatly and legibly marked, in red pencil, set of full size record drawings showing all changes in the Contract Drawings as specified in Section 01 78 39, Project Record Documents. Changes shall include, but not be limited to the field changes or adjustments in the final location or dimensions of the Contract work; changes due to requests for information, changes due to Change Orders, and changes to reflect the actual existing conditions. Marking of the drawings shall be accurate and current, and be done at the time work is performed. These drawings shall be furnished within 5 calendar days after the completion of the sewer work at each location to the City Representative for review.
- B. Each completed Record Drawing shall be signed by the Contractor, and Construction Manager shall indicate it has reviewed the drawings for completeness. Each completed Record Drawing shall be transmitted to the City Representative as soon as the work on that drawing is completed.
- C. If record drawings are not furnished, the respective progress payment will be withheld.

### 3.20 CLEANING EXISTING CATCH BASINS LOCATED WITHIN PROJECT LIMIT

- A. At the conclusion of all the work under this contract, Contractor shall clean all existing catch basins and storm water inlets located within the project limit as specified on the contract drawings. Cleaning shall include but not limited to removal of sediments and other debris in the barrels and cast iron traps. The Contractor shall notify the City Representative at least 24 hours in advance before cleaning the existing catch basins. After cleaning catch basins, the Contractor shall get approval of City Representative for satisfactory work performance.

### 3.21 SIDE SEWER FLOW DIVERSION

- A. The Contractor shall contact and notify the residents affected by his sewer work 72 hours in advance. The Contractor shall provide pumps and adequate drainage system at each side sewer locations as directed by the City Representative.
- B. Failure to provide sufficient pumps will result in a liquidated damage of Five Hundred Dollars (\$500.00) per occurrence per calendar day where flooding or overflowing occurs due to lack of side sewer flow diversion. Liquidated damages will not be assessed if the pumps are in operation at all times prior to flooding or overflowing. Mechanical breakdown will not be considered as valid cause for non-assessment.

### 3.22 CONTRACTOR SHALL NOT ALLOW DEBRIS TO ENTER THE SEWAGE SYSTEM

- A. The Contractor shall take adequate measures to prevent the impairment of the operation of the sewer system. He shall prevent construction material, pavement, concrete, earth, or other debris from entering a sewer, sewer structure, catch basin, or storm water inlet.

**3.23 HANDLING AND DISPOSAL OF SEEPAGE, STORM WATER, AND SEWAGE**

- A. Contractor shall protect the work from water damage; shall keep excavations dry; shall dispose of water from all sources; shall do all necessary pumping; and shall install suitable conduits to remove and divert all sanitary, ground water, tidewater, storm water flow, and unforeseen sub-drain, so as to prevent back-up, by-passing to the San Francisco Bay, flooding damage to property, and damage to City's Right Of Way in accordance with the requirements of Sections 301 and 700.08 of SFDPW Standard Specifications and the requirements as set forth in this Section.
- B. Contractor shall not impede or obstruct wet weather flow anywhere in the sewer system. Backing up of flow is not allowed. Contractor shall be cautioned that a sudden storm can cause heavy flow in the sewer system that could reach ground level. The bypassing sewer flow system shall be adequate to handle a 5-year storm routinely and heavy flow that could reach ground level during the period of construction, and as required in the Contract Plans.
- C. Contractor is hereby informed that the work inside existing sewers or sewer trench involves contact with raw sewage, sludge, and grease. Hydrogen sulfide may also be present. Contractor shall provide all safety equipment including gas-monitoring devices to detect the presence of toxic gases. OSHA health and safety requirements will be strictly enforced.
- D. Contractor shall take adequate measures to prevent the impairment of the operation of the sewer system. Contractor shall prevent construction material, pavement, concrete, earth, paints, thinner, solvents, and other debris or toxic material from entering a sewer or sewer structure including surface flow collection system, such as catch basins and culverts.
- E. Contractor shall provide for the transfer and disposal of sanitary and storm flow around the section or sections of pipe that are to be installed. The bypass shall be made for diversion of the flow at an existing upstream access point and gravity or pumping the flow into a downstream access point of adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The flow height shall not exceed 1 foot above the crown of any active sewer pipe access point.
- F. The bypass pumping shall be scheduled for 24-hour continuous duty from the start of the operation with backup equipment available for periods of maintenance and refueling. Contractor shall obtain a night noise permit for work between the hours of 8:00 pm and 7:00 am, as specified in Section 2908 of the Police Code.

**3.24 REMOVAL OF EXISTING CONCRETE SLURRY**

- A. The Contractor shall notify the City Representative immediately upon discovering concrete slurry within the sewer trench. The City Representative will arrange appropriate authority to witness the slurry material.
- B. The Contractor shall remove existing concrete slurry when encountered within the trench width limit including all incidental work.
- C. Concrete slurry removal from the trench shall be disposed of as Contractor's property in a legal manner.

END OF SECTION





## SECTION 33 34 00

## SANITARY UTILITY SEWAGE FORCE MAINS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. The Contractor shall furnish and install cement-lined ductile iron flanged w/ exterior epoxy coating and mechanical joint pipes and fittings as specified herein and as shown in Drawings.
- B. The work of this section includes installation labor, trenching, excavating, backfilling, thrust bracing, concrete thrust blocks, installation labor, piping accessories, flexible expansion joints, temporary and permanent piping support and bracing systems, pipe painting, identification, cleaning and hydrostatic testing as shown on the Contract Drawings and as specified in order to provide complete and functional water supply piping system.

## 1.2 RELATED WORK DESCRIBED IN OTHER SECTIONS

- A. Section 22 04 00 – General Requirements for Plumbing
- B. Section 22 05 53 – Identification for Plumbing Piping and Equipment
- C. Section 09 90 00 – Painting and Coating

## 1.3 REFERENCE STANDARDS

Cited Standards shall be the most recent edition:

ANSI B16.1 - Cast Iron Pipe Flanges and Flange Fittings, Class 125, 250, and 800

ASTM A47 - Ferritic Malleable Iron Castings

AWWA/ANSI C151/A21.51 - Ductile - Iron Pipe, Centrifugally Cast in Metal Mold or Sand-Lined Molds, For Water or Other Liquids

AWWA/ANSI C110/A21.10 - Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch for Water and Other Liquids

## 1.4 SUBMITTALS

- A. Complete piping layout including all pertinent dimensions of all pipe, fittings and equipment. Piping and equipment shop drawings with installation details, pipe support locations, and types shown thereon shall be submitted to and approved by the Engineer at least 30 days prior to ordering or fabricating materials for the work.
- B. The arrangement of equipment, piping and appurtenant items shown on the Contract Drawings is schematic only and may be varied where necessary to fit the approved equipment. All such variations shall be approved in advance by the Engineer and the Contractor shall bear the cost of any such redesign.
- C. The Contractor's installation drawings, after approval by the Engineer, shall be used to supplement the Contract Drawings. Shop drawings shall include detailed piping drawings for all piping systems of 2½-inches and larger, indicating appurtenant equipment dimensions which have been used in determining the piping layout dimensions.
- D. Shop Drawings and calculations of seismic bracing and piping/equipment anchoring shall be submitted for review and approval by the Engineer prior to fabrication.

## 1.7 QUALITY ASSURANCE

- A. All pipe and fittings delivered to the job site shall be clearly marked to identify the material, class, and thickness. All material shall be new and free of defects.

- B. Installation of equipment furnished under this Section shall have a minimum of ten (10) years verifiable experience in the installation of such equipment.

## 1.8 WARRANTY

The Contractor shall furnish a two (2) year Warranty for all work covered under this Section.

## PART 2 PRODUCTS

### 2.1 MATERIALS:

#### A. Pipe and fittings

##### 1. Pipe Joints for Exposed Piping

- a. Ductile iron pipe with threaded flanged joints and fittings with flanged joints including gaskets, Class 53 and meeting the requirements of ANSI/AWWA C151/A21.51 and ANSI/AWWA C115.
- b. Fittings shall meet the requirements of ANSI/AWWA C110.
- c. Flanges shall conform to ANSI B16.1 standards.
- d. Ductile iron flanged pipe and fittings shall be manufactured by U.S. Pipe, Tyler Union, or equal.

##### 2. Pipe Joints for Buried Piping

- a. Ductile iron pipe with mechanical joints restrained by tie rods and fittings with flanged joints including gaskets, Class 53 and meeting the requirements of ANSI/AWWA C151/A21.51.
- b. Ductile iron mechanical joint pipe and fittings shall be manufactured by U.S. Pipe, Tyler Union, or equal.
- c. Mechanical Joint shall meet the requirements of ANSI/AWWA C111.
- d. Fittings shall meet the requirements of ANSI/AWWA C110.
- e. Anchoring of retainer glands with set screws is not acceptable.

#### B. Flexible couplings

Mechanical flexible couplings for plain-end pipe shall be designed for the type, size and working pressure of the pipe with which they are to be used. All nuts and bolts shall be 316 stainless steel.

##### 1. Couplings

Couplings are bolted, split-sleeve type and consist of four basic components: one piece housing, gasket assembly, bolts and nuts, and end rings as required for pipe restraint. Coupling shall meet or exceed the quality and performance standards called for in AWWA C-219.

##### 2. Coupling Housing

Coupling shall be manufactured from ASTM A-240 316 Stainless Steel. The coupling shall be of the split-sleeve type with a double arch cross section which closes around the pipe ends with stainless steel end rings affixed for pipe end restraint requirements.

As the coupling closes, it confines the elastomeric gasket beneath the arches of the sleeve to create the radial seal. The axial seal is effected at the closure plates as the bolts pull the coupling snug around the pipe.

The coupling shall permit a degree of angular pipe deflection, flexibility, contraction and expansion as specified in the manufacturer's latest literature.

Coupling width shall be the maximum width available. Coupling wall thickness shall be for the design pressure.

## 3. Gasket

Elastomers shall have properties as designated by ASTM D-2000. The sealing members are comprised of two "O" ring gaskets and an elastomer sealing pad bonded to the integral sealing plate. Internal pressure is not required to effect the seal. "O" ring gasket supplied shall be Isoprene conforming to ASTM D-2000 for potable water service.

## 4. End rings

End rings shall be furnished with the restrained couplings. One end ring welded to each of the pipe ends fits beneath the coupling and is protected by the coupling.

5. Manufacturers: Victaulic Depend-O-Lok (FxF) & (ExE) or approved equal.

## D. Bolts

For Class 125  
FF Flanges

316 stainless steel, ASTM A312, Grade A  
hex head bolts & ASTM A563, Grade A hex head nuts

## 2.2 AIR AND VACUUM VALVES

- A. Air/Vacuum valve(s) shall be installed at high points in the line, or as directed by the engineer to relieve a vacuum due to column separation or draining the line. The valve disc shall be center guided and held normally closed by a stainless steel spring. The seat surfaces shall be bronze and Buna-N. The minimum flow area, perpendicular to the direction of flow thru the valve, shall be equal to the pipe area. The outlet shall be protected by a hood and screen.
- B. The valve(s) materials shall include a cast iron body, stainless steel spring, and cast bronze disc with a Buna-N seat. The inlet shall be ANSI Class (125) Flange.
- C. Manufacturers: Valmatic 301 series, Crispin X Series, APCO 401 series, or approved equal.

## 2.3 SWING CHECK VALVE:

- A. General: Check valve shall be full flow body type, with domed access cover, one moving part, non-slamming characteristics, flexible disc suitable for cold working pressures up to 250psig in wastewater service. Designed and tested to meet the requirements of ANSI/AWWA C508.
- B. Body: Body shall be Ductile Iron ASTM A536, Grade 65-45-12.
- C. Seat: The seat shall be on a 45 degree angle to the centerline of the pipe.
- D. Disc: Disc shall be precision molded Buna-N (NBR); integral O-ring type sealing surface,
- E. Connections: Connections shall meet ANSI B16.1, Class 125.
- F. Mechanical disc position indicator.
- G. The exterior and interior of the valve shall be coated with a fusion bonded epoxy coating.
- H. Manufacturers: Valmatic 500 series, APCO CRF, or approved equal.

## 2.4 ECCENTRIC PLUG VALVES

- A. General: All eccentric, permanently lubricated plug valve shall be of the water tight-closing, rubber seal type. Valves shall be design for sewage service and rated 150 LB WOG,
- B. Body: Body shall be cast iron ASTM A-126, Class B and shall have 125 LB ANSI flanged connections with manual operator.
- C. Plug: Plug shall be balanced type, cast iron ASTM A-126, Class B and shall be coated with Vulcanized Buna-N rubber.
- D. Bearing: Upper and lower bearings shall be stainless steel, permanently lubricated.
- E. Packing: U-cup or V-cup, self adjusting, wear compensating. Packing shall be replaceable without removing the valve bonnet or plug.
- F. Port Area: Full round port design. Passage size shall be at least 80% of the full port area.
- G. Coating: Interior coating shall be epoxy coated – 8 mill minimum per AWWA 550-81 and exterior coating shall be alkyd enamel.
- H. Body Seat: Seating surfaces shall meet the requirements of AWWA.
- I. Actuator: Actuator shall be manually operated and actuator mechanism must be fully isolated from line media.
- J. Manufacturers: DeZurik PEC; Valmatic; or approved equal.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Handling Pipe  
Care shall be taken not to damage the cement lining when handling the pipe.
- B. Cutting Pipe  
Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.
- C. Dressing Cut Ends
  1. Dress cut ends of pipe in accordance with the type of joint to be made.
  2. Dress cut ends of mechanical joint pipe to remove sharp edges or projections which may damage the rubber gasket.
  3. Dress cut ends of pipe for flexible couplings and flanged coupling adapters as recommended by the coupling or adapter manufacturer.
- D. Fabrication of Flanged Pipe  
Flanged pipe shall be fabricated in the shop, not in the field, and pickup by Contractor for delivery to the jobsite with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the Contractor. Contractor shall verify all controlling field dimensions before fabricating flanged pipes.
- E. Jointing Pipe
  1. Flanged: Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall

be taken to assure proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.

2. Mechanical joint: Refer to manufacturer instructions for assembling mechanical joint pipe and fittings. Install restrained rods for field cut pipe. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstances.
3. Provide insulating flange kit with gaskets for jointing ductile iron and steel flanges. Submit manufacturer cut-sheet for review and approval prior to ordering of material.

### 3.2 THRUST BLOCKS

Furnish and install thrust blocks at each bend.

### 3.3 FIELD TESTING

- A. Discharge line shall be hydrostatically tested at the pressure of 125 psig.
- B. Unless otherwise directed by the Engineer, the pipe joints shall be exposed during test.
- C. The Contractor shall furnish all necessary labor, material and equipment, such as pumps, piping, connections, pressure gauges, etc., for the test. The Contractor shall also furnish and install necessary anchorage and blocking to prevent movement of the pipe under test.
- D. If any section of the pipe under test develops a leak visible to the eye in the rubber gasket joints or the pipe itself, the Contractor shall repair or replace the defective portion of the pipe as directed by the Engineer. After all repairs are made, the pipe shall be retested.

### 3.4 CORROSION PROTECTION

Wrap buried pipe and fittings with 8 mil polyethylene film in accordance with AWWA C105. Single wrap all pipe and appurtenances not required to be double wrapped. Double wrap flanged fittings, mechanical joints and other appurtenances with significantly different outside diameters from the pipe. Continuously seal seams and overlaps with tape.

Seal circumferential overlaps with two turns of tape, half lapped. Gather excess polyethylene on top of pipe so as not to block backfill material from getting under bottom of pipe. Use caution so as not to rip or cut the polyethylene film. Seal any rips or cuts in the film with tape.

### 3.5 PAINTING AND COATING

- A. Aboveground Piping:  
Equipment furnished under this Section shall be prime painted and finish coated by the Contractor per the requirements of Section 09 90 90 – Painting and coating.

END OF SECTION



## SECTION 33 41 00.10

## REINFORCED CONCRETE PIPE

## PART 1 - GENERAL

## 1.1 SUMMARY

This section covers the material specifications, factory and field testing for the reinforced concrete pipe (RCP).

## 1.2 RCP AND FITTINGS

Precast reinforced concrete pipe and fittings will be installed under the requirements of Section 33 33 00 and the applicable requirements in Section 304 of the Standard Specifications.

## 1.3 SUBMITTALS

- A. Refer to Section 01 33 00 for submittal procedures.
- B. Within a minimum of five (5) working days prior to commencement of plant testing, the Contractor shall notify the City Representative so that tests may be witnessed if desired. Three edge bearing testing of RCP shall be in accordance with ASTM C76.
- C. Shop Drawings and Design Calculations: Detailed shop drawings showing the D-load, cement type, concrete strength, and details of the wall class, and fittings. These details shall include the type of cage or cages, the location of the cage or cages in the pipe wall, the size and spacing of circumferential and longitudinal reinforcing steel, and the cross-sectional area of reinforcing steel in each cage per lineal foot of pipe. Submit design calculations.
  - 1. The gasket details shall include the diameter of the cross-section and the unstretched diameter and volume. Pipeline layout drawings shall include pipe numbers, where applicable, stationing, manhole and structure locations, and all other pertinent details required to construct locations, and all other pertinent details required to construct the pipeline. No pipe manufacturing will be allowed prior to acceptance of the calculations and drawings by City Representative.
  - 2. Product Data: Gaskets.
  - 3. Certifications: Test certificates guaranteeing that the pipe furnished hereunder is in compliance with the requirements of the Specifications.
- D. The Contractor shall prepare, submit for review, and not begin trench construction, until given approval by the City Representative of a Joint Layout Plan of the entire pipe under this contract. This plan shall include all details necessary for the construction. Such details shall be in accordance with the standards of the respective manufacturing industry, ASTM, AWWA, etc., except as modified by requirements within these Specifications.
- E. The Joint Layout Plan shall include but not be limited to the following:
  - 1. Steel wall bell detail including gasket spigot pipe connecting to reinforced concrete structures.
  - 2. Rubber or Neoprene rubber gaskets.

3. All RCP bells shall be placed in the same direction unless otherwise approved by the City Representative.
  4. Closing joint detail including coupling as necessary.
  5. Proposed pipe delivery schedule.
  6. Layout plan for proposed alignment showing customized spigot end pipe length, graphical layout and spreadsheet count of pipes.
- F. Submit for review test reports of the physical properties of the O-ring gaskets.
- G. The Contractor's installation drawings, after approval by the RE, shall be used to supplement the Contract Drawings. The installation and detail drawings shall utilize an identification system for piping elements that will ensure their correct placement when received in the field.

#### 1.4 QUALITY ASSURANCE

Quality control records of tests required by the Specifications.

#### 1.5 MAKING OF PIPE

- A. Each pipe section shall be identified by indicating the following:
1. Name of manufacturer.
  2. Date of manufacture.
  3. Inside diameter of pipe, in inches.
  4. Length of pipe, in feet.
  5. Class of pipe or D-loading in pounds.
  6. Top of pipe if elliptical reinforcing is used.
  7. Sequential numbering of each piece of pipe.

### PART 2 - PRODUCTS

#### 2.1 CLASS IV RCP

RCP materials designated on Plans as Class IV shall conform to the requirements of latest ASTM Designation C76 and the applicable requirements of Section 304 of the Standard Specifications. The designated D-load to produce a 0.01-inch crack of pipe shall be 2000. The D-load to produce the ultimate load shall be 3000. Class IV RCP shall be designed and manufactured with concrete strength at 5000 psi with wall B design. The RCP shall be spun pipe or vertically cast (wet cast) pipe. **Concrete shall have a minimum slump of 2 ½ inches and pipe shall remain in the form for a minimum of 6 hours. Dry cast pipe will not be allowed.**

#### 2.2 GENERAL REQUIREMENTS FOR ALL RCP

All RCP shall be designed and manufactured with minimum wall B Design. For all RCP, double circular steel reinforcements shall be provided. The area of the outer cage steel reinforcement shall not be less than 75 percent of the inner cage. Joints of RCP shall be of Deep Bell (Flared Bell) with gasket type. Design calculations shall be submitted for approval. No wire fabric/mesh or welded wire design shall be allowed. All pipe to pipe connections shall be of a water-tight bell/spigot connection. No cast-in-place joint connections will be allowed.

#### 2.3 LONGITUDINAL BARS



Not less than 12 longitudinal bars at approximately equal spacing shall be provided for each cage. A minimum 3/8-inch diameter size shall be used for the longitudinal bars.

#### 2.4 CONCRETE COVERING

A minimum 1-1/2 inches concrete covering over reinforcing steel from the outside and one inch from the inside surface of the pipe shall be provided. Cement shall be Type II conforming to ASTM C150.

#### 2.5 INTERNAL WORKING PRESSURE

Internal working pressure shall be designed for 20 feet.

#### 2.6 PIPE JOINTS

- A. The pipe shall be furnished with bell-spigot ends for the open cut construction. Pipe joints of 12-inch and 15-inch shall be single gasket design. Refer to 3.14 of this Section for details on hydrostatically testing single gasket joints.
- B. The joint surfaces shall be of such shape and dimensions that the joints will be self-centering when the pipes are laid, so that the gasket will not be required to support the weight of the adjoining pipe. The joint shall be designed and made so that when completed, the pipe will form a continuous line without projections, indentations, offsets, or irregularities of any kind, and shall be capable of satisfying the pressure and leakage requirements specified.
- C. Gaskets shall be rubber O-rings in accordance with ASTM A-361 specifications. Only manufacturer-recommended lubricants shall be used.
- D. Steel pipe wall bells or fittings to be encased in the reinforced concrete structures shall be fabricated as shown on Plans.

#### 2.7 PIPE LENGTH

The length of each pipe section shall be determined by the Contractor based on the field conditions. Pipe ends shall be square with the axis of the pipe within 1/4 inch except when beveled ends are furnished. In areas where the pipe ends connect to RC structures, the first joint on both sides of the structure must be a maximum of 4' from the edge of structure. Pipe joints shall not be located where an existing side sewer or culvert is supposed to reconnect.

#### 2.8 BEDDING

Bedding material and details shall be as shown on H-drawings.

### PART 3 - EXECUTION

#### 3.1 DISTRIBUTING MATERIALS

Distribute materials along the trench only as will be used each day unless otherwise approved by the City Representative. Store materials in a manner that will not be a hazard to traffic or to the public in general, will not obstruct access to adjacent property, or will not obstruct other Contractor's working in the area.

#### 3.2 HANDLING AND TRANSPORTATION

- A. During loading, transportation, unloading, storage, and laying, every precaution shall be taken to prevent damage to the pipe. Trucks, trailers, or railway cars used for transporting coated pipe shall be provided with bolsters between each layer of pipe curved to fit the outside of the pipe.
- B. Lifting of pipe during unloading shall be done using two slings placed at the quarter points of the pipe sections. Pipe may be lifted into the trench using one sling near the center of the pipe, provided the pipe is guided to prevent uncontrolled swinging and no damage will result to the pipe or harm to the workers. The slings shall bear uniformly against the pipe. When not being handled, the pipe shall be supported on timber cradles or on properly prepared ground, graded to eliminate all rock points and to provide uniform support along the full length. Any unit of pipe that, in the opinion of the City Representative, is damaged beyond repair shall be removed from the site of the work and replaced with another unit.
- C. Pipe and fittings shall not be stored on rocks or gravel, or other hard material which might damage the pipe or lining and coating. No pipe shall be allowed to rest on the bell end of the pipe. This shall include storage areas and along the pipe trench.
- D. Heavy canvas, or nylon slings of suitable strength shall be used for lifting and supporting materials; do not use chains or cables.

### 3.3 RUBBER GASKET STORAGE

- A. Store all rubber gaskets in a cool, well-ventilated place and do not expose to the direct rays of the sun. Do not allow contact with oils, fuels, petroleum, or solvents.

### 3.4 PIPE PREPARATION AND HANDLING

- A. Each pipe and fitting shall be carefully inspected before being installed. The interior and exterior shall be inspected, and all damaged areas patched in the field with material equal to the original. Any pipe or coating system which, in the opinion of the City Representative, is damaged beyond repair shall not be used and shall be promptly removed from the site. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.
- B. Use proper implements, tools, and facilities for the safe and proper protection and installation of the pipe. Carefully handle pipe in such a manner as to avoid any physical damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

### 3.5 PREPARATION OF TRENCH

- A. Line and Grade:
  - 1. For pipelines intended to be straight, do not deviate more than 1 inch from line or 1/8 inch from grade. Measure for grade at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness.
  - 2. Grade the bottom of the trench by hand to the line and grade to which the pipe is to be laid, with proper allowance for pipe thickness and pipe base. Remove hard spots that would prevent a uniform thickness of bedding. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.

3. Geo-Fabric, if required, shall be placed inside the trench and thoroughly compacted as shown on Plan before any bedding to be put on.
4. Pipe bedding shall be compacted in a single lift to a minimum of 90 percent relative compaction. Thickness shall conform to the Drawings.

If during pipe installation it is found that a pipe section will be at an incorrect grade, that piece shall be removed and the base regraded to the proper elevation.

- B. Bell (Joint) Holes: At the location of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides as required to permit the joint to be made properly and to permit easy visual inspection of the entire joint and checking the joint gap and the gasket with a feeler gauge.
- C. Removal of Water: The trench shall be kept dry until the pipe laying and jointing are completed.
- D. Corrosion protection, if required, shall be used to protect pipe from corrosion in areas of soil contamination.

### 3.6 PREPARING PIPE FOR TRENCH

- A. Inspect each pipe and fitting before the pipe and/or fitting is lowered into the trench.
- B. Damaged portions of coating or lining shall be cleaned and repaired by experienced personnel, so that the protective coating or lining is equal to the original. Manufacturer's recommendations for repairs shall be followed.
- C. Wipe the joints of pipe, fittings, and appurtenances clean of all dirt, grease, and foreign matter before the pipe is lowered into trench.

### 3.7 LAYING PIPE

- A. Installation: All pipe, fittings, and appurtenances shall be installed in accordance with the manufacturer's instructions and these Specifications.
- B. Laying Plan: The pipe and fittings shall be laid in accordance with the laying plan, except as modified by the City Representative.
- C. All pipe shall be prepared as herein before specified and shall be laid on the prepared pipe bedding and bedded to ensure uniform bearing. No pipe shall be laid in water or when, in the opinion of the City Representative, trench conditions are unsuitable. Joints shall be made as specified for the respective types.
- D. Where the pipe is connected to concrete structures or manholes, the connection shall be made as shown. A standard pipe joint shall be located no more than 18 inches from the structure or manhole.
- E. Joining Pipe: Assemble joint in accordance with manufacturer's instructions, or as modified by these Specifications. As the next section of pipe is being readied for laying, clean the bell of the previously laid pipe of all foreign material and apply a thin film of the specified lubricant to the entire surface of the bell ring. At the same time, lubricate the gasket and install in the spigot groove. The gasket tension shall be uniform around the groove before placing the pipe in the trench. Lower the pipe section to be laid into the trench until it is

approximately in line with the previously laid pipe section and the spigot is centered in the bell. Then force the pipe home and secure to proper alignment and grade with the specified pipe zone material, well tamped. The gasket position shall be checked with a feeler gauge, furnished by the pipe manufacturer, to assure proper seating.

- F. The Contractor shall submit a procedural description of how he intends to effectively make field connections of joints without damaging the neoprene gasket or the pipe. The Contractor's submittal must include a structure or method that positively centers and concentrically controls the closing of the joint without damaging the neoprene gaskets or the pipe.
- G. In the event that the Contractor cannot adequately demonstrate the ability of not damaging the neoprene gasket, even with absolute control for centering and concentrically making the joint connection, the City Representative may require all concrete surfaces in contact with the neoprene gasket to be coated with an approved epoxy to reduce the abrasive effect from the concrete.
- H. Prevent foreign material from entering the pipe while it is being placed in the trench. Remove all foreign material from the pipe or joint ring before the next pipe is placed. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into the pipe, the City Representative may require that snugly fitted, tightly woven canvas bags be placed over each end before lowering the pipe. The bags shall be left in place until the connection is to be made to the adjacent pipe. During laying operations, keep debris, tools, clothing, or other materials out of the pipe.
- I. Take all precautions necessary to prevent the "uplift" or floating of the line prior to the completion of the backfilling operation.
- J. Follow pipe laying operations closely with backfilling of the trenches with sufficient material to prevent the pipe from moving. Place backfill carefully and simultaneously on both sides of the pipe to avoid displacement of the pipe and damage to the joints and coating.
- K. Bell End to Face Direction of Laying: Unless otherwise allowed, lay pipe with bell end facing in the direction of the laying.

### 3.8 PERMISSIBLE DEFLECTION AT JOINTS

Where it is approved by the City Representative to deflect pipe from a straight line, either in the vertical or horizontal plane, do not exceed 50 percent of the amount of deflection recommended by the pipe or coupling manufacturer and as reviewed by the City Representative.

### 3.9 PIPE ZONE MATERIAL

- A. Particular attention must be given to the area of the pipe zone from the flow line to the centerline of the pipe to ensure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of the pipe zone.
- B. Place the pipe zone backfill material around the pipe in even lifts on each side of the pipe not exceeding 8 inches prior to compaction, then compact to 90 percent relative compaction. Operate compaction equipment in such a manner as to prevent damage to the pipe. The limits of the pipe zone backfill material shall be as shown on the Drawings.

### 3.10 PIPELINE CLOSING

Take the necessary precautions required to prevent excavated or other foreign material from entering the pipe during the laying operation. At all times, when laying operations are not in

progress, at the close of the day's work, or whenever the workers are absent from the job, close and block the open end of the last laid section of pipe with a watertight plug to prevent entry of foreign material or creep of the gasket joints. End closure shall be sufficient to prevent trench water from entering pipe. Keep water out of the trench.

### 3.11 PIPELINE

Pipelines shall not be used as conductors for trench drainage during construction.

### 3.12 SIDE SEWER AND CULVERT CONNECTIONS

Side sewer and culvert connections to RCP shall be constructed per detail on H-drawings.

### 3.13 INSPECTION, TESTS AND ACCEPTANCE

- A. Acceptance will be on the basis of the successful results of the tests of materials, the required D-load bearing tests, pressure tests, and inspection of the complete product. The quality of all materials used in the pipe, the process of manufacture, and the finished pipe shall be subject to inspection by the City Representative. Inspection may be conducted at the place of manufacture, or at the work site after delivery, or both. The pipe shall be subject to rejection at any time due to failure to meet any of the specification requirements, even though sample units may have been accepted as satisfactory at the place of manufacture. All pipe which is rejected shall be immediately removed from the project site by the Contractor.
- B. Certified copies in triplicate of test results will be required for the materials and the finished pipe units as described herein. In addition, the City reserves the right to have any or all pipe units inspected or tested, or both, by an independent testing laboratory at either the manufacturer's plant or elsewhere. Such additional inspection and/or tests shall be at the City's expense and shall be the test results of record. The Contractor shall notify the City Representative minimum 5 working days in advance prior to the D-load testing. Pipe units to be tested may be selected at random at the option of the City Representative.

### 3.14 HYDROSTATICAL TEST FOR DOUBLE GASKET JOINT

- A. The Contractor shall submit his joint testing procedure and equipment for the City Representative's review prior to testing.
- B. All pipe shall be tested for leakage per ASTM C443 and thoroughly cleaned of any obstructions or debris. Pipes shall be tested and retested, at the Contractor's cost, per the following paragraphs until acceptance by the City Representative. **All pipe shall be joint-tested prior to backfill.**
- C. Prior to placement of backfill, the joint shall be tested in a sequential operation with tests conducted on each joint as they become available two or three pipe sections maximum behind the last section being installed, as directed by the City Representative, in order that the pipe laying operations shall have no adverse effect upon the security of the completed joint after testing.
- D. Joint preparation for double gasket RCP: The Contractor shall test the annular space between double gaskets using two integral testing ports. Water shall be used as a testing medium. To test, remove the caps from both testing ports. Inject water into the lower testing port. When all the air has been displaced and water is coming out of the testing port located on the soffit of the pipe, place the pressure gage on the upper testing port.

- E. Prior to backfill operations, the isolated joint shall be pressurized to 13 psi. If the pressure holds, or drops less than 1 psi in 10 minutes, the joint is acceptable.
- F. If the pressure test at 13 psi fails, the pipe joint shall be pressurized to 13 psi and maintained for 10 minutes, the pressure bled off and again tested. This pressurizing cycle may help seat the gasket.
- G. When individual joints have been tested and accepted by the City Representative, the testing tubes shall be capped securely with plugs at each testing port.
- H. Joints which show leakage shall be repaired or the joint relayed subject to the approval of the City Representative, and the joint retested. Joints that do not pass the initial pressure test shall have the pipe removed, gaskets cleaned, pipe reinstalled and retested. If the initial pressure test fails, grouting of the joint will not be accepted as an alternative repair. A minimum of two iterations to seat the gasket will be required before failure of the pressure test is considered. All joints shall have been tested and shall comply with the above leakage requirement prior to acceptance of the work.
- I. The Contractor shall maintain a current log of all pipe testing, including, but not limited to, the following information:
  - Type of test: i.e., hydrostatic, initial test, or retest number.
  - Time, beginning, and end.
  - Maximum pressure and pressure drop over test time.
  - All special precautions, considerations, or remarks concerning the particular test.

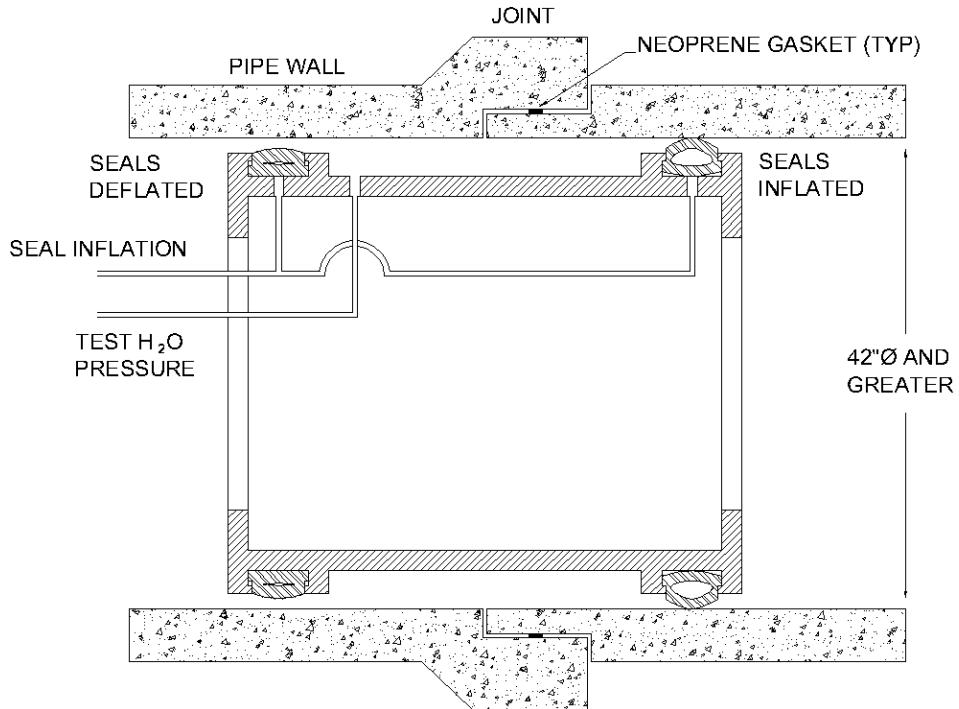
### 3.15 HYDROSTATICALLY TESTED FOR SINGLE GASKET JOINT

- A. The Contractor shall submit his joint testing procedure and equipment for the City Representative's review prior to testing.
- B. All pipe shall be tested for leakage and thoroughly cleaned of any obstructions or debris. Pipes shall be tested and retested, at the Contractor's cost, per the following paragraphs until acceptance by the City Representative. All pipe shall be joint-tested prior to backfill.
- C. Prior to placement of backfill, the joint shall be tested in a sequential operation with tests conducted on each joint as they become available two or three pipe sections behind the last section being installed, as directed by the City Representative, in order that the pipe laying operations shall have no adverse effect upon the security of the completed joint after testing.
- D. Joints shall be tested in accordance with ASTM C-1103-03.

Joints which show leakage shall be repaired or the joint relayed subject to the approval of the City Representative, and the joint retested. All joints shall have been tested and shall comply with the above leakage requirement prior to acceptance of the work.
- E. The Contractor shall maintain a current log of all pipe testing, including, but not limited to, the following information:
  - Type of test: i.e., hydrostatic, initial test, or retest number.
  - Time, beginning, and end.
  - Maximum pressure and pressure drop over test time.

- All special precautions, considerations, or remarks concerning the particular test.
- . See Exhibit "A" and "B"

END OF SECTION



TYPICAL PIPE JOINT TESTER FOR PIPES  
42"Ø AND GREATER (NOT TO SCALE)

EXHIBIT "A"

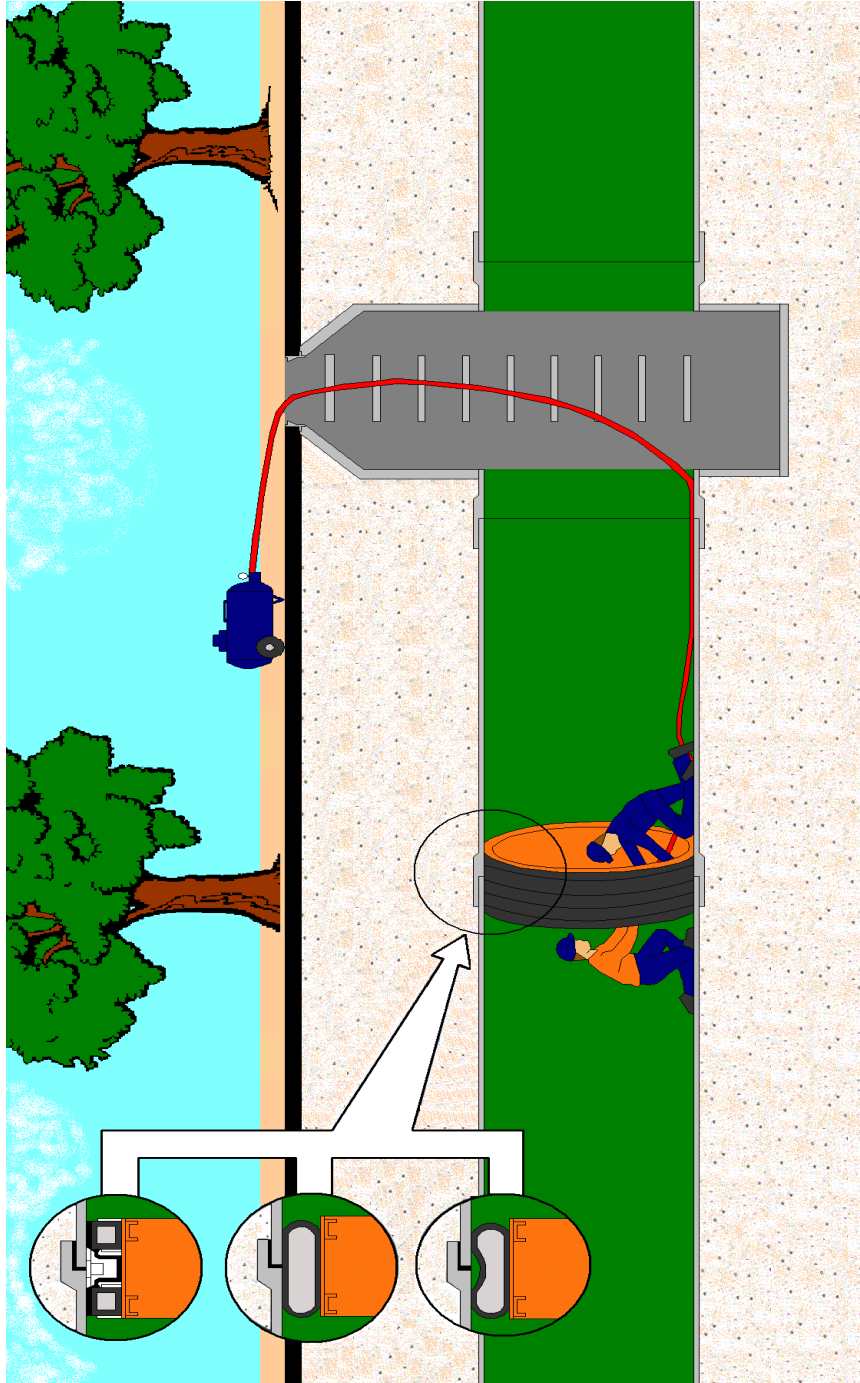
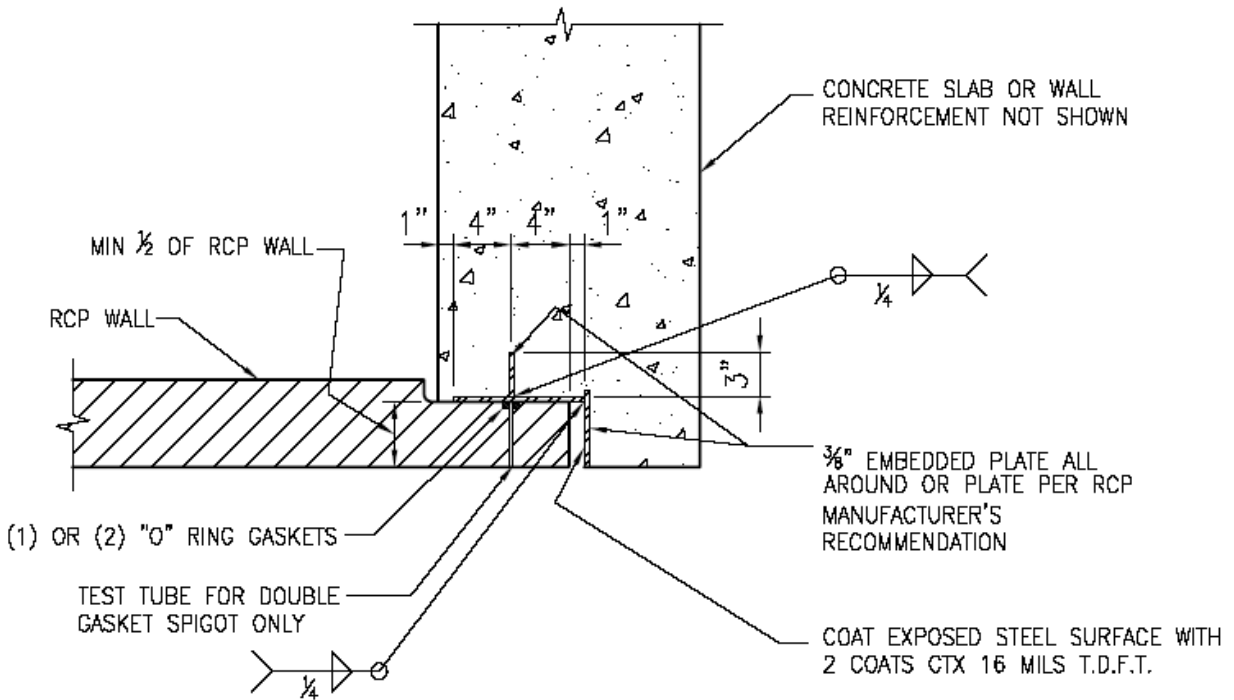


EXHIBIT "B"





**STEEL WALL BELL DETAIL**

SCALE: N.T.S.

NOTE: DETAIL TO BE USED W/ ALL CAST-IN-PLACE RCP STRUCTURES CONNECTING TO 42" Ø RCP OR GREATER, INCLUDING DPW STANDARD PLANS 87,182 AND 87,183.

**DETAIL NO. 1**



## SECTION 33 45 10

## MAIN SUBMERSIBLE PUMPS

## PART 1 – GENERAL

## 1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install:
  - 1. Four (4) Submersible Non-Clog Wastewater Pump Units
  - 2. Remove as Contractor's property the existing pumps and existing pumping system components including but not limited to the discharge elbows, and intermediate and upper guide bar brackets.
  - 3. All other components and accessories as required providing a complete and functional pumping system as described herein and as shown on the Drawings.
- B. The Contractor shall furnish
  - 1. Four (4) submersible non-clog waste water pump units.

## 1.02 EQUIPMENT NUMBERS

- A. SP-1
- B. SP-2
- C. SP-3
- D. SP-4

## 1.03 SUBMITTALS

- A. In addition to the requirements of the Standard Specifications, Submittals shall be made in accordance with the following provisions of the SPECIAL PROVISIONS:
  - 1. Section 01 33 00 - Submittal Procedures
  - 2. Section 01 77 00 - Closeout Submittals
  - 3. Section 01 78 23 - Operation and Maintenance Data
  - 4. Section 01 45 00 - Quality Control
- B. Submittal data shall consist of:
  - 1. Pump performance curves.
  - 2. Pump outline drawing.
  - 3. Station layout drawing showing accessories.

4. Detailed electrical data.
  5. Control drawing and data.
  6. Access frame drawing.
  7. Operational information including installation guide, technical manuals, and parts list.
  8. Manufacturer's start-up procedures and start-up report form.
  9. Motor performance curve.
  10. Maintenance information, materials and other characteristics.
- C. No pump equipment or accessories shall be ordered until the required drawings and curves have been approved by the City Representative.
- D. All pump performance data submitted shall be based on uncoated impellers. Any attempt to alter the pump performance by coating the impeller shall not be acceptable.

#### 1.04 RELATED SECTIONS

- A. Section 22 04 00 - General Requirements for Plumbing

#### 1.05 QUALITY ASSURANCE (FACTORY TESTING)

- A. Factory testing shall be carried out in the presence of two City-employed City Representatives.
- B. Triaxial vibration readings shall be performed at the factory for all pumps furnished under this Section. Readings shall be taken on each pump bearing housing for all six pumps. The overall allowable limit of mechanical vibration for any pump bearing during this test shall not exceed 0.1 in/sec. peak velocity. Testing criteria shall be in accordance with the Hydraulic Institute's "Accepted Field Vibration Limits For Vertical Non-Clog Pumps-Non Rigid."
- C. Vibration testing instrumentation shall be similar to IRD-300 Vibration Meter or equal. Calibration of such instrumentation shall be certified by the pump manufacturer and traceable to the National Bureau Of Standards.
- D. All rotating components (impeller and rotor) shall be dynamically balanced at the point of manufacture both as individual components and as an assembly. Balancing data shall be submitted to the City prior to the factory performance testing. Rotors shall be balanced per ISO "G1" balancing standards.
- E. The manufacturer shall conduct a factory test of each pump in accordance with the most recent test code of the Hydraulics Institute to determine head versus capacity and required kilowatt draw.
- F. Factory testing and inspection shall include the following inspections:
1. Check impeller, motor rating and electrical connections for compliance with these specifications.

2. Prior to submergence, each pump shall be run dry to establish correct rotation.
  3. Each pump shall be run submerged in water.
  4. Motor and cable insulation shall be tested for moisture content or insulation defects.
  5. All tests shall be conducted in accordance with the requirements of the test code for centrifugal pumps of the Standards of Hydraulic Institute, as last revised. The City Representative shall be permitted to observe all tests and to check and record all instrument readings and shall be given four (4) weeks written notice prior to the start of all tests. Contractor shall furnish round trip air transportation and per diem expenses for the City Representative.
  6. The Contractor shall submit drawings showing the test setup and instruments that are to be used for the test to the City Representative for approval. Complete data on all instruments and equipment to be used for the test and layouts showing exactly how the test is to be performed shall be submitted for approval before the pump is placed on the test stand. The pump motor must be used as the test motor. The motor and pump shall be tested as a unit.
  7. The Contractor shall perform a trial run of the shop tests before he notifies the City Representative that he is ready to run the witnessed shop tests. The pump manufacturer shall perform all tests and record and interpret all recorded data.
  8. The performance tests shall be sufficient to determine the curves of capacity, electric input, horsepower, water horsepower, and overall efficiencies for heads from shutoff to the minimum specified head for the pumping unit. The shop tests shall be run at the rated speed of the pump. A variable frequency drive shall be furnished by the manufacturer and two additional speed test runs shall be performed for each of the six pumps. Sufficient certified test data shall be submitted. Discharge shall be expressed in gallons per minute, and head in feet on the curves.
  9. Six copies of the curves showing the results of the shop tests, along with certified motor test data, shall be furnished to the City Representative for approval. Shipment of the pumping units shall not be made until the City Representative has approved the test data and curves.
- G. A written quality assurance record confirming the above testing and inspections shall be supplied with each pump at the time of shipment.
- H. The pumps, seals and motor units shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, manufacturer's service and warranty. Mechanical seals shall be non-proprietary in design, and available from sources other than the pump manufacturer.
- I. Pumps may be rejected by the City if the above requirements are not satisfied.
1. All pump motors furnished under this Section shall be subjected to a routine test as specified by IEEE Test Standards to include high potential, no load amperage, locked rotor amperage and resistance. Test Report shall include IEEE Standard 112 Test Method B data for either an actual project motor or an identical duplicate. Test reports shall be approved by the City Representative prior to shipment of equipment.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Gorman Rupp Pumps
- B. Liberty Pumps
- C. Or approved equal

2.02 OPERATING CONDITIONS

- A. The required units shall be non-clog, inverter-duty rated submersible pumps passing at minimum a 3” spherical solid.
- B. The pump shall have a continuously rising head capacity curve from run-out flow through shutoff.
- C. The pump shall be designed to operate continuously for an extended periods at any point in the allowable operating range of the curve without cavitation, overheating or excessive vibration. The motor nameplate horsepower rating shall not be greater than specified herein.

D. TABLE 1 - PERFORMANCE DATA

Pump Item Number	
Number of Units Required	Four
Rated Duty Point Condition	
Capacity (Flow)	210 GPM
Total Dynamic Head (TDH)	55 Feet
Minimum Hydraulic Efficiency	55%
Minimum Wire to Water Efficiency	n/a%
Minimum Motor Efficiency (full load)	88.9%
Minimum Motor HP Required	10 HP
Maximum Pump Operating Speed	n/a RPM
Electrical Characteristics Required	
Voltage	230Volt
Phase	3PH
Hertz	60Hz
Service Factor	1.15
Minimum Shutoff Head	74.5 Feet
Maximum NPSH Required	--
Minimum Spherical Diameter Passage Through the Impeller (in)	3 Inches

Minimum Suction Size	4 Inches
Minimum Discharge Size	4 Inches
Pumped Liquid	sewage
Pumping Temperature	55 -90°F
Specific Gravity @ Pumping Temperature	1 – 1.5

2.03 PUMP DESIGN

- A. Each pump shall have a flanged guide claw attached to the pump discharge flange by an ANSI flange connection. A replaceable Nitrile Butadiene Rubber (NBR) profile seal shall be provided as an integral part of the guide claw to form a leak-proof seal with the base discharge elbow.
- B. The guide claw shall direct the pump down by two vertical guide rails to the discharge connection in a simple linear movement without tilting the pump side wards. There shall be no need for any personnel to enter the wet well in order to remove the pumps. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails or lifting chain. A cast iron or fabricated steel base plate with integral guide rail holders shall be provided. The base plate shall be designed with an integral 90° elbow.
- C. Equipment and materials shall be third-party certified by a listing as complying with the approved applicable recognized standards and shall be free from defects.

2.04 PUMP CONSTRUCTION

- A. Major pump components including casing, impellers, motor frame shall be of at minimum Class 30 cast iron with smooth surfaces devoid of blowholes or other irregularities.
- B. All exposed nuts or bolts shall be 316 stainless steel. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied impact-resistance powder coating finish on the exterior of the pump.
- C. Critical mating surfaces where watertight sealing is required shall be machined and fitted with NBR O-rings. Joint sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal.
- D. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Motor shaft shall be 17-4 PH or 316 Stainless Steel. Pump and motor shall be shipped from the factory as a finished product. Pumps that are assembled outside of the manufacture’s facility are not allowed.
- E. Pump housing and motor housing shall be fastened together by a 316 stainless steel clamp in lieu of bolts for easy serviceability.

**2.05 CABLE AND CABLE ENTRY SEAL**

- A. The power cable shall be sized in accordance with NEC and ICEA standards and shall be of sufficient length to reach the junction box without need of splices. The outer jacket of the cable shall be oil resistant chloroprene rubber.
- B. EMC Shielded power cables to be utilized when variable frequency drives are used.
- C. The pump shall be equipped with a leak-proof stainless steel cable plug where the unscreened conductors of the cable are cast into the plug by means of a two-component sealant to prevent moisture from entering the motor via the cable core.
- D. The pump cable end (plug) shall incorporate in its design the ability to quick disconnect the power cable from the pump without the need to enter the pump. This cable plug shall allow the same plug be utilized for 208/230/460 volt applications without the need to enter the pump.

**2.06 PUMP MOTOR**

- A. The pump motor shall be an induction type, IE3 component design with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber according to IEC class IP 68 and NEMA MG1, part 31. Stator housing to be ASTM A-48 Class 30 or better.
- B. The motor shall be explosion proof and inverter duty rated approved for use in Class I, Division 1, Group C & D hazardous areas. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 356°F (180°C).
- C. The stator shall be trickle impregnated and heat shrunk fitted into the cast iron stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 104°F (40°C) and capable of up to 10 spaced starts per hour.
- D. The motor shall have voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 104°F (40°C) ambient temperature, with a temperature rise of class A not to exceed 176°F (80°C).
- E. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out. Service factor shall be 1.15.

**2.07 COOLING SYSTEM**

- A. Pump shall be of submersible design cooled by ambient fluids with no additional cooling system required.

**2.08 BEARINGS**



- A. The pump shaft shall rotate on two bearings. Motor bearings shall be grease lubricated for the life of the bearing. The upper motor bearing and the lower bearings shall compensate for axial thrust and radial forces and shall consist of a roller bearing and two angular contact ball bearing.

#### 2.09 MECHANICAL SEALS

- A. Mechanical seal shall be a cartridge style encased with a 316 stainless steel housing.
- B. Primary seal faces shall be silicon carbide / silicon carbide and secondary seal faces shall be carbon / ceramic.

#### 2.10 PUMP SHAFT

- A. Pump shaft must be a short overhung and dynamically balanced to eliminate shaft deflection. Motor shaft shall be 17-4 PH or 316 Stainless Steel.

#### 2.11 IMPELLER

- A. The single vane semi-open impeller shall be of hard iron.
- B. Single channel tube impellers shall be fitted with a 304 stainless steel removable wear ring.
- C. Single channel tube impellers shall be wet balanced.

#### 2.12 VOLUTE

- A. The pump volute shall be single piece cast iron, with NBR coated 304 stainless steel seal ring, with smooth passages large enough to pass any solids that may enter the impeller. Minimum thru let shall be 3".

#### 2.13 AUTO COUPLING SYSTEM

- A. Pumps shall be equipped with a complete auto coupling system to include factory upper guide rail brackets, base elbow, guide claw. Fabricated non factory components will not be accepted.
- B. Upper guide rail bracket shall be 316 stainless steel.
- C. Base elbow shall have a smooth interior to allow for specific solids passage. Base elbow shall be gray cast iron, ASTM A-48, Class 30 or better, with smooth surfaces devoid of blowholes or other irregularities. Base elbows shall have a factory applied spray coating.

- D. Minimum guide rail diameter shall be 2". Guide rails to be 316 stainless steel with minimum thickness of 0.15" (schedule 40).

2.14 PUMP PROTECTION

- A. Each pump shall incorporate three thermal switches, one per stator phase wind and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall be stopped and an alarm indication shall be activated.
- B. Pumps shall have one normally closed moisture switches. The moisture switches shall be incorporated into the pump to sense moisture in the bottom of the motor dome. The switch shall be wired in series so that if a switch opens the motor is de-energized and the pump is stopped.
- C. A water in oil (WIO) sensor shall be installed in the seal chamber to monitor the condition of the primary seal. The WIO sensor measures the water content in the oil and converts the value into an analog current signal. The sensor shall measure the water content from 0%-20% and send a continuous 4-20mA signal to a factory supplied, DIN rail mounted seal fail module to allow for seal fail monitoring. The WIO sensor shall be fitted in a stainless steel tube for mechanical protection. Seal fail sensor in pump shall be FM Approved.

2.15 MATERIALS OF CONSTRUCTION

- A. The non-clog pump shall conform to the materials of construction as listed for this design.
- B. MATERIALS

Pump Components	Standard Material
Pump Casing	Ductile Iron
Impeller	Hard Iron
Motor Housing	Cast Iron ASTM A-48, Class 30
Lifting Bail	316 Stainless Steel
Mechanical Seals	Silicon Carbide/Silicon Carbide primary and Carbon/Ceramic secondary
Pump Shaft	17-4 PH or 316 Stainless Steel

2.16 TESTING

- A. Pump Control Panel
  - i. Furnish and install pump manufactured control panel in accordance with Div 26 requirements.

- ii. Pump control panel shall be designed for outdoor applications.
- iii. UL listed Control Panel.

B. FACTORY TESTING

- i. All factory testing shall be in accordance with the standards of the Hydraulic Institute, ANSI/HI 11.6:2012, 3B. All testing is to be performed at the pump manufacturer's facility.
- ii. Performance testing shall be witnessed.
- iii. A single line certified performance curve shall be completed after the test and included in the final data package.
- iv. Field/functional testing will be performed to insure proper mechanical operation at the jobsite. All testing to be used for evaluation shall be performed at the pump manufacturer's facility.

PART 3 – EXECUTION

3.01 MANUFACTURER'S CERTIFICATE

- A. An authorized manufacturer's representative shall inspect the installation of all equipment furnished under this Section and shall provide a certificate of satisfactory installation in accordance with the provisions of Section 01750-Manufacturer's and Contractor's Services. Particular attention shall be paid to the correct installation of the pump Type 316 Stainless Steel guide bars.

3.02 SPARE PARTS

- A. The Contractor shall provide a complete list of spare parts for all equipment furnished under this Section. The list shall include part numbers, part description and current pricing. Prices are to be valid for a period of one year following the date of system commissioning.

3.03 START-UP SERVICE

- A. The pump manufacturer shall furnish the services of a qualified factory trained field inspector for three (3) 8 hour working days at the job site to inspect the installation and to instruct City personnel as to the operation and maintenance of the pumps.
- B. Upon completion of the pump installation and wiring, the Contractor shall insure that the manufacturer's representative does the following:
  - 1. Megger stator and power cables.
  - 2. Check seal lubrication.
  - 3. Check for proper rotation.
  - 4. Check power supply voltage.
  - 5. Measure motor operating load and no load current.

6. Check level control operation and sequence.

### 3.04 IN-PLACE VIBRATION TESTING

- A. Triaxial vibration measurements shall be performed after all pumps furnished under this Section have been installed in place. Such measurements shall be taken by a Sub-Contractor who can demonstrate a minimum of five (5) years experience in the field of mechanical vibration analysis. Readings shall be taken on each pump bearing housing for all six pumps. The overall allowable limit of mechanical vibration for any pump bearing during this test shall not exceed 0.25 in/sec. peak velocity. Testing criteria shall be in accordance with the Hydraulic Institute's "Accepted Field Vibration Limits For Vertical Non-Clog Pumps-Non Rigid."
- B. The results of such measurements shall be submitted directly to the City Representative.
- C. If overall vibration readings of the pumps in place exceed the limit of 0.25 in/sec. peak velocity with a maximum 10 mil displacement, then the Contractor shall, at no additional cost to the City, provide discrete frequency analysis to trace and correct the source of any excessive vibration.
- D. Vibration testing instrumentation shall be similar to IRD-300 Vibration Meter or equal. Calibration of such instrumentation shall be certified by the pump manufacturer and traceable to the National Bureau Of Standards.

### 3.05 FIELD TESTING

- A. Each of the 4 pumps shall be tested individually as follows:
  1. Fill the sump, as required to a sump level elevation of (-15) feet.
  2. Each pump shall be tested at full speed.
  3. During each test, pump the sump from the initial level of (-15) feet down to the shutoff elevation of (-17.61) feet, recording the flow rate and discharge line pressure at one foot intervals.
  4. Repeat the procedure described above until the 4 tests have been accomplished.
  5. After installation and before final acceptance of the pumps, performance curves shall be prepared by the Contractor and submitted to the City Representative.
  6. A representative of the pump manufacturer shall be present during the entire testing procedure.
  7. Field performance testing shall be conducted in accordance with the most recent revision of the Hydraulic Institute Test Standards.

### 3.06 IDENTIFICATION

- A. The Contractor shall furnish and install a 16 gauge Type 316 stainless steel identification plate which shall be securely mounted on each pump furnished under this Section in a readily visible location. The plate shall bear, in 1/4 inch die-stamped lettering, the equipment identification number indicated in this Specification and as shown on the Drawings.

### 3.07 PAINTING

- A. The pumps and control components shall be painted in strict accordance with the manufacturer's recommendations and in accordance with the provisions of Section 09 91 90.

### 3.08 WARRANTY

- A. In addition to the general Warranty requirements mentioned elsewhere in these special provisions, the Contractor shall provide a written warranty covering the performance of all equipment furnished under this Section for a period of five (5) years. The Contractor shall assume responsibility for all costs incurred in achieving satisfactory performance during the warranty period. The performance warranty shall cover performance as stated in Paragraph 2.02D Performance.
- B. The pump manufacturer shall have established a service agency within a 100 mile radius of the project site. Any emergency Warranty-related service calls must be responded to by the manufacturer within 24 hours. Warranty service calls of a non-emergency nature must be responded to within 72 hours. If the Manufacturer should fail to honor the time requirement above, then the City will use alternate repair sources and charge the Manufacturer for such repairs.

END OF SECTION



SECTION 33 45 20  
DEWATERING PUMPS

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install:
1. One (1) Submersible Non-Clog Wastewater Pump Units and
  2. All other components and accessories as required providing a complete and functional Sewage Pumping system as described herein and as shown on the Drawings.
- B. The Contractor shall furnish:
1. One (1) Submersible Non-clog Wastewater Pump Unit as spare pump.

1.02 EQUIPMENT NUMBERS

- A. DW-1 (Dewatering Pump)
- B. DW-2 (Dewatering Pump spare)

In addition to the requirements of the Standard Specifications, Submittals shall be made in accordance with the following provisions of the SPECIAL PROVISIONS:

1. Section 01 33 00 - Submittal Procedures
  2. Section 01 78 00 - Closeout Procedures
  3. Section 01 78 23 - Operation and Maintenance Data
  4. Section 01 45 00 - Quality Control
- C. Submittal data shall consist of:
1. Pump performance curves.
  2. Pump outline drawing.
  3. Station layout drawing showing accessories.
  4. Detailed electrical data.
  5. Control drawing and data.
  6. Access frame drawing.

7. Operational information including installation guide, technical manuals, and parts list.
  8. Manufacturer's start-up procedures and start-up report form.
  9. Motor performance curve.
  10. Maintenance information, materials and other characteristics.
- D. No pump equipment or accessories shall be ordered until the required drawings and curves have been approved by the City Representative.
- E. All pump performance data submitted shall be based on uncoated impellers. Any attempt to alter the pump performance by coating the impeller shall not be acceptable.

### 1.03 RELATED SECTIONS

- A. Section 22 04 00 - General Requirements for Plumbing

### 1.04 QUALITY ASSURANCE (FACTORY TESTING)

- A. The manufacturer shall conduct a factory test of each pump in accordance with the most recent test code of the Hydraulics Institute to determine head versus capacity and required kilowatt draw.
- B. Factory testing and inspection shall include the following inspections:
1. Check impeller, motor rating and electrical connections for compliance with these specifications.
  2. Prior to submergence, each pump shall be run dry to establish correct rotation.
  3. Each pump shall be run submerged in water.
  4. Motor and cable insulation shall be tested for moisture content or insulation defects.
  5. All tests shall be conducted in accordance with the requirements of the test code for centrifugal pumps of the Standards of Hydraulic Institute, as last revised.
  6. The Contractor shall submit drawings showing the test setup and instruments that are to be used for the test to the Engineer for approval. Complete data on all instruments and equipment to be used for the test and layouts showing exactly how the test is to be performed shall be submitted for approval before the pump is placed on the test stand. The pump motor must be used as the test motor. The motor and pump shall be tested as a unit.
  7. The Contractor shall perform a trial run of the shop tests before he notifies the Engineer that he is ready to run the witnessed shop tests. The pump manufacturer shall perform all tests and record and interpret all recorded data.
  8. The performance tests shall be sufficient to determine the curves of capacity, electric input, horsepower, water horsepower, and overall efficiencies for heads from shutoff to the minimum specified head for the pumping unit. The shop tests shall be run at the rated speed of the pump. Sufficient certified test data shall be



- submitted. Discharge shall be expressed in gallons per minute, and head in feet on the curves.
9. Six copies of the curves showing the results of the shop tests, along with certified motor test data, shall be furnished to the Engineer for approval. Shipment of the pumping units shall not be made until the Engineer has approved the test data and curves.
- C. A written quality assurance record confirming the above testing and inspections shall be supplied with each pump at the time of shipment.
- D. The pumps and their mechanical seals and motor units shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, manufacturer's service and warranty.
- E. Triaxial vibration readings shall be performed at the factory for all pumps furnished under this Section. Readings shall be taken on each pump bearing housing for all four pumps. The overall allowable limit of mechanical vibration for any pump bearing during this test shall not exceed 0.1 in/sec. peak velocity. Testing criteria shall be in accordance with the Hydraulic Institute's "Accepted Field Vibration Limits For Vertical Non-Clog Pumps-Non Rigid."
- F. Vibration testing instrumentation shall be similar to IRD-300 Vibration Meter or equal. Calibration of such instrumentation shall be certified by the pump manufacturer and traceable to the National Bureau Of Standards.
- G. All rotating components (impeller and rotor) shall be dynamically balanced at the point of manufacture both as individual components and as an assembly. Balancing data shall be submitted to the City prior to the factory performance testing. Rotors shall be balanced per ISO "G1" balancing standards.
- H. Pumps may be rejected by the City if the above requirements are not satisfied.
- I. All pump motors furnished under this Section shall be subjected to a routing test as specified by IEEE Test Standards to include high potential, no load amperage, locked rotor amperage and resistance. Test Report shall include IEEE Standard 112 Test Method B data for either an actual project motor or an identical duplicate. Test reports shall be approved by the Engineer prior to shipment of equipment.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Weil
- B. Or approved equal.

### 2.02 DESIGN REQUIREMENTS

- A. The pumps shall be heavy duty, electric submersible (dry pit submersible where applicable), non-clog units designed for handling raw, unscreened sewage and wastewater and shall be certified by the manufacturer as being suitable for this use.
- B. The pumps shall be capable of handling liquid which temperature is up to 104 degrees F.

- C. The Dewatering pump systems, including the pump, motor, and power cabling shall be approved (at the time of Bid) for use in areas classified as hazardous locations in accordance with the NEC Class I, Division 1, Group C and D service as determined by a testing laboratory acceptable to the City such as Underwriter's Laboratories (U.L.) or Factory Mutual (FM). The Sump Flushing Pump SHALL NOT be bound by Class I, Division 1, Group C & D requirements. As required by Factory Mutual (FM), the motor shall be capable of operating in pumped media up to 104 degrees F. The motor thermal switch shall allow safe operation up to 260 degrees F. In addition, an internal Float Switch shall be available in the motor chamber. Installation of explosion proof submersible pumps shall be performed by qualified FM trained personnel.
- D. The pumps and motors shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged or totally non-submerged. The use of shower systems, secondary pumps or cooling fans to cool the motor shall not be acceptable.
- E. The pump shall be floor mounted with vertical discharge.
- F. Major pump components shall be of grey cast iron, ASTM A-48, Class 30, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 316 stainless steel construction. All metal surface coming into contact with the pumped fluid, other than stainless steel or brass, shall be protected by a factory applied spray coating of alkyd primer with a chlorinated rubber paint finish on the exterior of the pump.
- G. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.
- H. Each pump/motor unit shall be provided with an integral self-supplying cooling system. The water jacket shall encircle the stator housing, thus providing heat dissipation for the motor. Impeller back vanes shall provide necessary circulation of the cooling liquid, a portion of the pumped fluid, through the water jacket. The two cooling media supply channels and the two return ports, located 180 degrees apart shall pass at least a 2-1/2 inch sewage solid without clogging. Provisions for external cooling and seal flushing shall also be provided. The cooling system shall provide for continuous pump operation in liquid temperature up to 104 degrees F. Raw sewage cooling jackets will not be required for motors which are adequately designed for ambient cooling.
- I. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual entry cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body providing a strain relief function. The cable entry junction chamber and motor shall be separated by a terminal board of non-hydroscopic material, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones or other secondary sealing systems shall not be acceptable.
- J. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air-filled watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class F insulation rated for 311 degrees F. The motor shall be capable of 15 evenly spaced starts per hour. The combined motor service factor shall be a minimum of 1.10 and the motor shall have a voltage tolerance of

- +/- 10%. A performance chart shall be provided showing curves for torque, current, power factor, input/output KW and efficiency. This chart shall also include data on starting and no-load characteristics.
- K. The power cable shall be sized according to NEC standards and shall be of sufficient length to reach the junction box without the need for any splices. The outer jacket shall be of oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submersion under water without loss of watertight integrity to a depth of at least 65 feet. The cable entry seal shall prevent any intrusion of water into all high voltage areas of the motors even in the event that the cable is damaged or severed below the water level.
- L. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
- M. The pump shafts shall rotate on grease lubricated bearings. Only bearings which are double sealed or shielded shall be considered "permanently lubricated". All open type bearings shall be provided with a means of adding grease in the amount and at the interval specified by the bearing manufacturer. The upper bearing provided for radial forces shall be a single roller bearing. The two lower bearings shall be permanently grease lubricated. The upper bearing shall be on a single roller bearing. The two lower bearings shall consist of one roller bearing for radial forces and one angular contact bearing for axial thrust. The minimum B10 bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed. Both the lower and the upper bearing housings shall include a resistance type (RTD) temperature sensor to monitor bearing temperatures. The pump manufacturer shall furnish a thermal switch for annunciation and pump shutdown on high bearing temperatures. Single row lower bearings are not acceptable.
- N. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an oil reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower primary seal unit, located between the pump and the oil chamber, shall contain one stationary and one positively driven rotating tungsten carbide ring. The upper, secondary seal unit, located between the oil chamber and the motor housing, shall contain one stationary tungsten carbide seal ring and one positively driven rotating tungsten carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent over-filling and to provide oil expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate DRY without damage while pumping under load.
- O. The pump and motor shaft shall be a solid continuous shaft. The pump shaft shall be an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be of carbon steel C1035 and shall be completely isolated from the pumped liquid by a replaceable Type 420 Stainless Steel shaft sleeve, or if a sleeve is not used, furnish the entire shaft of ASTM A276 Type 420 stainless steel.
- P. The impeller shall be Semi-Open or enclosed type, statically and dynamically balanced for a quiet, efficient operation. Cast iron impellers are standard on all models
- Q. A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with wastewater standard hard

steel wear rings, one on the volute inlet and one on the impeller. Wear rings shall be AISI 329 or equal with a Brinnell hardness of 300 and a 50 Brinnell difference between the two rings.

- R. The pump volute shall be single-piece gray cast iron, Class 30, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.
- S. All stators shall have thermal switches in series to monitor the temperature of each phase winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm. A lower bearing temperature monitor shall also be provided. A leakage sensor shall be provided to detect water in the stator chamber. The float leakage sensor, small float switch shall be used to detect the presence of water in the stator chamber. When activated, this sensor will stop the motor and activate an alarm. Use of voltage sensitive solid state sensors shall not be allowed. The thermal switches, float leakage sensor and the lower bearing temperature monitor shall be connected to a monitoring unit which shall be mounted in the control panel.
- T. Impeller Speed 1750 rpm.
- U. Provide pump control manufactured by pump manufacturer.

## 2.03 PERFORMANCE REQUIREMENTS

- A. Each pump shall be capable of delivering flows as shown on drawings.

## PART 3 – EXECUTION

### 3.01 MANUFACTURER'S CERTIFICATE

- A. An authorized manufacturer's representative shall inspect the installation of all equipment furnished under this Section and shall provide a certificate of satisfactory installation in accordance with the provisions of Section 01 45 00 – Quality Control.

### 3.02 SPARE PARTS

- A. The Contractor shall provide a complete list of spare parts for all equipment furnished under this Section. The list shall include part numbers, part description and current pricing. Prices are to be valid for a period of one year following the date of system commissioning.

### 3.03 START-UP SERVICE

- A. The pump manufacturer shall furnish the services of a qualified factory trained field inspector for three (3) 8 hour working days at the job site to inspect the installation and to instruct City personnel as to the operation and maintenance of the pumps.
- B. Upon completion of the pump installation and wiring, the Contractor shall insure that the manufacturer's representative does the following:
  - 1. Megger stator and power cables.
  - 2. Check seal lubrication.

3. Check for proper rotation.
  4. Check power supply voltage.
  5. Measure motor operating load and no load current.
  6. Check level control operation and sequence.
- C. After installation and before final acceptance of the pumps, performance curves shall be prepared by the contractor. Data for the curves shall be obtained from pressure and flow instruments installed in the pump station. Performance points shall be plotted to show conformance with the specifications. Each of the dewatering pumps shall be tested at its best efficiency point for thirty (30) minutes. A representative of the pump manufacturer shall be present for tests.

### 3.04 FIELD TESTING

- A. The Dewatering Pumps shall be tested simultaneously with the Main Pumps.
- B. With one Dewatering Pump running, pump the sump from the initial level of (-15) feet down to the elevation of (-20) feet, recording the flow rate and discharge line pressure at one foot intervals.
- C. Repeat this procedure for the spare pump. The Contractor shall prepare the spare pump for testing.
- D. Prepare pump curves using data obtained during the field tests.
- E. After installation and prior to acceptance by the City, submit pump curves described in "Startup Service" to the Engineer.
- F. A representative of the pump manufacturer shall be present during the entire testing procedure.
- G. The Sump Flushing Pump will be tested in the same manner as the Dewatering Pumps.
- H. Field performance testing shall be conducted in accordance with the most revision of the Hydraulic Institute Test Standards.

### 3.05 IN-PLACE VIBRATION TESTING

- A. Triaxial vibration measurements shall be performed after all pumps furnished under this Section have been installed in place. Such measurements shall be taken by a Sub-Contractor who can demonstrate a minimum of five (5) years experience in the field of mechanical vibration analysis. Readings shall be taken on each pump bearing housing for all six pumps. The overall allowable limit of mechanical vibration for any pump bearing during this test shall not exceed 0.25 in/sec. peak velocity. Testing criteria shall be in accordance with the Hydraulic Institute's "Accepted Field Vibration Limits For Vertical Non-Clog Pumps-Non Rigid."
- B. The results of such measurements shall be submitted directly to the Engineer.
- C. If overall vibration readings of the pumps in place exceed the limit of 0.25 in/sec. peak velocity with a maximum 10 mil displacement, then the Contractor shall, at no additional

cost to the City, provide discrete frequency analysis to trace and correct the source of any excessive vibration.

- D. Vibration testing instrumentation shall be similar to IRD-300 Vibration Meter or equal. Calibration of such instrumentation shall be certified by the pump manufacturer and traceable to the National Bureau Of Standards.

### 3.06 IDENTIFICATION

- A. The Contractor shall furnish and install a 16 gauge Type 316 stainless steel identification plate which shall be securely mounted on each pump furnished under this Section in a readily visible location. The plate shall bear, in 1/4 inch die-stamped lettering, the equipment identification number indicated in this Specification and as shown on the Drawings.

### 3.07 PAINTING

- A. The pumps and control components shall be painted in strict accordance with the manufacturer's recommendations and in accordance with the provisions of Section 09 91 91.

### 3.08 WARRANTY

In addition to the general Warranty requirements mentioned elsewhere in these SPECIAL PROVISIONS, the Contractor shall provide a written warranty covering the performance of all equipment furnished under this Section for a period of five (5) years. The Contractor shall assume responsibility for all costs incurred in achieving satisfactory performance during the warranty period. The performance warranty shall cover performance as stated in Paragraph 2.03 PERFORMANCE REQUIREMENTS.

END OF SECTION

**SECTION 40 61 00****COMMON WORK RESULTS FOR CONTROL  
SYSTEM****PART 1 GENERAL****1.01 DESCRIPTION**

- A. Work included: This section covers all work necessary for engineering, equipment fabrication, furnishing, installing, calibrating, adjusting, testing, documenting, starting up and commissioning of the Process Control and Instrumentation Systems (PCIS), complete including training of PORT staff on the controls. The following Sections expand on the requirements of this Section:
1. Section 40 61 21, Process and Facility Control System Testing
  2. Section 40 61 96, Control Strategies
  3. Section 40 70 00, Instrumentation for Process Systems
  4. Section 40 94 31, Control Panel Construction
  5. Section 40 94 45, Programmable Logic Controller with Integrated HMI
- B. Detailed Design: The design as shown and specified includes functional and performance requirements. The Contractor shall complete the detailed design as specified herein.
- C. Completeness: The instrumentation and control systems shall be furnished, installed, programmed and ready for use.
- D. Coordination: Instrumentation and controls provided under this section shall be designed and coordinated for proper operation with related equipment and materials provided under other Sections of these Specifications.
- E. Use a PCIS Subcontractor (System Integrator) to implement the PCIS.

**1.02 RELATED SECTIONS**

- A. Divisions 40 for mechanical and process equipment
- B. Division 26 Electrical

**1.03 CODES AND STANDARDS**

- A. All work performed and all materials furnished shall conform to the applicable publications and standards of the organizations listed below. Latest editions and revisions shall be used as of the date of these Specifications:

1. American Society for Testing and Materials (ASTM)
2. International Association of Automation (ISA)
3. National Electrical Manufacturers' Association (NEMA)
4. National Fire Protection Association (NFPA)
5. Underwriters' Laboratories (UL)
6. San Francisco Electrical Code.

#### **1.04 MINIMUM PCIS SUBCONTRACTOR SCOPE:**

- A. For I&C equipment and ancillaries required in this Section:
  1. Furnish, install, and test instruments and control panels included under this Section and related sections.
  2. Provide all necessary mounting hardware and materials for proper installation.
  3. Calibrate startup, and testing of all new instruments furnished and installed under this contract.
  4. Furnish, install and configure control system network under this contract.
  5. Complete detailed design, including evaluating, tracing, labeling, and accounting for all existing components.
  6. Provide required submittals and system documentation.
  7. Conduct system start-up.
  8. Be responsible for coordination with, and providing all required information to, Port of San Francisco for DCS development.
  9. Provide As-built documentation.
- B. For equipment not provided under this Section, but directly connected to equipment required in this Section:
  1. Obtain manufacturer's information on installation, interface, function, and adjustment.
  2. Coordinate to allow required interface and operation with the PCIS.



3. For operation and control, verify that installations, interfacing signal terminations, calibration, and adjustments have been completed in accordance with manufacturer's recommendations.
4. Test to demonstrate required interface and operation of control system as specified in packaged equipment specification or specification section describing control narratives for the project.

## 1.05 SUBMITTALS

### A. General

1. Format: Orderly, indexed with labeled tab dividers.
2. In accordance with Section 01 33 00 requirements.

### B. Shop Drawings:

1. General:
  - a. Shop drawings: Full scaled details, wiring diagrams, catalog cuts, and descriptive literature.
  - b. Identify proposed items and options, installed spares, and other provisions for future work (e.g., reserved panel space; unused components, wiring and terminals).
  - c. Legends and abbreviation: Submit complete definitions of symbols and abbreviations used.
2. Submittals required for PCIS:
  - a. Material list including spares, expendables, test equipment proposed for this Project.
  - b. Instrument list showing tag numbers, process description, instrument range, setpoint(s) if any, referenced drawings, manufacturer and model number, minimum.
  - c. Remote IO Module's I/O list where applicable showing tag number, I/O module and input/output channel.
  - d. Component data sheets format and level of details in accordance with ISA-S20. Include process parameters, manufacturer, complete model number, and the nearest representative and service facility.
  - e. Panel construction drawings showing location of panel mounted devices, doors, louvers, subpanels, electrical and mechanical devices. Include tag numbers, nameplate inscriptions, service legends, annunciator inscriptions, color and sizes where applicable,

- NEMA rating, lifting lugs, brackets, and other connection callouts and details.
- f. Interconnection diagrams for discrete control and power circuits similar to those shown in the Drawings. Include wire number, color, and cable if part of multi-conductor cable; terminals strip and block numbers, junction boxes, MCC number, enclosure number, relay coils and contacts with switching action, ground wires and connections.
  - g. Loop diagrams for analog devices similar to those shown in the Drawings. Conform to the minimum requirements of ISA S5.4. Show terminal numbers, switching contacts, dropping resistors, power supplies, and components.
  - h. Installation details for the proper installation of the instrumentation components. Include bill of materials, troubleshooting and calibration procedures. Provide internal schematic and wiring diagrams where applicable.
  - i. Testing procedures and forms: Factory demonstration test, operational readiness test, and functional acceptance test. Submit example forms and instructions for PCIS equipment.
  - j. Ladder diagram logic listings: Each I/O point shall have a tag number, PLC addressing and/or description. Ladder rungs shall have comments that describe the function of the rungs. Provide the following additional information integral to the ladder listings to document the PLC program:
    - 1) I/O point cross reference list.
    - 2) Internal coil cross reference list.
    - 3) Data register cross reference list.
    - 4) Listing of all program special functions. Include descriptions and pertinent memory locations used, and programmed values

## 1.06 SYSTEM PERFORMANCE REQUIREMENTS

- A. Furnish all PCIS functions as shown on Drawings and specified in the loop specifications.
  - 1. For Control System's discrete and continuous process and process equipment variables:
    - a. Measure and monitor.
    - b. Present to plant operators for monitoring of Control System status.

2. Control system shall provide means for plant operators to be able to control process both automatically and manually.
3. Meet the following specific functional requirements:
  - a. Shown on P&IDs and control diagrams.
  - b. Stated for each loop in Loop Specifications.

### 1.07 LOOP SPECIFICATIONS

- A. Location: P&ID drawings and Control Description in relevant sections of the specifications.
- B. Organization: By P&ID Drawings and loop numbers.
- C. Functional Requirements for Control Loops:
  1. Shown on Control Panel Drawings and Process and Instrumentation Diagrams (P&ID). P&ID format and symbols are in accordance with ISA S5.1, except as specified or shown on Drawings.
  2. Supplemented by Loop Specifications that describe requirements not obvious on P&ID's or control panel drawings.
  3. Supplemented by loop diagrams.
- D. Subheadings for Each Loop:
  1. Special Functions: Clarifies functional performance of loop including abstract of interlocks.
  2. Components: Lists major components for each loop. Information listed includes:
    - a. Tag numbers.
    - b. Manufacturer.
    - c. Model numbers.
    - d. Instrument ranges.
    - e. Calibrated ranges.
    - f. Component Names and Options: Names of components followed by options required to tailor general Component Specifications to specific application.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers, and related equipment as recommended by the capsule manufacturer.
- B. Prior to installation, store items in dry indoor locations.
- C. Cover panels and other elements that are exposed to dusty construction environments.

**1.09 SEQUENCING AND SCHEDULING**

- A. Progress Schedule:
  - 1. Supplements the overall project schedule to:
    - a. Coordinate interaction with CCSF designated representative for coordination meetings, submittal reviews, and test witnessing.
    - b. Clarify required Work sequences and major milestone prerequisites.
  - 2. Content:
    - a. Include:
      - 1) Preparation of submittals.
      - 2) Purchasing, fabrication, and assembly activities.
      - 3) Factory tests.
      - 4) Shipment and delivery.
      - 5) Installation.
      - 6) Project site testing.
      - 7) Start-up.
      - 8) Substantial completion.
      - 9) Acceptance.
- B. Activity Completion Dates:
  - 1. Shop drawings review and acceptance.
  - 2. Quality Control Submittals: Reviewed and accepted.
  - 3. Hardware delivered.
  - 4. Tests completion and documentation accepted.
  - 5. Substantial completion.

- C. PCIS Acceptance:
  - 1. Punch list item completed.
  - 2. Functional acceptance test completed.
  - 3. City Representative issues written notice of acceptance.

## 1.10 WARRANTY

- A. The Contractor shall provide a written warranty covering the performance, workmanship, and installation of all equipment furnished under this Section for a period of two (2) years from date of Substantial Completion. The Contractor shall assume responsibility for all costs incurred in achieving satisfactory performance during the warranty period. Warranties shall be in accordance with Section 01 78 36.

## 1.11 SYSTEM INTEGRATOR QUALIFICATIONS

- A. It is the intent of these Specifications, that Division 40 Sections related to instrumentation and control systems, be supplied by one System Integrator (SI) or packaged equipment manufacturer where applicable. The SI shall perform all work necessary to design, select, furnish, customize, debug, supervise installation, connect, calibrate, field modify existing control and instrumentation wirings and place into operation, all hardware, communication lines and equipment, and coordinate the programming of all software specified within these Sections.
- B. The SI must be a manufacturer or a “systems house,” regularly engaged in the design, the installation and commissioning of computerized control systems and their associated subsystems as they are applied to the municipal water or wastewater industry. For the purposes of this specification section, a “systems house” shall be interpreted to mean an organization that complies with all of the following criteria:
  - 1. Employs a registered California Professional Engineer to supervise or perform the work required by this Specification Section. The Control System Engineer shall have at least five years’ experience working with Water Wastewater Treatment Plant and large pump station projects and be with the company for at least five years.
  - 2. Employs personnel on this project who have successfully completed a manufacturers training course on the configuration and implementation of the specific Moxa RIO.
  - 3. Has performed work of similar or greater complexity on at least three previous projects, having RIO, PLCs, LOI and HMI computers, Local

- Area Network (LAN), Wide Area Network (WAN) and fiber optic data communications.
4. Has been actively engaged in the type of work specified in this Specification Section for a minimum of 15 years.
- C. For the purposes of this Specification Section, a “manufacturer” shall be interpreted to mean an organization that complies with all of the following criteria:
1. Manufactures at least 50 percent (as measured by equipment cost) of the system specified in this section and furnished for this Contract.
  2. Complies with the preceding criteria established for a “system house.”
- D. The SI shall maintain a permanent, fully staffed and equipped service facility, where they assemble, configure and test the systems, within 100 miles of the project site with personnel and equipment required to assemble, maintain, repair, calibrate and program the systems specified herein within a 24 hour response time, 7 days a week all year round.
- E. The SI shall have full service for UL listing and shall have a C-10 California Electrical Contractor License for the last 5 years. This requirement is to allow the SI to supervise the electrical installation necessary for all control and monitoring and meet all applicable San Francisco Electrical Code provisions and standards required for the installation of the Facilities Systems. No exception is allowed for this requirement. The SI shall demonstrate that there are no litigations pending against their license.
- F. The SI shall have the facilities and capabilities to perform Control System Engineering and design, computer and PLC software development, graphic screens development, AutoCAD drafting and documentation, technical writing and field service support. This requirement is to allow the SI to understand the needs and to provide all required peripherals for a complete system.
- G. Project site representative: Minimum 5 years’ experience installing systems similar to PCIS for this Project.
- H. The SI shall furnish equipment, which is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer and UL listed.
- I. The descriptions of the Control Panels are in another Section of the Contract.
- J. The SI shall submit the equipment submittal document as required in other section with his/her qualification and detailed written plan indicating work to be performed to meet the objective of this contract prior to construction. The list of qualification shall include Name and Certification of each individual who will perform configuration and installation for this contract. A copy of certification shall be provided for verification.

K. The following list of System Integrators is approved.

1. Telstar Instrument Inc, Concord, CA
2. TESCO Controls, Inc. Sacramento, CA
3. Primex, Vacaville, CA

Packaged equipment manufacturers and other System Integrators who have equivalent experience and qualifications will be accepted after they submit documents related to their qualifications.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. Provide PCIS functions as shown on Drawings and as required for each Loop. Furnish all materials, equipment, and software, whether indicated or not but necessary to effect required subsystem and loop performance.
- B. First Named Manufacturer: PCIS design is based on first named manufacturers of equipment, materials, and software required in PCIS Subsystems.
  1. If an item is proposed from other than first named manufacturer, obtain approval from City Representative for such changes in accordance with Article SUBMITTALS.
  2. If proposed item requires, different installation, wiring, raceway, enclosures, intrinsic safe barriers, and accessories, all cost associated with the additional provision shall be borne by the contractor.
- C. Like Equipment Items:
  1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.
  2. Implement all same or similar functions in same or similar manner. For example, but not limited to, control logic, sequence controls and display layouts.

### **2.02 MISCELLENEOUS ELECTRICAL PRODUCTS**

- A. Electrical provisions in accordance with applicable sections of Division 26, ELECTRICAL.
- B. I&C and electrical components, terminals, wires, and enclosures UL recognized. UL listed, for control panels.
- C. Wires within Enclosures:
  1. AC Circuits:
    - a. Type: 600-volt, in accordance with applicable sections in Division 26, Electrical.

- b. Size: For current to be carried, but not less than No. 16 AWG.
  2. Analog Signal Circuits:
    - a. Type: 300-volt stranded copper, twisted shielded pairs.
    - b. Size: No. 18 AWG, minimum.
  3. Other DC Circuits.
    - a. Type: 300-volt, Type MTW stranded copper.
    - b. Size: No. 18 AWG, minimum.
  4. Special Signal Circuits: Use manufacturer's standard cables.
  5. Wire Identification: Numbered and tagged at each termination.
    - a. Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Use the "Grafoplast" or Equal wire marking system. Adhesive or taped-on tags are not acceptable.
- D. Wires entering or leaving enclosures terminate and identify as follows:
  1. Analog and discrete signal, terminate at numbered terminal blocks.
  2. Special signals, terminated using manufacturer's standard connectors.
  3. Identify all wiring in accordance with requirements in Division 26, ELECTRICAL.
- E. Wiring Interface: Terminate and identify wiring entering or leaving enclosures.
  1. Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.
  2. Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer's standard connectors for the device to which the signals terminate.
- F. Terminal Blocks for Enclosures:
  1. Quantity:
    - a. Sufficient to accommodate present needs.
    - b. Wire all spare or unused panel mounted elements to their panels' terminal blocks.
    - c. Spare Terminals: twenty (20) percent of all connected terminals.



2. General:
  - a. Connection Type: Screw connection clamp.
  - b. Compression Clamp:
    - 1) Complies with VDE 0611.
    - 2) Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.
    - 3) Guides all strands of wire into terminal.
  - c. Screws: Hardened steel and are captive and self-locking.
  - d. Current Bar: Copper or treated brass.
  - e. Insulation:
    - 1) Thermoplastic rated for minus 55 to plus 110 degree C.
    - 2) Two (2) funneled shaped inputs to facilitate wire entry.
  - f. Mounting:
    - 1) Standard DIN rail.
    - 2) A terminal block can be extracted from an assembly without displacing adjacent blocks.
    - 3) End Stops: One (1) at each end of rail, minimum.
  - g. Wire preparation: Stripping only.
  - h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
  - i. Marking System:
    - 1) Terminal number shown on both sides of terminal block
    - 2) Allow use of preprinted and field marked tags.
    - 3) Terminal strip numbers shown on end stops.
    - 4) Terminal block and terminal strip numbers shall be recorded on the Loop Diagrams and Interconnection Diagrams.
    - 5) Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.
  - j. Test Plugs: Soldered connections for 18-AWG wire.
    - 1) Pin Diameter: 0.079 inch.
    - 2) Quantity: 10
    - 3) Manufacturer and Product: Entrelec; Type FC2, equal by Phoenix Contact, Weidmuller or Equal.
3. Terminal Block, General Purpose:

- a. Rated Voltage: 600V ac.
  - b. Rated Current: 30 amps.
  - c. Wire Size: 22 to 10 AWG.
  - d. Rated Wire Size: 10 AWG.
  - e. Color: Grey body.
  - f. Spacing: 0.25 inch, maximum.
  - g. Test Sockets: One screw test socket 0.079-inch diameter.
  - h. Manufacturer and Product: Entrelec; Type M4/6.T.
4. Terminal Block, for Grounding:
- a. Wire Size: 22 to 12 AWG.
  - b. Rated Wire Size: 12 AWG.
  - c. Color: Green and yellow body.
  - d. Spacing: 0.25 inch, maximum.
  - e. Grounding: Ground terminal blocks electrically grounded to the mounting rail.
  - f. Manufacturer and Product: Entrelec; Type M4/6.P, equal by Phoenix Contact, Weidmuller, or Equal.
5. Terminal Block, Blade Disconnect Switch with test socket screw:
- a. Rated Voltage: 600V ac.
  - b. Rated Current: 10 amps.
  - c. Wire Size: 24 to 10 AWG.
  - d. Rated Wire Size: 12 AWG.
  - e. Color: Grey body, orange switch.
  - f. Spacing: 0.25 inch, maximum.
  - g. Test Sockets: Two screw test sockets 0.079-inch diameter on each side of switch.
  - h. Manufacturer and Product: Phoenix Contac; Type: UK5- MTK, equal by Entrelec, Weidmuller or Equal.
6. Terminal Block, Fused, 120V ac:
- a. Rated Voltage: 600V ac.
  - b. Rated Current: 16 amps.
  - c. Wire Sizes: 20 to 6 AWG.
  - d. Color: Black body.

- e. Fuse: 0.25 inch by 1.25 inch.
  - f. Indication: LED 110V ac or 24 V dc
  - g. Spacing: 0.512 inch, maximum
  - h. Manufacturer and Product: Phoenix Contact; Type: UL 6.3-HESILED 24 or UK6.3-HESILA250, equal by Entelec, Weidmuller or Equal.
7. Terminal Block, Fused, 120V ac, High Current:
- a. Rated Voltage: 600V ac.
  - b. Rated Current: 35 amps.
  - c. Wire Size: 18 to 8 AWG.
  - d. Color: Grey.
  - e. Fuse: 13/32 inch by 1.5 inch.
  - f. Spacing: 0.95 inch, maximum.
  - g. Manufacturer and Product: Entelec; Type MB10/24.SF, equal by Phoenix Contact, Weidmuller or Equal.
- G. Relays:
- 1. General:
    - a. Relay Mounting: Plug-in type socket.
    - b. Relay Enclosure: Furnish dust cover.
    - c. Socket Type: Screw terminal interface with wiring.
    - d. Socket Mounting: Rail.
    - e. Provide hold-down clips.
  - 2. Signal Switching Relay:
    - a. Type: Dry circuit.
    - b. Contact Arrangement: 4 Form C contacts.
    - c. Contact Rating: 0 to 5 amps at 28V dc or 120V ac.
    - d. Contact Material: Gold or silver.
    - e. Coil Voltage: As noted or shown.
    - f. Coil Power: 0.9 watts (dc), 1.2VA (ac).
    - g. Expected Mechanical Life: 10,000,000 operations.
    - h. Expected Electrical Life at Rated Load: 100,000 operations.
    - i. Indication Type: LED indicator lamp.

- j. Seal Type: Hermetically sealed case.
  - k. Manufacturer and Product: Potter and Brumfield; Series KH/KHA, Omron Electronics LY Series, or Equal.
3. Control Circuit Switching Relay, Nonlatching:
- a. Type: Compact general purpose plug-in.
  - b. Contact Arrangement: 3 Form C contacts.
  - c. Contact Rating: 10A at 28V dc or 240V ac.
  - d. Contact Material: Silver cadmium oxide alloy.
  - e. Coil Voltage: As noted or shown.
  - f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
  - g. Expected Mechanical Life: 10,000,000 operations.
  - h. Expected Electrical Life at Rated Load: 100,000 operations.
  - i. indication Type: Neon or LED indicator lamp.
  - j. Push to test button.
  - k. Manufacturer and Product: Potter and Brumfield; Series KUP, Omron Electronics, MY Series or Equal.
4. Control Circuit Switching Relay, Latching:
- a. Type: Dual coil mechanical latching relay.
  - b. Contact Arrangement: 2 Form C contacts.
  - c. Contact Rating: 10A at 28V dc or 120V ac.
  - d. Contact Material: Silver cadmium oxide alloy.
  - e. Coil Voltage: As noted or shown.
  - f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
  - g. Expected Mechanical Life: 500,000 operations.
  - h. Expected Electrical Life at Rated Load: 50,000 operations.
  - i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP; Omron Electronics, MMK Series or Equal.
5. Control Circuit Switching Relay, Time Delay:
- a. Type: Adjustable time delay relay.
  - b. Contact Arrangement: 2 Form C contacts.
  - c. Contact Rating: 10A at 240V ac.
  - d. Contact Material: Silver cadmium oxide alloy.
  - e. Coil Voltage: As noted or shown.

- f. Operating Temperature: Minus 10 to 55 degrees C.
  - g. Repeatability: Plus or minus 2 percent.
  - h. Delay Time Range: Select range such that time delay set point fall between 20 to 80 percent of range.
  - i. Time Delay Set Point: As noted or shown.
  - j. Mode of Operation: As noted or shown.
  - k. Adjustment Type: Integral potentiometer with knob external to dust cover.
    - 1) Manufacturer and Products: Potter and Brumfield; Series CB for 0.1 second to 100 minute delay time ranges, Series CK for 0.1 to 120 second delay time ranges; or Equal.
6. Intrinsicly Safe Switching Relays & Barriers:
- Intrinsic safe relays for switching application & LED pilot light or lighted pushbutton switches shall be multi-channel modules IDEC EB3C and EB3L series respectively or approved equal. Unit shall operate from 120VAC power supply and provide dry contact output suitable for direct 120V input circuit to a PLC or energizing a 120VAC coil interposing relays.
- H. Analog Signal Isolators - Provide DIN rail mounted 24VDC or 120VAC powered field configurable single and/or dual channel isolators offering wide ranging input/output for the following functions:
1. To isolate analog signals shown on plans that are sent from one enclosure to another
  2. To provide isolation where a single analog output is used to drive multiple active devices (e.g. single level signal used to control multiple adjustable speed motor controllers).
  3. To provide analog signal for instruments on different panels, cabinets, or enclosures (wiring instrument mounted in different panel in series shall not be allowed).
  4. Single/Dual Input/Output Analog signal isolator unit shall be Action Instrument, Action I/Q model Q406, equal by Phoenix Contact, or equal.
- I. Power Supplies:
1. Furnish as required to power instruments requiring external dc power, including two-wire transmitters and dc relays.
  2. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.

3. Furnish redundant dc power supplies. Provide a contact closure for alarm in case of dc power supply failure.
  4. Provide output over voltage and over current protective devices to:
    - a. Protect instruments from damage due to power supply failure.
    - b. Protect power supply from damage due to external failure.
  5. Enclosures: As noted on the drawing.
  6. Mount such that dissipated heat does not adversely affect other components.
  7. Fuses: For each dc supply line to each individual two-wire transmitter.
    - a. Type: Indicating.
    - b. Mount so fuses can be easily seen and replaced.
  8. Manufacturer:
    - a. Sola/Hevi-Duty
    - b. Phoenix Contact
    - c. Weidmuller or approved equal
- J. Hand Switch (or pushbutton) and Light, Oil tight, Round
1. General:
    - a. Function: Select, initiate, and display discrete control functions.
    - b. Type: Heavy-duty, oil tight, industrial, LED light.
    - c. Use color codes and inscriptions listed in Table 13400.1 for pushbutton unless otherwise noted.
    - d. Unused or Non-inscribed Buttons: Black.
    - e. Lettering Color:
      - 1) Black Lettering on white and yellow buttons.
      - 2) White lettering on black for red and green buttons

Function	Inscription	Color
OO	ON OFF	Red Green
OC	OPEN CLOSE	Red Green
OCA	OPEN CLOSE AUTO	Red Green Blue

OOA	ON OFF AUTO	Red Green Blue
MA	MANUAL AUTO	White Blue
SS	START STOP	Red Green
RESET	RESET	Red
EMERGENCY STOP	EMERGENCY STOP	Red
LOCAL	LOCAL	White

**Table 40 61 00.1 Pushbutton Colors**

2. General Features:
  - a. Mounting: 30.5 mm single round hole where panel thickness is between 1/16 inch to 1/4 inch.
  - b. Legend Plate: Standard size square style aluminum field and black markings, unless otherwise noted. Markings as shown.
  - c. Configuration: Light, pushbutton, or switch as noted or shown.
3. Indicator Light Features:
  - a. Lights: 6V ac lamps and integral transformer for operation from 120V ac, LED indicator light with glass lens, unless otherwise noted.
  - b. Lens Color: Color as noted.
4. Pushbutton and Switch Features:
  - a. Guard: Full guard with flush button, unless otherwise noted.
  - b. Operator: Black pushbutton, black non-illuminated knob on switch, unless otherwise noted.
  - c. Boot: None, unless otherwise noted.
5. Signal Interface:
  - a. Contact Block:
    - 1) Type: Silver-coated butting, unless otherwise noted.
    - 2) Rating: 10 amps continuous at 120V ac or as noted.
    - 3) Sequence: Break-before-make, unless otherwise shown.
    - 4) Arrangement: Normally open or normally closed as shown, or perform functions noted.
    - 5) Terminals: Screw with strap clamp, unless otherwise noted.

6. NEMA Rating: NEMA 4X, watertight and dust-tight.
  7. Manufacturers:
    - a. Square D Co., Class 9001, Type SK.
    - b. Allen-Bradley, Bulletin 800T.
    - c. Eaton Corp., Cutler-Hammer, Type 10250T.
- K. Grounding of Enclosures:
1. Isolated copper grounding bus for all signal and shield ground connections.
  2. Ground this ground bus at a common signal ground point in accordance with National Electrical Code requirements.
  3. Single Point Ground for Each Analog Loop:
    - a. Locate: At dc power supply for loop.
    - b. Use to ground all wire shields for loop.
    - c. Group and connect shields in the following locations:
      - 1) In Control Panel, for all field instrument wiring brought in to the panel for termination.
      - 2) In Local Panels, for all field instrument wiring being terminated in the field panel.
  4. Ground terminal block rails to ground bus.

### **2.03 PANEL FABRICATION**

- A. Panel with external dimensions and instruments arrangement as shown on Drawings except as modified in City Representative approved shop drawings.
- B. Factory Assembly: Assemble enclosures at PCIS Subcontractor's factory. No fabrication other than correction of minor defects or minor transit damage shall be done on panels at Project site.
- C. All panels shall have UL Label for Enclosures: UL label stating "Listed Enclosed Industrial Control Panel."
- D. Wiring within PCIS Enclosures:
  1. Restrain by plastic ties or ducts or metal raceways.
  2. Hinge Wiring: Secure at each end so that bending or twisting shall be around longitudinal axis of the wire. Protect bend area with sleeve.



3. Arrange wiring neatly, cut to proper length, and remove surplus wire.
  4. Abrasion protection for all wire bundles which pass through holes or across edges of sheet metal.
  5. Connections to Screw Type Terminals:
    - a. Furnish locking-fork-tongue lugs.
    - b. Use manufacturer's recommended tool with required sized anvil to make all crimp lug terminations.
    - c. Wires terminated in a crimp lug, maximum of one.
    - d. Lugs installed on a screw terminal, maximum of two.
  6. Connections to Compression Clamp Type Terminals:
    - a. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.
    - b. Wires installed in a compression screw and clamp, maximum of one.
  7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
  8. Terminate 24VDC and analog signal circuits on separate terminal block from AC circuit terminal blocks.
  9. Separate all analog and DC circuits by at least 6 inches from all AC power and control wiring, except at unavoidable crossover points and at device terminations.
  10. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.
- E. Temperature Control:
1. Furnish with louver and forced ventilation as required to prevent temperature buildup due to electrical devices mounted inside panel or on panel.
  2. Furnish ventilation fans and filters required to provide adequate cooling. Fan motors power: 120VAC, 60 Hz.
- F. Internal Panel Lights for Freestanding Panel:
1. Type: Switched LED enclosure light.
  2. Quantity: One light for every 4 feet of panel width.

3. Mounting: Inside and in the top of back-of-panel area.
  4. Protective metal shield for lights.
  5. The panel light shall produce 470 lumens and minimum 50,000 hours rated life, equipped with door activated switch.
  6. Manufacturer: Hoffman or equal
- G. Service Outlets for Freestanding Panel:
1. Type: Three-wire, 120-volt, 15-ampere, duplex receptacles.
  2. Quantity: One for every 4 feet of panel width, two minimum per panel.
  3. Mounting: Evenly spaced along back-of-panel area.
- H. Factory Finishing:
1. All equipment and material furnished under this Section shall be painted in strict accordance with the manufacturer's recommendations.
  2. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with light gray color.

## 2.04 SOURCE QUALITY CONTROL

- A. General:
1. Test all PCIS elements, both hardware and software, to demonstrate that PCIS satisfies all requirements.
  2. Factory Tests Described Under this Article: Factory Demonstration Tests (FDT).
  3. Onsite Tests Described Under PART 3, EXECUTION:
    - a. Operational Readiness Tests (ORT).
    - b. Functional Acceptance Tests (FAT).
  4. Test Format: Cause and effect.
    - a. Person conducting test initiates an input (cause).
    - b. Specific test requirement is satisfied if correct result (effect), occurs.

5. Procedures, Forms, and Checklists:
    - a. Conduct all tests in accordance with, and documented on, City Representative accepted procedures, forms, and checklists.
    - b. Describe each test item to be performed.
      - . Have space after each test item description for sign off by appropriate party after satisfactory completion.
  6. Required Test Documentation: Test procedures, forms, and checklists. All signed by City Representative and contractor.
  7. Conducting Tests:
    - a. All special testing materials and equipment.
    - b. Wherever possible, perform tests using actual process variables, equipment, and data.
    - c. If it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation.
    - d. Define simulation techniques in test procedures.
  8. Coordinate PCIS testing with City Representative and affected Subcontractors.
  9. City Representative will actively participate in all of the tests.
  10. City Representative reserves right to test or retest all specified functions whether or not explicitly stated Test Procedures.
  11. City Representative's decision shall be final regarding acceptability and completeness of all testing.
- B. Factory Demonstration Tests (FDT):
1. Scope: Test entire PCIS, with exception of primary elements, final control elements, and smaller AS panels, to demonstrate that it is operational.
  2. Location: PCIS Subcontractor's factory or City Representative approved staging site.
  3. Loop-Specific Functions: Demonstrate functions shown on P&ID's and as required. Special Functions:
    - a. One of each type function. For example, for the sump pump startup control, demonstrate controls for one pump.
    - b. One of each type of function in a panel; for example annunciator operation, controller operation, and recorder operation.
    - c. All required and shown functions for all loops.

4. Correct all deficiencies found and complete prior to shipment to Project site.
5. Failed Tests:
  - a. Repeated and witnessed by City Representative.
  - b. With approval of City Representative, certain tests may be conducted by PCIS Subcontractor and witnessed by City Representative as part of ORT.
6. Make following documentation available to City Representative at test site both before and during FDT:
  - a. All Drawings, Specifications, Addenda, and Change Orders.
  - b. Master copy of FDT procedures.
  - c. List of equipment to be tested including make, model, and serial number.
  - d. Shop Drawing hardware submittals for equipment being tested.
  - e. Software documentation submittal.

## **PART 3 – EXECUTION**

### **3.01 EXAMINATION**

- A. Equipment furnished by PCIS Subcontractor and installed by CONTRACTOR, requires PCIS Subcontractor to observe and advise on installation to extent required to certify with ORT that equipment has been properly installed and shall perform as required.
- B. For equipment not provided by PCIS Subcontractor, but that directly interfaces with the PCIS, verify the following conditions:
  1. Proper installation.
  2. Calibration and adjustment of all instruments.
  3. Correct control action.
  4. Switch settings.

5. Input and output signals.

### 3.02 INSTALLATION

- A. Material and Equipment Installation:
  1. Follow manufacturers' installation instructions, unless otherwise indicated or directed by the City Representative.
  2. Retain a copy of manufacturers' instructions at Project site, available for review at all times.
- B. Wiring: All wiring connected to PCIS components and assemblies including power wiring in accordance with requirements in Division 26, ELECTRICAL.
- C. Removal or Relocation of Materials and Equipment:
  1. Remove from Project site all materials that were part of the existing facility but are no longer used, unless otherwise directed by City Representative to deliver to CITY.
  2. Repair affected surfaces to conform to type, quality, and finish of surrounding surface.

### 3.03 FIELD QUALITY CONTROL

- A. General: All requirements listed in paragraph General under Article SOURCE QUALITY CONTROL, also apply to Article FIELD QUALITY CONTROL.
- B. Onsite Supervision:
  1. PCIS Project Site Representative to supervise and coordinate all onsite PCIS activities.
  2. PCIS Project Site Representative shall be onsite during total period required to complete all onsite PCIS activities.
- C. Startup and Testing Team:
  1. Thoroughly check installation, termination, and adjustment for all PCIS Subsystems and their components.
  2. Complete onsite tests.
  3. Complete onsite training.

4. Provide startup assistance to CONTRACTOR and CITY.
- D. Operational Readiness Test (ORT): Prior to startup, inspect, test, and document that entire PCIS is ready for operation.
1. Loop/Component Inspections and Tests:
    - a. Check PCIS for proper installation, calibration, and adjustment on a loop-by-loop and component-by-component basis.
    - b. Provide space on forms for sign off by PCIS Subcontractor.
    - c. Use Loop Status Report to organize and track inspection, adjustment, and calibration of each loop and include the following:
      - 1) Project name.
      - 2) Loop number.
      - 3) Tag number for each component.
      - 4) Check offs/sign offs for each component:
        - A) Tag/identification.
        - B) Installation.
        - C) Termination-wiring.
        - D) Termination-tubing.
        - E) Calibration/adjustment.
      - 5) Check offs/sign offs for the loop:
        - A) Panel interface terminations.
        - B) I/O interface terminations with PLC.
        - C) I/O signals for PLC are operational: received/sent, processed, and adjusted.
        - D) Total loop operational.
      - 6) Space for comments.
    - d. Component calibration sheet for each active component (except simple hand switches, lights, gauges, and similar items) and each PLC, I/O module and include the following:
      - 1) Project name.
      - 2) Loop number.
      - 3) Component tag number or I/O module number.
      - 4) Manufacturer.
      - 5) Model number/serial number.
      - 6) Summary of functional requirements, for example, but not limited to:
        - A) Indicators scale ranges.
        - B) Transmitters, input and output ranges.

- C) Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
  - D) I/O Modules: Input or output.
  - 7) Calibrations, for example, but not limited to:
    - A) Analog Devices: Actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
    - B) Discrete Devices: Actual trip points and reset points.
    - C) I/O Modules: Actual inputs or outputs of 0, 10, 50, and 100 percent of span, rising and falling.
  - 8) Space for comments.
  - e. Maintain Loop Status Reports and Component Calibration Sheets at Project site and make them available to City Representative at all time.
  - f. These inspections and tests shall be spot checked by City Representative.
  - g. City Representative reviews loop status sheets and component calibration sheets and spot-check their entries periodically, and upon completion of ORT. Correct deficiencies found.
- E. Functional Acceptance Tests (FAT):
- 1. Once facility has been started up and is operating, perform a witnessed FAT on complete PCIS to demonstrate that it is operating as required by the Contract Documents. Demonstrate each required function on a paragraph-by-paragraph and loop-by-loop, basis.
  - 2. Loop-specific and non-loop-specific tests same as required for FDT except that entire installed PCIS tested using actual process variables and all functions demonstrated.
  - 3. Perform local and manual tests for each loop before proceeding to remote and automatic modes.
  - 4. Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.
- F. Specialty Equipment: For certain components or systems provided under this section but not manufactured by PCIS Subcontractor, provide services of

qualified manufacturer's representative during installation, startup, demonstration testing, and CITY training.

### **3.04 CLEANING/ADJUSTING**

- A. Repair affected surfaces to conform to type, quality, and finish of surrounding surface.
- B. Cleaning:
  - 1. Keep premises free from accumulation of waste material and rubbish.
  - 2. Upon completion of Work, remove materials, scraps, and debris from premises and from interior and exterior of all equipment.

### **3.05 PROTECTION**

- A. Protect all enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.
- B. Periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace all capsules just prior to Final Payment and Acceptance. Contractor shall submit letter to City Representative stating the date and panel location capsules where replaced.

**END OF SECTION**



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**SECTION 40 61 21****PROCESS AND FACILITY CONTROL SYSTEM TESTING****PART 1 GENERAL****1.01 SUMMARY****A. Scope**

1. This Section specifies testing requirements applicable to all sections as specified in division 26 (Electrical), division 40 (Valves, Process Piping, Control System and Instrumentation), instrumentation, communication, network, and signal systems. This work will be referenced as the Process and Instrumentation Control System (PCS) to be provided by a CS Testing Manager meeting the Qualifications section of this Specification. Section includes:
  - a. Testing documentation.
  - b. Testing organization and sequencing.
  - c. Factory Demonstration Acceptance Testing
  - d. Performance testing.
  - e. Loop testing.
  - f. Functional testing.
  - g. Pre-Startup testing
  - h. Startup testing.
2. The term “instrumentation” covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies, instrument networks, communications networks, network panels, and monitoring devices.
3. All testing and commissioning work shall be covered by a test plan. Preparation and execution of test plans shall be the responsibility of the Contractor.
4. The test plan will outline the responsibility and involvement of all parties involved in the Work for all tests. Testing and commissioning work shall not commence until the requisite test plans are submitted by the Contractor and approved by the City Representative.
5. The test plan shall contain copies of any test reports/sheets to be used. Specific test reports must be prepared for testing every device, control loop and at each stage (i.e. Factory Acceptance, System Loop Validation, Software Test, Functional Testing, etc.).

6. The test plan shall contain a description of any impacts and/or disruption to existing operations and show how existing operations are to be maintained. All outages and equipment operations associated with commissioning shall be identified and estimated outage times determined.
7. A detailed schedule shall be included in the test plan indicating where and when testing will be carried out and by whom.
8. Test procedures described within the test plan shall describe an overall plan for testing and provide a description of the system test configuration including required test equipment and any simulation techniques. The procedures shall be a detailed step by step checklist which will be followed during system testing including check off blanks and signature locations at the completion of each major functional section.
9. The Contractor shall provide all testing records and documents. Calibration documentation shall include identification (by make, Supplier, model and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method and test laboratory.
10. Provide the labor, tools, material, power, and services necessary to provide the process and facility HVAC instrumentation and control system inspection and testing specified herein. Coordinate all testing with 01 75 60 – Testing Coordination and Start-up Testing:
11. Factory Demonstration Acceptance Testing (Pre-FDAT)
  - a. Factory Demonstration Acceptance Testing (FDAT)
  - b. Functional Testing Sequence:
    - 1) Wiring Testing
    - 2) Network and Bus Cable System Inspection and Testing
    - 3) Piping Testing
    - 4) Installation Inspection
    - 5) Instrumentation Calibration
    - 6) Loop Testing
  - c. Pre-Startup Testing Sequence:
    - 1) Control Strategy Testing
    - 2) Control System Closed Loop Commissioning
    - 3) Functional Checkout
  - d. Startup Testing:
    - 1) System Acceptance Test

**1.02 QUALITY CONTROL**

A. Reference Codes and Standards

1. This Section contains references to the following documents. Those documents are a part of this Section as specified and modified. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
  
2. References to documents shall mean the documents in effect as of February 2016 unless otherwise noted by a specific date noted in the listed reference below. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced. In all cases, the 2016 California Building Code shall be considered as the Building Code in effect.

Reference Title	Specific Section and Paragraph, if applicable	Version, if other than latest as of February 2016
ISA RP7.1 Pneumatic Control Circuit Pressure Test	Entire Document	-
ISA S51.1 Process Instrumentation Terminology	Entire Document	-

B. Additional PCS References:

1. This Section contains references to the following documents with additional references listed in Section 40 61 00 – Common Work Results of Control Systems (ICS).
  - a. References are part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the referenced documents, the requirements of this Section prevail.

C. Unit Responsibility

1. The Supplier shall accept Unit Responsibility in accordance with Section 40 90 00 - Common Work Results of Instrumentation and Control Systems (ICS). to warrant, design, manufacture, Factory Test (performance and seismic testing), ship, provide coordination of installation, provide all specified Field Testing and Commissioning,

Training, and Operations and Maintenance Manuals for all the equipment specified in this Section. A Certificate of Unit Responsibility Form shall be furnished for the equipment specified in this Section.

D. Factory Testing

1. Factory Testing shall be performed by the Supplier prior to delivery in order to verify the accuracy and performance of the systems as specified. Factory Testing need not be witnessed by the City Representative unless a special Witness Testing paragraph is included in this Section or other Specification Section. However, the Supplier shall certify and provide copies of the tests and guarantee the equipment's performance as specified in this Section. All certifications of Factory Testing shall be submitted and approved by the City Representative, prior to shipping equipment.

E. Warranty

1. A warranty for the equipment specified under this Section shall be provided in accordance with the General Conditions and Section 01 78 36 – Warranties. The Warranty shall be for one (1) year from the date of the Notice of Substantial Completion certificate issued by the City for the Work. If extended warranties are required, a special paragraph calling for an extended warranty will be included in this Section or other Specification Section.

F. CS Testing Manager

1. Appoint a startup engineer or qualified specialist as CS Testing Manager to manage, coordinate, and supervise the testing work.
2. The quality control program includes:
  - a. Definition of process areas and systems, with testing executed on an area-by-area basis, based on the P&ID drawings and control strategies.
  - b. Testing for each process area executed in sequential tasks.
  - c. Regularly updated testing status tracking by process area, system, and task.
  - d. Regularly updated separate testing documentation for each process system.
  - e. CS Testing Manager Qualifications:
  - f. The PCS Testing Manager shall have at least five (5) years of total experience, or experience on at least five (5) separate projects, in managing the testing and startup of similar electrical and instrumentation control systems.

3. CS Testing Technician Qualifications:
  - a. Technicians shall be qualified by completion and certification from training courses offered by the International Society of Automation (ISA), the instrumentation and analyzer Supplier's training courses, or technician training courses at a recognized trade school that specializes in instrumentation calibration.

### 1.03 SUBMITTALS

- A. Preconstruction/Action Submittals: The following minimum submittals shall be submitted prior to construction of this element of the Work in accordance with Section 01 33 00 - Submittal Procedures.
  1. A copy of this Section, with addendum updates included, and all referenced and applicable Sections, with addendum updates included, with each paragraph check-marked to indicate Specification compliance or marked to indicate requested deviations from Specification requirements or those parts which are to be provided by the Contractor or others shall be provided. Check marks (✓) shall denote full compliance with a paragraph as a whole.

If deviations from the Specifications are indicated, and therefore requested, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The City Representative shall be the final authority for determining acceptability of requested deviations.

The remaining portions of the paragraph not underlined shall signify compliance with the Specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the requirements of the Specification shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.
  2. Certificate of Unit Responsibility attesting that the Contractor has assigned unit responsibility in accordance with the requirements of this Section. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
  3. PCS and FMCS submittal requirements in accordance with Section 40 61 00 – Common Work Results for Controls System.
    - a. Submit process and facility HVAC and instrument control system instrumentation, hardware, and software together as an integrated system in staged submittal groupings as defined in Section 40 61 00- Common Work Results for Process Controls System.
  4. Quality Control submittal:
    - a. CS Testing Manager Qualifications.

- b. CS Testing Technician Qualifications.
  - c. Network Testing Firm Qualification.
  - d. Proposed process area and process system organization.
  - e. Submit test procedures and sample forms for approval within 180 days from the date of Notice to Proceed.
- B. Informational Submittals: The following minimum informational submittals shall be submitted in accordance with the timing requirements specified in these Contract Documents, prior to Substantial Completion and in accordance with Section 01 33 00 - Submittal Procedures.
1. Operations and Maintenance Manuals (including Warranty) in accordance with Section 01 78 23 - Operations and Maintenance Data
  2. Factory Test Reports
  3. Certificate of Proper Installation
  4. Field Test Reports
  5. Certificate of Field Testing and Commissioning
  6. Certificate of Training Completion
  7. Testing submittal:
    - a. Submit detailed testing plan and proposed testing documentation after review of the Quality Control submittal showing conformance with Part 2 of this Specification. Obtain approved submittal prior to testing:
      - 1) Control descriptions.
      - 2) I/O interface.
      - 3) Testing status spreadsheets.
      - 4) Test procedures.
      - 5) Proposed test forms per this Section, detailed for each test for this Work.
      - 6) Certified Factory Calibration Reports.
    - b. Test equipment and test equipment calibration date.
    - c. List of factory-calibrated items and calibration certificates.
    - d. Performance test results.
    - e. Loop test results.
    - f. Functional test results.
    - g. Pre-startup test results
    - h. Startup test results.
  8. FDAT:
    - a. FDAT schedule and location.
    - b. FDAT procedures and test forms.
  9. PCS Closeout Submittals



- a. Completed test forms
- b. Calibration forms and calibration certificates.
- c. Documentation of all system, instrument, network, and any other device settings.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

##### **A. Coordination:**

1. Coordinate testing with Section 01 75 60 – Testing Coordination and Start-up Testing.
2. Provide notice to the City Representative prior to conducting a test.
3. Provide a detailed step-by-step test procedure, between sixty (60) and seventy (70) days before the commencement of testing activity, complete with forms for the recording of test results, testing equipment used, and a place for identification of the individuals performing and witnessing the test.
4. Submit detailed form prior to testing per the requirements of Section 01 75 60.
5. Equipment and System Performance and Operational Testing: Section 01 75 60 specifies testing of the mechanical, electrical and instrumentation. Coordinate, manage, and supervise the work with the quality control program including:
  - a. Testing plan with the sequence for the test work.
  - b. Calibration program for instruments and analyzers.
  - c. Documentation program that records tests results.
  - d. Performance testing program systems.

### **PART 2 – PRODUCTS**

#### **2.01 GENERAL**

- A. Test forms: Conform to the requirements of Referenced Forms 40 61 21. Develop additional or detailed forms as necessary to suit complex instrumentation. Use terms on test forms that comply with ISA S51.1.
- B. Work Labeling:
- C. The items specifying Work labeling herein include the following as a minimum: the City name, facility name, Work name, and project number.

D. Documentation Records:

1. Develop a record-keeping system to document progress and completion for each task in each process area or system. Coordinate overall organization of areas and systems with overall testing required by Section 01 75 60 – Testing Coordination and Start-up Testing.
2. The following shall be kept current and available for inspection on site in a location designated by the City Representative:
  - a. CS Testing Manager’s qualifications, startup, and testing history, including resume per Paragraph CS Testing Manager.
  - b. List of names of Contractor’s and System Integrator’s personnel associated with final construction and testing, and normal and emergency contact telephone numbers
  - c. Testing Status spreadsheet with breakdown for each process system, with percentage complete on each testing sequence task.
  - d. Testing status specific to pre-loop test and loop testing status spreadsheet to include the I/O list organized by area and system and loop number. Percent complete of the PCS will be based on percentage of I/O points tested.
  - e. Test Report Volumes.

## 2.02 TESTING DOCUMENTATION

A. Test Report Volumes:

1. The Contractor shall develop and maintain testing documentation for each process area or system in separate volumes. Always keep each volume current and available for inspection on-site in a location designated by the City Representative. Each volume shall include the following as a minimum:
  - a. Three-ring binder with front cover and spine labeled: “Testing Documentation for (applicable) Process System” including Work labeling per paragraph 2.01C Work Labeling.
  - b. Table of Contents with same labeling as the volume cover with tabs for each section:
  - c. Section 1: Control Description
  - d. Section 2: I/O Interface
  - e. Section 3: Instrument Index
  - f. Section 4: Test Procedures and Forms
  - g. Section 5: Certified Factory Calibration Reports (process systems only)

- h. Section 6: Test Report
- B. Control Description:
- 1. Provide a control description outlining operation for each process system. The Control Narrative Specification Section 40 61 96 may be used as a basis.
- C. I/O Interface:
- 1. Provide I/O spreadsheets for each process system. Spreadsheets are to include the following for each I/O point:
    - a. Signal number/tag.
    - b. Annotation description that may be logically abbreviated and that is subject to approval.
    - c. Complete physical I/O channel designation and addressing or communication I/O register designation.
    - d. True/false status designations for digital I/O.
    - e. Process range; engineering units and multipliers; and raw signal range count for analog I/O.
    - f. Signals: Fixed point and scaled at the controller with minimum four (4) significant implied digits of scaling; e.g., 0 to 1,400 at controller for a pH range of 0 to 14 at operator interface.
    - g. Provide operator interface scaling to display decimal digits required.
    - h. Indicate pass/fail for each point for both pre-loop test and loop tests.
    - i. Indicate date of tests and comment for failed points.
- D. Instrument Index:
- 1. Provide a detailed Instrument Index. Indicate actual calibration ranges, set points, and deadbands.
- E. Field Test Procedure Documentation:
- 1. Organize and assemble test procedures for each analog and discrete loop in the process control system in separate volumes for each process or test group. Organize by I/O point. Submit final test records in electronic form by scanning and converting the records and files to Adobe PDF format, to preserve actual signatures and signoffs.
  - 2. Include a detailed, step-by-step description of the required test procedure, panel and terminal block numbers for points of measurement, input test values, expected resultant values, test equipment required, process setup requirements, and safety precautions.

3. Include test report forms for each loop, including forms for wiring, piping, and individual component tests, with the test procedure documentation. Record the actual test results on these forms and assemble them into final test reports.
4. Preprint and populate information in the test report forms to the extent possible prior to commencing testing.
5. Include on the test report forms:
  - a. Work name.
  - b. Process area associated with the equipment under test.
  - c. Instrument loop description.
  - d. Instrument loop identification number.
  - e. Instrument nameplate data.
  - f. Instrument setup and configuration parameters.
  - g. Time and date of test.
  - h. Inspection checklist and results.
  - i. Reference to applicable test procedure.
  - j. Expected and actual test results for each test point in the loop including programmable controller data table or register values.
  - k. Test equipment used.
  - l. Space for remarks regarding test procedure or results, observations, etc.
  - m. Name, date, and signature of testing personnel.
  - n. Test witness's name and signature.

### **PART 3 – EXECUTION**

#### **3.01 SUPPLIERS FIELD SERVICES**

- A. Supplier shall provide field services in accordance with Section 01 60 00 – Product Requirements and as further required within this Section.
- B. Supplier shall provide assistance during equipment installation as required by the Contractor.
- C. The equipment provided under this Section shall be started and tested only under the direction of personnel provided by the Supplier.

### 3.02 GENERAL

#### A. General Requirements:

1. Provide the labor, tools, material, power, and services necessary to provide the process and facility HVAC instrumentation and control system inspection and testing specified herein.
2. Process and facility control system testing shall be performed in accordance with Section 01 75 60 Testing Coordination and Start-up Testing, and as described herein.
3. Materials, equipment, and construction included under this Specification shall be inspected in accordance with this Section and subsequent sections of this division. Testing shall be performed by the Contractor in accordance with this and subsequent sections of this division.
4. A certified instrument technician qualified to calibrate the instrumentation shall calibrate and set up field instruments and analyzers.
5. No required test shall be applied without prior notice to the City. Between sixty (60) and seventy (70) days before the commencement of any testing activity, the Contractor shall provide a detailed step-by-step test procedure complete with forms for the recording of test results, testing equipment used, and a place for identification of the individual performing or, if applicable, witnessing the test.
6. Provide detail assistance to the Contractor in generating Forms, customized for this Work. Submit detailed form prior to testing per the requirements.

#### B. Test Equipment and Materials:

1. Provide test equipment to conduct the specified tests that simulate inputs and read outputs with a rated accuracy at the point of measurement at least three (3) times greater than the component under test.
2. Test instruments shall have a current calibration sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required. Certified calibration reports traceable to the National Institute of Standards and Technology shall be included with the final test report.
3. Provide a documenting calibration system to conduct instrumentation calibration activities that consist of a documenting calibrator and an instrumentation data management software system that captures the calibration results and electronically document instrument data, date of

calibration, calibration procedures, and as-found and as-left instrument calibration data.

4. Provide an instrument calibration system such as Fluke 743B with Fluke DPC/Track Instrumentation Management software or similar system. Calibration files shall be submitted with the final test report in hard-copy and electronic formats that does not require specialized equipment or software to read and print the files.
5. Provide buffer solutions and reference fluids for tests of analytical equipment.

C. Performance Deviation Tolerances:

1. Tolerances are specified in individual sections. Where tolerances are not specified, refer to the Supplier's published performance specifications.
2. Calculate overall accuracy requirements for loops consisting of two (2) or more components shall be the root-summation-square (RSS) of the component accuracy specifications. Calculate and record tolerances for each required calibration point on the associated test report form.

D. Installed Tests:

1. Equipment and System Performance and Operational Testing specifies testing of the mechanical, electrical, instrumentation and HVAC systems. The Contractor shall coordinate, manage, and supervise the quality control program that includes:
  - a. Testing plan with the sequence for the test work.
  - b. Calibration program for all instruments and analyzers.
  - c. Documentation program that records tests results.
  - d. Performance testing program systems.
  - e. Coordinate with DCS manufacturer, equipment manufacturer and subcontractors for the test work.
2. Test forms provided shall conform to the requirements of reference Forms 40 61 21. Additional or detailed forms shall be developed as necessary to suit complex instrumentation. Usage of terms used on test forms shall comply with ISA S51.1.

E. Witnessing:

1. The City Representative reserves the right to observe factory and field instrumentation testing and calibration procedures. Notify the City Representative prior to testing, as specified herein.

**3.03 FACTORY DEMONSTRATION ACCEPTANCE TEST (FDAT)****A. General Requirements.**

1. Sixty days prior to the FDAT, the Contractor or Packaged Equipment Supplier will develop and submit a FDAT plan for use during test of cabinets, special control systems, flow measuring systems, and other pertinent systems that were factory assembled.
2. Contractor or Packaged Equipment Supplier will be responsible for covering travel costs for the City and the City Representative for all factory acceptance tests. Travel costs covered by the Contractor or Packaged Equipment Supplier include: air travel (round trip), all meals, rental vehicle(s), and lodging for each day of test.
3. Shop drawings will be made available for use by the City and the City Representative.
4. The FDAT shall include a System Configuration Inventory List to be verified at the Contractor's or Packaged Equipment Supplier's facility. Model and serial numbers of major equipment shall be verified and recorded in the System Configuration Inventory List. This list will be used to confirm receipt of shipped equipment and that only equipment accepted at the FDAT is shipped to the site.
5. The Contractor or Packaged Equipment Supplier will resolve any discrepancies found during the FDAT and documentation will be corrected. A minimum of 30 working days notification will be provided to the City prior to testing.
6. No shipments will be made without the City approval.

**B. Pre-Factory Demonstration Acceptance Test (Pre-FDAT):**

1. The Contractor or Packaged Equipment Supplier will conduct a PRE-Factory Acceptance Test (PRE-FDAT) to be held at the Contractor's or Packaged Equipment Supplier's facility and must be completed prior to FDAT. All trouble-shooting should be done at this phase. This is to ensure that the FDAT can be demonstrated according to the approved FDAT Plan without unanticipated delays. The PRE-FDAT will be a documented test performed by the Contractor or Packaged Equipment Supplier. The PRE-FDAT will not be witnessed by the City or its designated City representative. A statement of FDAT readiness will be required of the Contractor or Packaged Equipment Supplier.

**C. Factory Demonstration Acceptance Test (FDAT):**

1. General: Control system equipment shall be subject to a Factory Demonstration Acceptance Test. Control system panels containing DCS equipment or programmable logic controllers shall be loaded with the PLC/DCS software at the Contractor's or Packaged Equipment Supplier's facility prior to the FDAT.
2. The purpose of the FDAT is to check the integrity and readiness of each panel prior to delivering it to the site. The FDAT, once completed, will ensure the panel will function as designed by the City Representative. The FDAT is the first step in the testing process and consists of a PRE-FDAT and the actual FDAT itself. The intent of PRE-FDAT is to identify and correct any deficiencies that would cause delays during the FDAT.
3. During FDAT, the Contractor or Packaged Equipment Supplier will serve as the lead role while the City Representative and City will witness the FDAT.
4. Provide written notice to the City thirty (30) working days before the commencement of the FDAT activity and shall include:
  - a. Schedule for the FDAT.
  - b. Location of the FDAT.
  - c. Testing equipment used.
  - d. Detailed test procedure with forms for the recording of test results.
  - e. Sign-off spaces for the individuals performing and witnessing the tests.
5. Factory Demonstration Acceptance Test procedures: Panels provided shall be interlocked or networked as applicable, operated, and checked-out by the Contractor or Packaged Equipment Supplier prior to the FDAT. Submit completed panel checkout forms indicating that the panels are ready for the FDAT. The FDAT shall include the following:
  - a. Visual inspection of equipment, instruments, control panels, and graphic displays.
  - b. Validation of each input loop and output loop by simulated signals for analog inputs and by shorting discrete inputs.
  - c. Validation shall include:
    - 1) Monitoring state changes on operator interface screens based on the inputs state change.
    - 2) Observation of online PLC/DCS programming application software with the associated PLC/DCS outputs state change.
    - 3) Outputs triggered by operator interface software devices (pushbuttons, sliders, manually-entered values, etc.)



- 4) Calibration and operation of instruments on or in the control panels.
  - d. Repair of loops which do not pass validation.
  - e. Retest of the FDAT at no additional cost.
6. Panels that pass the FDAT may be shipped to the site upon shipping schedule and storage accommodation approval by the City.

### 3.04 COMPONENT TESTING

#### A. General Requirements:

1. Component testing shall be in accordance with Section 01 75 60 Testing Coordination and Start-up Testing, and as described herein.
2. Component Testing includes testing of the completed structural, electrical, mechanical, instrumentation, and control systems as required per the specifications. It also demonstrates the hardware and software operating together to verify the DCS control strategies. The following specific tests are included in Component Testing as related to automation requirements. This list of tests is not meant to be inclusive of all Component Testing that may be required for all aspects of a given project.
3. In general, tests shall be performed in the following order:

#### B. Wiring Tests:

1. Verify that electrical power and signal cable ring-out and resistance testing has been performed as specified in Sections 26 05 00 – Common Work Results for Electrical and 26 08 00 - Commissioning of Electrical Systems. Conduct wiring tests after cables have been properly terminated, tagged, and inspected.
  - a. Power and Control: Section 26 08 00 - Commissioning of Electrical Systems.
  - b. Signal: Section 40 61 21-Testing Forms.

#### C. Network and Bus Cable Inspection and Testing:

1. Inspected and tested by independent industrial network testing firms.
2. Proprietary bus systems may be tested by the Supplier's qualified field services technician. Supplier's sales personnel are not considered to be qualified technicians unless qualifications are documented and certified by the Supplier.

3. Standardized networks and buses may be tested by a qualified independent network testing service. The following types of cabling and networks shall be tested and certified by the independent industrial network testing firm:
4. Ethernet system cabling.
5. Other networks provided as a part of a packaged monitoring or control system.
6. Test and verify control and instrumentation bus cabling using the standards that apply to the specific cable and bus type as follows:
7. Ethernet Category 6: per TIA/EIA-568B standards.
8. Pre-Active Testing: Prior to energizing, cabling shall be inspected and tested to verify the following:
  - a. Media type and specifications.
  - b. Physical routing and Work-specific cable identification tagging.
  - c. Correct termination installation and connection of conductors to pins at terminations.
  - d. Record cable run length and compare to the Supplier or industry standards to verify that lengths are within specifications.
  - e. Locations and values of network termination resistance.
  - f. Integrity and grounding of cable shields.
  - g. Values of transient protection (surge) elements.
  - h. Firmware revision level of network devices available prior to energization.
  - i. Settings of dip switches and configuration parameters.
9. Active System Testing: After the cable or network system has been activated for testing, provide diagnostic monitoring and signal analysis for the bus network system to evaluate network and bus integrity and data transfer quality. The following parameters shall be measured, verified, and recorded:
  - a. Node addressing.
  - b. Signal attenuation before and after a repeater device and at the farthest point in the network.
  - c. Total network trunk voltage and current loading as applicable.
  - d. Baud rate, message traffic rate, percent bandwidth used, error rate, and lost packet count.
  - e. Firmware revision level of the network devices.

- f. Pre-active and active testing: within the specified range of values established by the References.
  - g. Correct the functionality of networks and devices connected to the network.
- D. Instrument and Component Inspection:
- 1. PCS and FMCS components inspection activities include the following:
    - a. Compare and validate instrument type and nameplate data with the Drawings, Specifications, and data sheet.
    - b. Validate instrument identification tag.
    - c. Confirm that instrument installation conforms to Drawings, Specifications, and Supplier's instructions.
    - d. Verify proper conductor termination and tagging.
    - e. Visually check for physical damage, dirt accumulation, and corrosion.
    - f. Verify that isolation amplifiers, surge protection, and safety barriers are properly installed.
    - g. Report deficiencies identified within twenty-four (24) hours of discovery. No instrument or system component shall be tested until deficiencies are addressed.
- E. Instrumentation Calibration:
- 1. Instruments and final elements shall be field calibrated in accordance with the Supplier's recommended procedures and tested in accordance with the Contractor's test procedure.
  - 2. Individual Component Calibration and Testing shall not commence until Instruments and Component Inspections are completed and documented to the satisfaction of the City Representative.
  - 3. Calibrate analog instrument at 0, 10, 50, 90, and 100 percent of the specified full-scale range. Each signal sensing trip and sensing switch shall be adjusted to the required setting. Verify instrument readout matches loop signal. Test data recorded on test forms as specified herein.
  - 4. Final element alignment tested and adjusted to verify that each final element operates smoothly over the full range in response to the specified control signals.
  - 5. Test data shall be entered on the applicable test forms at the time of testing: Alarm trips, control trips, and switches shall be set to initial values

specified. Final elements shall be checked for range, deadband, and speed of response.

6. Any component that fails to meet the required tolerances shall be repaired or replaced by the Supplier. Repeat the specified tests until the component is within tolerance.
7. Install a calibration sticker on each instrument following successful calibration that indicates the date of calibration, the name of the testing company, and personnel who calibrated the instrument.
8. Test forms Section 40 61 21-Forms.
9. Certified Test Reports: Field test and inspection activities include verification of instrument parameter setup, verification of instrument zero, and performance at three (3) operating points within the instrument range. Each instrument that fails to demonstrate proper performance shall be returned for recalibration or replaced as agreed depending on the impact to the Work as determined by the City Representative.
  - a. Where instrument field calibration is not feasible, certified factory calibration reports may be submitted that include the name and address of the laboratory that conducts the calibration testing.

F. Loop Testing:

1. Provide a request to perform loop testing at least two (2) weeks prior to the requested loop test date. Include the following with the request:
  - a. Area/system for which request is being made.
  - b. Written certification that performance testing has been completed, documented, and passed for the area/system for which loop testing is being requested.
  - c. Submittal numbers that define the tests and data points for the I/O to be tested. Provide updates to the I/O list or instrument calibration as an outcome of the performance testing.
2. Loop testing shall not commence until the installation inspection and calibration testing has been completed and documented to the satisfaction of the City Representative.
3. Each instrument loop shall be tested as an integrated system. Check operation from field instruments to transmitter to receiving components to the Supplier panel or the Plant Control System Operator Interface Station. Test signals shall be injected at the impulse line connection where the

measuring technique permits, and otherwise at the most primary signal access point.

4. Testing of loops with an interface to the DCS I/O shall include verification of the input/output assignment and verification of operation of the input/output system and processor. Inspect the data table or register in the DCS memory to verify proper operation.
5. If the output control or monitoring device fails to indicate properly, corrections to the loop circuitry or device shall be made. The test shall be repeated until devices and instruments operate as required.
6. Correct loop circuitry and repeat the test until the instruments operate properly.
7. The Contractor will submit completed Loop Test Sheets within fifteen (15) days after completion of Functional Testing. Any deficiencies will be noted on the Loop Test Sheet. Once the deficiencies are resolved, the City Representative will initial the note and the Loop Test Sheet will be signed off.

### **3.05 FUNCTIONAL TESTING**

#### **A. General Requirements.**

1. Functional testing shall be in accordance with Section 01 75 60 Testing Coordination and Start-up Testing., and as described herein.
2. Functional Testing is performed on a completed subsystem to demonstrate that equipment/ system meets Suppliers' calibration and adjustment requirements and other requirements as specified.
3. Functional Testing includes operating equipment/system manually in local, manually and automatically from the DCS under clean water conditions, unless otherwise noted by city representative during construction.
4. Functional Testing will commence only after the completion of the Component Testing, including the DCS Software Test, the DCS Communications Test and System Loop Validation.
5. Functional Testing will demonstrate proper operation of all systems, with the process control system equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.
6. Once Functional Testing is completed, the new DCS controls should be fully operational.

7. The Contractor will deliver an instrumentation and control system Functional Testing Completion Report which will state that all Contract requirements have been met and will include a listing of all instrumentation and control system maintenance and repair activities conducted during the Functional Testing. Acceptance of the instrumentation and control system Functional Testing must be provided in writing by the City Representative before the Pre-Startup Testing may begin. Final acceptance of the control system will be based upon Substantial Completion as stated in the General Conditions.
  8. The Contractor is responsible for generating a control strategy validation check list. The check list will include all monitoring, alarming, historical data collection, trending, remote manual control, and automatic control. As each function is verified, it will be signed off by the Contractor and City Representative.
  9. System Functional Testing activities will include the use of water, where feasible, to establish service conditions that simulate normal final control element operating conditions in terms of applied process, operating ranges, and environmental conditions.
  10. Final control elements, control panels, and ancillary equipment will be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits.
  11. Initial control loop tuning will take place for modulating control loops.
  12. All hardwired and software control circuit interlocks and alarms will be operational. The control of final control elements and ancillary equipment will be tested using both manual and automatic (where provided) control circuits.
  13. The Contractor will correct any inconsistent or erroneous equipment and instrument operation within five (5) working days.
- B. Process Control Strategy/Pre-Startup Testing:
1. Commence control strategy testing after loop testing has been completed and documented to the satisfaction of the City Representative.
  2. Control strategy testing, performed by the Contractor, consists of installing and debugging the DCS control logic program, verifying the interface points between the controller I/O cards and field devices and equipment, and exercising the control strategies.
  3. Provide qualified personnel to immediately correct deficiencies in the work that may be encountered during control strategy testing. Failure of

the Contractor to provide such personnel in a timely manner may prolong the time allotted to complete control strategy testing.

C. Control System Closed-Loop Testing:

1. Closed-loop commissioning shall not commence until the control strategy testing has been successfully completed and documented to the satisfaction of the City Representative.
2. Closed-loop commissioning tests, performed as part of the system tests, shall demonstrate stable operation of each loop under operating conditions. Tests shall include adjustment of loop tuning parameters.
3. Tuning parameters: gain (or proportional band), integral time constant, and derivative time constant for each control loop, adjusted to provide 1/4 amplitude damping, unless otherwise specified.
4. Provide the loop response to a step disturbance for each loop. Provide two (2) graphs for cascaded control loops, one showing the secondary loop response with its set point in manual, and the second showing overall loop response.
5. Adjust control loops with “batch” features to provide optimum response following startup from an integral action saturation condition.
6. Graph recording shall be provided showing the response and made at sufficient speed and amplitude to show 1/4 amplitude damping. Label to show loop number and title, and settings of parameters and set point.

D. Pre-Startup Checkout:

1. Conduct to verify the operation of discrete and hardwired control devices. Exercise the operable devices and energize the control circuit. Operate control element, alarm device, and interlocks to verify that the specified action occurs.

### 3.06 PRE-STARTUP TESTING

- A. Pre-startup testing shall be in accordance with Section 01 75 60 Testing Coordination and Start-up Testing., and as described herein.
- B. Pre-startup testing shall be performed after Component Testing and Functional Testing has been completed. Perform the test of the completed system in full operation and demonstrate that functional requirements of this specification have been met. The Pre-Startup testing shall demonstrate the following:
  1. Each component of the system operates correctly with other components of the system.

2. Analog control loops operate in a stable manner.
3. Hard-wired and software equipment interlocks perform correctly.
4. Process control sequences perform correctly.
5. Application program performs monitoring and control functions correctly.
6. Operator interface graphics represent the monitoring and control functions correctly.

### **3.07 STARTUP TESTING**

- A. Startup testing shall be in accordance with Section 01 75 60 Testing Coordination and Start-up Testing., and as described herein.
- B. Startup testing shall be performed after Pre-startup Testing has been completed. The Startup testing will duplicate all of the Pre-startup testing requirements, except will operate using the Specified process media.
- C. Additional adjustments and tuning of the analog process control loops shall be done using the specified media.
- D. Startup testing shall test of the completed system in full operation and demonstrate that functional requirements of this specification have been met and shall continue for the time period as specified in Section 01 75 60 Testing Coordination and Start-up Testing.

### **3.08 ACCEPTANCE TESTING**

- A. Acceptance testing shall be in accordance with Section 01 75 60 Testing Coordination and Start-up Testing., and as described herein.
- B. Acceptance testing shall be performed after Startup Testing has been completed. Acceptance testing will demonstrate operation and control of the facilities in its entirety as provided under this Contract.
- C. Acceptance testing will include additional control loop tuning and adjustments as required to increase process optimization and to achieve maximum operational efficiency.
- D. System acceptance shall be based on the requirements of Section 01 75 60 Testing Coordination and Start-up Testing., and acceptance of any repair, corrections, or calibrations made during Acceptance testing shall be subject to the conditions of Section 01 75 60.
- E. Acceptance testing shall test the completed system in full operation and demonstrate that functional requirements of this specification have been met and



shall continue for the time period as specified in Section 01 75 60 Testing Coordination and Start-up Testing.

**3.09 SUPPLEMENTS**

- A. Factory Acceptance Test Form-Control Panels
- B. Field Instrument Installation and Calibration Checklist

	FACTORY ACCEPTANCE TEST – CONTROL PANELS	
<p><b>1. GENERAL INSPECTION</b></p> <p><b>A. Structural Inspection</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Verify Lifting Lugs Installed.</li> <li><input type="checkbox"/> Verify enclosure has lock and lock is functional.</li> <li><input type="checkbox"/> Confirm that seismic bracing components are provided per manufacturer’s installation instructions.</li> </ul> <p><b>B. Exterior Inspection</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Cabinet exterior is clean, scratch, and dent free.</li> <li><input type="checkbox"/> Inspect externally for corrosion and damage.</li> <li><input type="checkbox"/> Verify enclosure door opens and closes easily.</li> <li><input type="checkbox"/> Verify enclosure has a 3-point latch.</li> <li><input type="checkbox"/> Verify enclosure has a flange mounted disconnect (where voltages greater than 120 VAC enter the enclosure).</li> <li><input type="checkbox"/> Verify enclosure has the appropriate NEMA rating (1, 1G, 12, 3R, 4, 4X, etc.).</li> <li><input type="checkbox"/> Verify enclosure is the appropriate size (not grossly larger than design and will still fit in the plant).</li> </ul> <p><b>Nameplates</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Cabinet has identification nameplate.</li> <li><input type="checkbox"/> All door labels are straight, spelled correctly, and match the tagging defined in the Contract.</li> <li><input type="checkbox"/> Cabinet has a nameplate that includes the following:                             <ul style="list-style-type: none"> <li><input type="checkbox"/> Power Sources(s).</li> <li><input type="checkbox"/> Integrator’s Logo.</li> <li><input type="checkbox"/> Circuit ID(s).</li> <li><input type="checkbox"/> Short Circuit KAIC ratings.</li> </ul> </li> <li><input type="checkbox"/> If labels are screwed to door, silicone was utilized to cover screw holes (Labels screwed to the door of a NEMA 4/4X panel technically violates the NEMA rating.).</li> </ul> <p><b>Door Devices</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> All devices penetrating the outside of panel have gaskets, silicone or both.</li> <li><input type="checkbox"/> All door devices are installed (HMIs, Pilot Devices, etc.).</li> <li><input type="checkbox"/> Door mounted equipment is mounted straight and square</li> <li><input type="checkbox"/> All exterior or door mounted equipment present and accounted for, installed and securely fastened.</li> <li><input type="checkbox"/> NEMA classification has not been violated due to penetrations.</li> <li><input type="checkbox"/> Door mounted equipment has the same NEMA rating as the panel.</li> <li><input type="checkbox"/> All door mounted equipment installed at the correct height.</li> <li><input type="checkbox"/> All door mounted equipment installed in the correct positions and order (layout of door mounted equipment is grouped properly and in a logical manner).</li> <li><input type="checkbox"/> Doors with multiple penetrations have adequate bracing (if needed).</li> <li><input type="checkbox"/> Visually check condition of indicators, controllers and annunciators.</li> <li><input type="checkbox"/> Check that pilot lights illuminate correctly.</li> <li><input type="checkbox"/> Check the Push-To-Test function.</li> <li><input type="checkbox"/> Ensure correct pilot light color.</li> </ul> <p><b>Peripheral Devices</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Horn / Beacon is installed (where required).</li> </ul>		

Silence and Reset pushbutton.

PROJECT NAME: _____	TEST DATE: _____
FACILITY NAME: _____	TESTED BY: _____
PROCESS AREA: _____	COMPANY: _____
NETWORK ID: _____	PAGE: _____
WITNESSED BY: _____	SIGNATURE: _____

**FACTORY ACCEPTANCE TEST – CONTROL PANELS**

**1. GENERAL INSPECTION (continued)**

**C. Interior Inspection**

- Cabinet is cleaned of marks and dirt.
- Inspect internally for corrosion and damage.
- Back panel is clean of marks and dirt.
- Interior of panel vacuumed and shall be free of all debris.
- Check that the panel roof is clean and clear of foreign materials.
- Bottom of panel has been cut out (where bottom entry is required), with angle iron welded around the bottom perimeter. Re-painting has been performed.
- If internal light door limit switch is provided, ensure the light automatically turns "on" when the doors are
- Intrusion alarms (where required).

**Interior Labeling**

- All panel mounted equipment has identification labeling, by using either a Brothers or Phenolic type tags.
- Verify that door mounted components are mounted square and symmetrical.
- Verify that nameplates are straight, legible, and spelled correctly.
- All terminal blocks are identified/labeled with permanent labels including tight end blocks and caps.
- All wiring shrink labeled and or phased correctly to the specifications.
- All wire labels shrunk completely rotated and aligned alike for easy identification.
- All fuses and circuit breakers are labeled with ID and current rating.
- System Integrator's label or labels installed on door.
- Panel manufacturer model/serial number tag is present.
- All required safety/warning tags installed and straight.
- Correct UL (typically UL 508A) or cUL tag installed and registered and all other associated tags installed and straight (the UL tag might not be installed in the panel at the factory test. If the panel is modified due to changes during the factory test or a punch list generated from the factory test, the UL labeling would need to be re-applied. Some UL shops do not apply the UL label until the panel is released to be shipped.).

**Wireways**

- Plastic wireway covers installed properly.
- Plastic wireways have no sharp edges.
- No wire Ties inside wireways.
- No sharp edges on wire ties.
- Separation: White duct is used for DC voltages, Gray duct is used for AC voltages.
- Ensure wiring duct is not over-full, includes provision for 20% more wiring and the cover may easily be installed. Panduit recommends 50% duct fill, but 40% is a better practice.

PROJECT NAME: _____	TEST DATE: _____
FACILITY NAME: _____	TESTED BY: _____
PROCESS AREA: _____	COMPANY: _____
NETWORK ID: _____	PAGE: _____
WITNESSED BY: _____	SIGNATURE: _____

	<b>FACTORY ACCEPTANCE TEST – CONTROL PANELS</b>	
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**1. GENERAL INSPECTION (continued)**

**C. Interior Inspection (continued)**

**Wiring**

- Visually check terminals and condition of internal wirings.
- Verify that the control panel has been assembled and wired as designed.
- Verify that all components are operational and perform the functions intended.
- Verify that all components are sized appropriately for the application.
- Verify that equipment control circuits function as intended.
- Back of door wiring is labeled and neatly formed.
- Back panel to door wiring has sufficient bending radius with spiral wrap.
- Wire connection has been verified wired to correct points within the panel.
- Individual wires have been given a pull test to verify a good terminal connection.
- Wire and cable minimum bending radius have not been violated.
- All equipment installed straight and square to back panel.
- Wire colors are correct:
  - Black and White > AC hot and neutral, respectively.
  - Red > AC control signals.
  - Blue > DC power and control (Blue w/ White stripe for DC ground).
  - Yellow > Foreign voltages (those still present when panel power is disconnected).
  - Green > AC equipment ground.
  - Black > TSP (+).
  - White > TSP (-).
- Analog wiring shields are continuous (connected by a dedicated terminal block for such shields).
- Analog shield wires are grounded within the panel, where not otherwise grounded at the transmitter itself.
- Discrete inputs are separately fused or protected by a circuit breaker on a “per loop” basis.
- Intrinsic Safety Wiring
  - Ensure wiring associated with intrinsic safety circuits or intrinsic safety barriers is kept away from all other wiring by UL minimum distances or by a physical (grounded metal) barrier preventing non-intrinsically safe wiring from coming in contact with intrinsically safe circuits or wiring.
- Verify all spare terminals are installed according to the percentage listed in the specifications.

**Grounding**

- Equipped with “Blackburn” or other grounding type lug.
- Lug is securely fastened to the panel structure.
- Verify Grounding bar is installed.
- Verify Isolated ground bar is installed.

PROJECT NAME: _____	TEST DATE: _____
FACILITY NAME: _____	TESTED BY: _____

PROCESS AREA: _____	COMPANY: _____
NETWORK ID: _____	PAGE: _____
WITNESSED BY: _____	SIGNATURE: _____

	<b>FACTORY ACCEPTANCE TEST – CONTROL PANELS</b>	
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**2. POWER TEST**

**A. AC Power**

- AC Power is routed correctly within the panel and is isolated from DC and network wiring.
- All fuses are installed and sized properly.
- All breakers are installed and sized properly.
- 24 VDC Power Supplies are functional.
- 24 VDC Power fail contacts are functional.
- 24 VDC power supplies are redundant and have diode modules enabling the hot swap-over between supplies.
- 24 VDC supplies are equipped with dry contact failure alarms, wired as PLC inputs to signal failure of any DC power supply. Such alarm inputs to the PLC have been tested as being functional.
- Dedicated receptacle is wired to receive a dedicated AC supply.
- Verify continuity for all DC commons, ground and AC neutrals.
- Verify that the CP temporary input power is connected correctly and is the correct voltage.
- Close the CP main circuit breaker(s).
- Verify that voltages at subsequent circuit breakers are correct.
- Close circuit breakers.
- Verify that power feeding interruptible and uninterruptible power supplies is correct.
- Turn on power supplies if they are not already on.
- Verify that voltages at distribution terminals are correct.
- Energize any remaining hardware such as the PLC.

**B. Uninterruptible Power Supply (UPS)**

- Mounted appropriately within the cabinet, on a dedicated shelf, or rear of a swing-out sub panel.
- Is equipped with maintenance bypass switch (or at least plug/receptacle means for bypassing the unit).
- Test all UPS alarms (on inverter, failure, battery failure etc.)
- Turn off the AC power supply and verify that the UPS will be switched on to supply the designated vital loads in the control panel.

**3. CONTROLS & AUXILIARY DEVICES TEST**

- Verify all interposing and auxiliary relays are functioning.
- Verify panel lights are functioning.

**Ventilation and Heating**

- If ventilation fans are fitted, check the fans correctly operate any associated air filters are clean and not blocked.
- Verify components are installed in the correct orientation for proper air flow.

**4. HARDWIRED INTERLOCK AND SAFETY TEST**

- Verify that hardwired interlocks through the control panel as shown on schematic drawings are functioning. For example, outlet high pressure switch interlock to a pump.
- Verify that all hardwired safety devices through the control panel is functioning. For example, the pull cord emergency stops of conveyors.

PROJECT NAME: _____	TEST DATE: _____
FACILITY NAME: _____	TESTED BY: _____
PROCESS AREA: _____	COMPANY: _____
NETWORK ID: _____	PAGE: _____

WITNESSED BY: \_\_\_\_\_ SIGNATURE: \_\_\_\_\_

**FACTORY ACCEPTANCE TEST – CONTROL PANELS**

**5. PLC TEST**

**A. Components**

- PLC interior High Temperature alarm is installed, wired to the PLC, and is shown to be functional.
- Relays have transient suppression across their coils. This is particularly important for DC coil relays, where diodes in reverse polarity are often used.
- TVSS is installed across the main incoming 120 VAC.

**PLC and PLC Rack**

- Verify all cards are securely seated.
- Ensure clearance around PLC rack has been met, such that convective heat transfer is not impeded by devices erroneously mounted in the “no encroachment” area. Confirm with manufacturer clearance recommendations.

**B. PLC I/O Test**

- Furnish **I/O test forms** and test all the listed input and output points as follows:
  - Discrete Inputs: Simulate a field contact closure by “shorting” across the appropriate terminal blocks. Observe the transition between a logical “0” and “1” in the PLC software.
  - Discrete Outputs: Force the output bit to toggle between logical “0” and logical “1” using the PLC software. Measure contact resistance at the wired terminal blocks using a digital meter selected for the “ohms” setting.
  - Analog Inputs: Connect a signal generator to the appropriate terminal blocks. Tailor the connection depending on whether a 2-wire or 4-wire simulation is required. Modulate the 4-20mA signal. Observe the associated PLC internal memory register to transition between 0-65535 or if scaled in engineering units, between 0 and the maximum scaled engineering unit. The latter method is preferred.
  - Analog Outputs: Force the output register to a value between 0-65535 or 0-100%, if the scaling block can be manipulated. Observe the measured 4-20mA value increment and decrement using a digital ammeter.

**C. Redundant Controllers (where required) Test**

- Remove Communication cable from PLC-1 to verify switching to PLC-1A.
- Remove Communication cable from PLC-1A to verify switching back to PLC-1.
- Remove Power from PLC-1 to verify switching to PLC-1A.
- Remove Power from PLC-1A to verify switching to PLC-1.
- Remove Communication cable from PLC-1 to I/O rack and verify switching to PLC-1A.
- Remove Communication cable from PLC-1A to I/O rack and verify switching to PLC-1.

**D. PLC Control Logic Verification**

- The PLC control strategy is verified by following the Control Logic Verification Form based on the specifications. Each control strategy will be verified by simulating the process and checking the state or value of PLC outputs. The results of equipment status and alarms and process instrument values and trends shall also be verified on the Plant SCADA graphic screens stored in a temporary SCADA computer. Since all PLC input and output wiring has been verified and some field devices are not available during Factory Acceptance Testing, certain inputs will be simulated either by means of additional hardware and/or software as described below.
  - DI states are either simulated by hardwired switches or forced inputs using a programming terminal.
  - For example, when starters and drives are not provided as part of the contract, jumpers may be installed from the output call relays to the running confirmation inputs to simulate the running state of the motors.
  - AI values are either simulated by an external source or within software using a programming terminal.
  - For example, when a level transducer is not provided as part of the contract the level transducer loop current may be simulated with a loop powered potentiometer and adjusted manually for the level input.

PROJECT NAME: _____	TEST DATE: _____
FACILITY NAME: _____	TESTED BY: _____
PROCESS AREA: _____	COMPANY: _____
NETWORK ID: _____	PAGE: _____

WITNESSED BY: \_\_\_\_\_ SIGNATURE: \_\_\_\_\_

**FACTORY ACCEPTANCE TEST – CONTROL PANELS**

**5. PLC TEST (continued)**

**D. PLC Control Logic Verification (continued)**

**Typical Fault Logic**

- If the fault input is high and the disable (if applicable) for the fault is not high and the common disable (if applicable) is not high begin timing. If any of these conditions changes, stop timing and reset the timer. If the timer reaches its preset, activate the alarm output. If the fault alarm is a shutdown alarm stop the associated motor and latch the alarm so that it remains present even if the condition clears.
  
- The fault condition must return to normal and the alarm must be reset for a latched alarm to clear.

**Typical Fail to Start Logic**

- If the motor is called to run (call output high) and no running feedback is received (running input is low) and the fail to start and common alarm disables (if applicable) are not high start timing. If any of these conditions changes, stop timing and reset the timer. If the timer reaches its preset, activate the alarm output, stop calling the motor and latch the alarm.

**6. HMI OR OIT TEST**

**HMI / OIT Functionality**

- Communication with PLC.
- Screen Layouts.
- Screen Navigation.
- Set Point Entry.
- Animation.
- Color Correctness (Green=Run, Red=Off, Amber=Alarm, or the agreed upon convention).
- Alarms.
- Acknowledge and Reset.
- Security / Access Levels / Passwords.

**7. NETWORK COMMUNICATION TEST**

**A. Network Components**

- Fiber optic cabling terminates in a patch panel.
- Media converters are installed and functional.
- Terminating resistors have been installed for trunk/tap topologies or where required.
- Wire and cable bending limitations have not been violated.

**B. Network Functions**

- Verify data transfer via the network to different PLCs as shown on the Network Block Diagrams.
- Verify network traffic rate and error margin is acceptable.

PROJECT NAME: _____	TEST DATE: _____
FACILITY NAME: _____	TESTED BY: _____
PROCESS AREA: _____	COMPANY: _____
NETWORK ID: _____	PAGE: _____
WITNESSED BY: _____	SIGNATURE: _____

	<b>FACTORY ACCEPTANCE TEST – CONTROL PANELS</b>	
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**8. FAT DOCUMENTATION AND RECORD**

**Panel Documentation**

- As-built panel drawings showing actual panel construction and devices arrangement and c/w Bill of Material.
- Panel schematic and interconnection drawings.
- P&ID drawings and schematic drawings for the process area controlled by the panel that is to be tested.
- I/O list test forms of the process area to be tested.
- FAT procedure of the process area to be tested.
- Test record forms of the process area to be tested. Forms shall include area for signature of responsible test personnel.
- Hard copy of the PLC application program of the process area to be tested.
- Hard copy of the HMI/OIT graphic screens of the process area to be tested.

**9. FAT TOOLS AND SOFTWARE**

- Simulation software if required.
- Digital voltmeter Fluke 87.
- Process meter Fluke 787.
- Laptop computer with PLC application program.
- Temporary SCADA computer with HMI software and applicable graphic screens.
- Jumper wires.

PROJECT NAME: _____	TEST DATE: _____
FACILITY NAME: _____	TESTED BY: _____
PROCESS AREA: _____	COMPANY: _____
NETWORK ID: _____	PAGE: _____
WITNESSED BY: _____	SIGNATURE: _____





INSTRUMENT LOOP NO. \_\_\_\_\_

SERVICE DESCRIPTION \_\_\_\_\_

CHECK BELOW, WHEN COMPLETED:

- BENCH CALIBRATED PER SPECIFICATION SHEET NO. \_\_\_\_\_
- VERIFIED PER P&ID NO. \_\_\_\_\_
- CORRESPONDS TO SPECIFICATION SHEET NO. \_\_\_\_\_
- WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. \_\_\_\_\_
- INSTALLATION CORRECT PER DETAIL NO. \_\_\_\_\_
- ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED.
- INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL.
- ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED.

INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS? No  Yes

<b>FIELD CALIBRATION CHECK</b>						
CONTACT NO.	FUNCTION	FOR SIGNAL	CONTACT IS TO	AT SPECIFIED VALUE FOR	ACTUAL TRIP POINT WAS	
1	<input type="checkbox"/> ALARM	<input type="checkbox"/> INCR	<input type="checkbox"/> OPEN	SET PT = _____	SET PT = _____	
	<input type="checkbox"/> S/D PERM	<input type="checkbox"/> DECR	<input type="checkbox"/> CLOSE	RESET = _____	RESET = _____	
2	<input type="checkbox"/> ALARM	<input type="checkbox"/> INCR	<input type="checkbox"/> OPEN	SET PT = _____	SET PT = _____	
	<input type="checkbox"/> S/D PERM	<input type="checkbox"/> DECR	<input type="checkbox"/> CLOSE	RESET = _____	RESET = _____	
3	<input type="checkbox"/> ALARM	<input type="checkbox"/> INCR	<input type="checkbox"/> OPEN	SET PT = _____	SET PT = _____	
	<input type="checkbox"/> S/D PERM	<input type="checkbox"/> DECR	<input type="checkbox"/> CLOSE	RESET = _____	RESET = _____	
4	<input type="checkbox"/> ALARM	<input type="checkbox"/> INCR	<input type="checkbox"/> OPEN	SET PT = _____	SET PT = _____	
	<input type="checkbox"/> S/D PERM	<input type="checkbox"/> DECR	<input type="checkbox"/> CLOSE	RESET = _____	RESET = _____	

NOTE: PERM IS ABBREVIATION FOR PERMISSIVE

	<b>SWITCHES INSTALLATION AND CALIBRATION CHECKLIST</b>	
--	--	--

REMARKS: \_\_\_\_\_



OTHER

DESCRIPTION \_\_\_\_\_

INSTRUMENT TAG NO. \_\_\_\_\_ SERIAL NO. \_\_\_\_\_

SERVICE DESCRIPTION \_\_\_\_\_

BENCH CALIBRATION CHECK				
INPUT RANGE = _____		OUTPUT RANGE = _____		
HEAD CORRECTION = _____		<input type="checkbox"/> LINEAR		
CALIBRATED SPAN = _____		<input type="checkbox"/> SQUARE ROOT		
% CALIB SPAN	DESIRED VALUE	ACTUAL VALUE	EXPECTED VALUE	ACTUAL VALUE
0				
50				
100				

CHECK BELOW, WHEN COMPLETED:

- BENCH CALIBRATED PER SPECIFICATION SHEET NO. \_\_\_\_\_
- VERIFIED PER P&ID NO. \_\_\_\_\_
- CORRESPONDS TO SPECIFICATION SHEET NO. \_\_\_\_\_
- WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. \_\_\_\_\_
- INSTALLATION CORRECT PER DETAIL NO. \_\_\_\_\_
- ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED.
- INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL.
- ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED.

FIELD CALIBRATION CHECK				
INPUT RANGE = _____		OUTPUT RANGE = _____		
% CALIB SPAN	DESIRED VALUE	ACTUAL VALUE	EXPECTED VALUE	ACTUAL VALUE
0				
50				
100				
<b>TRANSMITTER/CONTROLLER/INDICATOR INSTALLATION AND CALIBRATION CHECKLIST</b>				

No     Yes

INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS?

INSTRUMENT TYPE     TRANSMITTER     CONTROLLER

INDICATOR

OTHER    DESCRIPTION \_\_\_\_\_

INSTRUMENT TAG NO. \_\_\_\_\_

SERIAL NO. \_\_\_\_\_

SERVICE DESCRIPTION \_\_\_\_\_

BENCH CALIBRATION CHECK				
INPUT RANGE = _____		OUTPUT RANGE = _____		
HEAD CORRECTION = _____		<input type="checkbox"/> LINEAR <input type="checkbox"/> SQUARE ROOT		
CALIBRATED SPAN = _____				
% CALIB SPAN	DESIRED VALUE	ACTUAL VALUE	EXPECTED VALUE	ACTUAL VALUE
0				
50				
100				

CHECK BELOW, WHEN COMPLETED:

- BENCH CALIBRATED PER SPECIFICATION SHEET NO. \_\_\_\_\_
- VERIFIED PER P&ID NO. \_\_\_\_\_
- CORRESPONDS TO SPECIFICATION SHEET NO. \_\_\_\_\_
- WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. \_\_\_\_\_
- INSTALLATION CORRECT PER DETAIL NO. \_\_\_\_\_
- ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED.
- INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL.
- ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED.

FIELD CALIBRATION CHECK				
INPUT RANGE = _____		OUTPUT RANGE = _____		
% CALIB SPAN	DESIRED VALUE	ACTUAL VALUE	EXPECTED VALUE	ACTUAL VALUE
0				
50				
100				
<b>TRANSMITTER/CONTROLLER/INDICATOR INSTALLATION AND CALIBRATION CHECKLIST</b>				

- DIRECT       REVERSE
- ACTION VERIFIED AT 50% SPAN
- ACTION VERIFIED AT \_\_\_\_\_ SPAN

<b>CONTROLLER SETTINGS</b>
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CHECK BELOW, IF TRUE:

- BENCH CALIBRATED PER SPECIFICATION SHEET NO. \_\_\_\_\_
- VERIFIED PER P&ID NO. \_\_\_\_\_
- CORRESPONDS TO SPECIFICATION SHEET NO. \_\_\_\_\_
- WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. \_\_\_\_\_
- INSTALLATION CORRECT PER DETAIL NO. \_\_\_\_\_
- ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED.
- INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL.
- ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED.

REMARKS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

CHECKED BY (COMPANY) _____	ACCEPTED BY (COMPANY) _____
SIGNATURE _____	SIGNATURE _____
DATE _____	DATE _____

**END OF SECTION**

## SECTION 40 61 96

### CONTROL STRATEGY

#### PART 1 – GENERAL

##### 1.01 SECTION SUMMARY

- A. This section describes the control strategy for four submersible pumps and one dewatering pump that shall be installed at Amador Street Infrastructure Improvements project.

##### 1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal-Procedures  
B. Section 40 61 00 - Common Work Results for Control Systems  
C. Section 40 61 21 – Process and Control System Facility Testing

##### 1.03 ABBREVIATIONS AND DEFINITIONS

HMI	Human Machine Interface
HOA	Hand-Off-Auto
PLC	Programmable Logic Controller
RVS	Reduced Voltage Starter
SEWPCP	Southeast Water Pollution Control Plant
T/S	Transport/Storage
WW	Wet Weather

##### 1.04 GENERAL DESCRIPTION

- A. The intent of furnishing and installing four submersible lift pumps (SP-1, SP-2, SP-3, and SP-4) in the wet well of Amador Pumping Station is to convey collected sewage to force main. The dewatering pump (DW-1) in the sump pit of the pump station will be used to completely empty the wet well for maintenance purpose. Lift pumps shall not be operated during dewatering cycle.

###### General Control Description:

Normally, the lift pumps will be on/off automatically based on the liquid level measured by radar level transducer. If radar transducer malfunctions, the liquid level will keep rising until high-high level float switch is energized. Then, the lift pumps will be started one by one in a sequential order with time on delay based on lead-lag selection. The liquid level will be pump down until low level float switch is de-energized. The liquid level sensing is redundant with radar liquid level transmitter and the liquid level float switches.

**PART 2 – CONTROL NARRATIVES.****A. Control Strategy:**

The lift pumps operation shall be controlled by **On-Off-Auto** selector switch.

In **On** mode, the lift pumps are manually started by an operator. The pumps shall be operable until the low water level or low-low water level is reached preventing submersible pumps from dry run.

In **Auto** mode, the lift pumps automatically turn on based on radar level setpoints or high-high level float switch.

In normal condition, there are six (6) level setpoints. Lead Pump 1 On level setpoint, Lag Pump 1 On level setpoint, Lag Pump 2 On level setpoint, Lag Pump 3 On level setpoint, High Level Alarm On/Off Setpoint and All Pumps Off level setpoint.

If radar transducer malfunctions, both float switches will be used to turn the lift pumps on/off. The PLC system will turn on two (2) lift pumps one by one in sequential order with time on delay once high-high level float switch is energized and shall automatically switchover to the next available lift pump once the operating pump is not working. All lift pumps will automatically go off when the liquid level is below low-low water level preventing submersible pumps from dry run.

In Auto Mode, the operator can select which lift pump will be Lead pump, Lag 1 pump or Lag 2 pump or Lag 3 pump based on the lift pump selector in HMI/PLC, Or in ALT mode the PLC will select alternating feature to let the system to alternate each pump in every cycle to ensure the pumps are operated in equal run time. The control system will automatically switchover to next available pump once the operating pump is not working.

Dewatering pump (DW-1) is started/stopped manually.



## B. Control Description:

## a) Control Panel Display:

- i. Lift pump-1 (SP-1):
  - One (1) Run status indication light
  - One (1) Off status indication light
  - One (1) High Temp status indication light
  - One (1) Moisture detection status indication light
  - One (1) Water in Oil fault status indication light
  - One (1) Overload status indication light
- ii. Lift pump-2 (SP-2):
  - One (1) Run status indication light
  - One (1) Off status indication light
  - One (1) High Temp status indication light
  - One (1) Moisture detection status indication light
  - One (1) Water in Oil fault status indication light
  - One (1) Overload status indication light
- iii. Lift pump-3 (SP-3):
  - One (1) Run status indication light
  - One (1) Off status indication light
  - One (1) High Temp status indication light
  - One (1) Moisture detection status indication light
  - One (1) Water in Oil fault status indication light
  - One (1) Overload status indication light
- iv. Lift pump-4 (SP-4):
  - One (1) Run status indication light
  - One (1) Off status indication light
  - One (1) High Temp status indication light
  - One (1) Moisture detection status indication light
  - One (1) Water in Oil fault status indication light
  - One (1) Overload status indication light
- v. Dewatering pump-1 (DW-1):
  - One (1) Run status indication light
  - One (1) Off status indication light
  - One (1) High Temp status indication light
  - One (1) Moisture detection status indication light
  - One (1) Overload status indication light

## b) Control Panel Control:

- i. Lift pump-1 (SP-1):
  - One (1) On-Off-Auto selector switch

- ii. Lift pump-2 (SP-2):  
One (1) On-Off-Auto selector switch
  - iii. Lift pump-3 (SP-3):  
One (1) On-Off-Auto selector switch
  - iv. Lift pump-4 (SP-4):  
One (1) On-Off-Auto selector switch
  - v. Dewatering pump-1 (DW-1):  
One (1) On-Off selector switch
- c) HMI/PLC display and Control: Per Port of San Francisco Standards.
- i. Configurable Parameters:
    - 1) Operator Adjustable Setpoints:
      - Time delay for the submersible Lead-Lag pumps (lift pumps)
      - Lead pump 1 on/off level set point
      - Lag pump 1 on/off level set point
      - Lag pump 2 on/off level set point
      - Lag pump 3 on/off level set point
      - 1-2-3-4/2-3-4-1/3-4-1-2/4-3-2-1/ALT
      - High Level Alarm On/Off Setpoint
      - All Pumps Off level setpoint

**END OF SECTION**

**SECTION 40 70 00****INSTRUMENTATION FOR PROCESS SYSTEM****PART 1 – GENERAL****1.01 SYSTEM DESCRIPTION**

This Section gives general requirements for the Analog Subsystem (AS) which includes primary elements and transmitters, analog display and control elements, discrete display and control elements, control panels, and associated devices.

**1.02 RELATED SECTIONS**

- A. Division 26 - Electrical
- B. Section 40 61 00 – Common Work Results for Control System (ICS)

**1.03 SUBMITTALS**

- A. Shop Drawings
  - 1. Bill of Materials: List of required Analog System (AS) equipment.
    - a. Group equipment items by common enclosure, and equipment type.
    - b. Data Included:
      - i. Equipment tag number.
      - ii. Description.
      - iii. Manufacturer, complete model number and all options not defined by model number.
      - iv. Quantity supplied.
  - 2. Catalog Cuts: AS Components, Electrical Devices, and Mechanical Devices:
    - a. Catalog information.
    - b. Descriptive literature.
    - c. External power and signal connections.
    - d. Scaled drawings showing exterior dimensions and locations of all electrical and mechanical interfaces.
  - 3. Component Data Sheets: Data sheets for all AS components.
    - a. Format and Level of Detail in accordance with ISA S20.
    - b. Specific features and configuration data for each component:
      - i. Location or service.
      - ii. Manufacturer and complete model number.
      - iii. Size and scale range.
      - iv. Set points.
      - v. Materials of construction.
      - vi. Options included.
    - c. Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.

4. Panel Construction Drawings:
  - a. Scale Drawings: Show location of panel mounted devices, doors, louvers, and subpanels.
  - b. Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
  - c. Bill of Materials: List devices mounted within panels that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
  - d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
  - e. Construction Notes: Finishes, wire color schemes, wire ratings, and wire numbering and labeling scheme.
  
5. Interconnection Diagrams: For discrete control and power circuits.
  - a. Diagram Type: Ladder/Loop diagrams in a format similar to those shown on Drawings. Include devices requiring electrical connections. Show unique rung numbers on left side of each rung where applicable.
  - b. Item Identification: Identify each item with attributes listed.
  - c. Wires: Wire number and color. Cable number if part of multi-conductor cable.
  - d. Terminals: Location (enclosure number, terminal junction box number, or MMC number), terminal strip number, and terminal block number.
  - e. Discrete Components:
    - i. Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).
    - ii. Switching action (open or close on rising or falling process variable), set point value and units, and process variable description.
  - f. Relay Coils:
    - i. Tag number and its function.
    - ii. On right side of rung where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.
    - iii. Relay Contacts: Coil tag number, function, and coil location (ladder number and sheet number).
  - g. Show each circuit individually. No "typical" diagrams will be allowed.
  - h. Ground wires and connections.
  - i. Circuit Names: Show names corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel. Refer to Division 26 - Electrical.
  
6. Loop Diagrams: Individual wiring diagram for each Analog Subsystem analog or pulse frequency loop.
  - a. Loop diagrams in a format similar to those shown on Drawings.
  - b. Conform to the minimum requirements of ISA S5.4.
  - c. Under paragraph 5.3 of ISA S5.4, include the information listed under subparagraphs 2, 5, 6 and 9.
  - d. Drawing Size: Individual 11-inch by 17-inch sheet for each loop.
  - e. Divide each loop diagram into areas for field panel, field, terminal junction boxes, control panel, PLC, DCS, etc.

- f. Show:
  - i. Terminal numbers, location of DC power supply, and location of common dropping resistors.
  - ii. Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
  - iii. Tabular summary on each diagram:  
Transmitting Instruments: Output capability.  
Receiving Instruments: Input impedance.
  - iv. Circuit and raceway schedule.
7. Panel Power Requirements and Heat Dissipation: For control panels tabulate and summarize:
  - a. Required voltages, currents, and phases(s).
  - b. Maximum heat dissipations Btu per hour.
  - c. All calculations.
8. Termination Wiring Diagrams:
  - a. Diagrams, device designations, and symbols in accordance with NEMA ICS 19.
  - b.
  - c. Show:
    - i. Electrical connections between equipment, consoles, panels, terminal junction boxes, and field mounted components.
    - ii. Component and panel terminal identification numbers, and external wire and cable numbers.
    - iii. Circuit names matching Circuit and Raceway Schedules.
    - iv. Intermediate terminations between field elements and panels for, but not limited to terminal junction boxes and pull boxes.
9. Installation Details: Provide installation details and bill of materials required for the proper installation of AS Components.
10. Spares, expendables, and test equipment.
- B. Samples: Color schedule with color samples for control panels.
- C. Quality Control Submittals
  1. Testing Related Submittals: In accordance with Section 40 61 00 –Common Work Result of Control Systems (ICS).
  2. O&M Manuals:
    - a. Documents shall be provided in accordance with requirements within Section 01 78 23 – Operations and Maintenance Data.
    - b. Process and Instrumentation Diagrams: One reproducible copy of revised P&ID to reflect ICS design after construction completion for record.
    - c. Refer to paragraph Shop Drawings for the following items:
      - i. Bill of Materials.
      - ii. Catalog Cuts.

- iii. Component Data Sheets.
- iv. Interconnection Diagrams, one reproducible copy.
- v. Loop Diagrams, one reproducible copy.
- vi. Termination Wiring Diagrams, one reproducible copy.
- d. Device O&M manuals for AS components, electrical devices, and mechanical devices shall include:
  - i. Operations procedures.
  - ii. Installation requirements and procedures.
  - iii. Maintenance requirements and procedures.
  - iv. Troubleshooting procedures.
  - v. Calibration procedures.
  - vi. Internal schematic and wiring diagrams.
  - vii. ORT Component and Calibration Sheets.
  - viii. List of required test equipment.
- e. List of spares and expendables required and recommended.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. In accordance with Section 40 61 00 – Common Work Result of Control Systems (ICS).

#### **1.05 ENVIRONMENTAL REQUIREMENTS**

- A. Standard Environmental Requirements: Unless otherwise noted, design AS equipment for continuous operation in these environments:

- 1. Inside (control room):
  - a. Temperature: 32 to 104-degrees F.
  - b. Relative humidity: 10 to 95% non-condensing.
  - c. NEC classification: Non-hazardous.
- 2. Outside:
  - a. Temperature: 32 to 104-degrees F.
  - b. Rain.
  - c. NEC classification: Non-hazardous.
- 3. Outside, hazardous:
  - a. Temperature: 32 to 104-degrees F.
  - b. Rain.
  - c. NEC classification: Class 1, Div. 1.

- B. Furnish and provide AS components and panels for continuous operation in its operating environments as shown and located on the Drawings.

#### **1.06 SEQUENCING AND SCHEDULING**

- A. In accordance with Section 40 61 00 – Common Work Result of Instrumentation and Control Systems (ICS).

#### **1.07 MAINTENANCE / SPARE PARTS**

- A. Spares Parts:

Description	Percent of Each Type and Size Used	No Less Than
Fuses	20	5
Indicating light bulb	20	10
Relays	20	5
Terminal Blocks	10	5
Hand Switches	10	5

Table 40 95 00.1 Spare Part Quantities Table List

B. Expendables

<u>Item</u>	<u>Quantity</u>
Corrosion-inhibiting vapor capsules	2-year supply

**PART 2 – PRODUCTS**

**2.01 AS COMPONENTS**

- A. Components for Each Loop: Major AS components for each loop shall be listed in ISA Data Sheets. Furnish all equipment that is necessary to achieve required loop performance.
- B. Component Specifications: Generalized specifications for each type of AS component are located in Article SUPPLEMENTS.

**2.02 NAMEPLATES AND TAGS**

- A. Panel Nameplates: Enclosure identification located on the enclosure face.
  - 1. Location and Inscription: As shown on panel Drawing.
  - 2. Materials: 16-gauge, Type 316, stainless steel, stamped, mounted with stainless steel screws.
  - 3. Letters: 1/2-inch, unless otherwise noted.
- B. Component Nameplates-Panel Face: Component identification located on panel face under or near component.
  - 1. Location and Inscription: As shown on panel Drawing.
  - 2. Materials: Adhesive backed laminated plastic.
  - 3. Letters: 3/16-inch white on black background, unless otherwise noted.
- C. Component Nameplates-Back of Panel: Component identification located on or near component inside of enclosure.
  - 1. Inscription: Component tag number.

2. Materials: Adhesive backed laminated plastic.
  3. Letters: 3/16-inch white on black background, unless otherwise noted.
- D. Service Legends: Component identification nameplate located on face of component.
1. Inscription: As shown on panel Drawing.
  2. Materials: Adhesive backed laminated plastic.
  3. Letters: 3/16-inch white on black background, unless otherwise noted.
- E. Nametags: Component identification for field devices.
1. Inscription: Component tag number.
  2. Materials: 16-gauge, Type 316 stainless steel.
  3. Letters: 1/4-inch imposed.
  4. Mounting: Affix to component with 16-gauge stainless steel wire or stainless-steel screws.

### **2.03 PANEL FABRICATION:**

- A. General
1. Panels with external dimensions and instruments arrangement as shown on Drawings except as modified in City Representative approved shop drawings.
  2. Panel Construction and Interior Wiring: In accordance with NEMA ICS 6, the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.
  3. All NEMA Type 12, 13, 4 & 4X panels larger than 12-inch x16-inch shall have doors with continuous hinge with internal 3-point latch and Type 316 SS padlocking Powerglide™ handle (there will be no exemption for this requirements).
  4. Fabricate panels; install instruments, wire, and plumb, all at the ICS subcontractor's factory.
  5. All panels shall be UL listed and shall bear UL label stating "LISTED ENCLOSED INDUSTRIAL CONTROL PANELS".
  6. Electrical Work: In accordance with the applicable requirements of Division 26 - Electrical.
- B. Temperature Control:
1. Freestanding NEMA 12 Panels:



- a. Furnish with louvers and forced ventilation as required to prevent temperature buildup due to electrical devices mounted inside panel or on panel.
  - b. Panels with backs directly against walls, furnish louvers on panel sides.
  - c. Panels without backs directly against walls, furnish louvers on top and bottom of panel back.
  - d. Louver Construction: Stamped sheet metal.
  - e. Ventilation Fans:
    - i. Furnish where required to provide adequate cooling.
    - ii. Create positive internal pressure within panel.
    - iii. Fan Motors Power: 120-vac, 60-Hz.
    - iv. Air Filters: Washable aluminum, Hoffman Series A-FLT or Equal.
2. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.
- C. Freestanding Panel Construction:
1. Materials: Sheet steel unless otherwise shown on Drawings with minimum thickness of 10-gauge.
  2. Panel Fronts:
    - a. Fabricated from a single piece of sheet steel unless otherwise shown on Drawings.
    - b. No seams or bolt heads visible when viewed from front.
    - c. Panel Cutouts: Smoothly finished with rounded edges.
    - d. Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.
  3. Internal Framework:
    - a. Provide structural steel for instrument support and panel bracing.
    - b. Permit panel lifting without racking or distortion.
  4. Lifting rings to allow simple, safe rigging and lifting of panel during installation.
  5. Adjacent Panels: Securely bolted together so front faces are parallel.
  6. Doors:
    - a. Full height, fully gasketed access doors where shown on Drawings.
    - b. Key lockable.
    - c. Latches: Three-point, Southco Type 44 or equal.
    - d. Handles: "D" ring, foldable type.
    - e. Hinges: Full length, continuous, piano type, steel hinges with stainless steel pins.
    - f. Rear Access Doors: Extend no further than 24-inches beyond panel when opened to 90-degree position.
    - g. Front and Side Access Doors: As shown on Drawings.
- D. Non-Freestanding Panel Construction:

1. Based on environmental design requirements required and referenced in Article ENVIRONMENTAL REQUIREMENTS, provide the following:
    - a. For panels located inside:  
Enclosure Type: NEMA 12.  
Materials: Steel.
    - b. For all other panels:  
Enclosure Type: NEMA 4X.  
Materials: 14-gauge minimum Type 304 Stainless Steel unless noted otherwise on the drawings.
  2. Doors:
    - a. Oil resistant gasket sealed with continuous hinge.
    - b. Internal 3-point latch with Type 316 SS padlocking Powerglide™ handle.
  3. Manufacturers:  
Hoffman or Approved equal.
- E. Control Panel Electrical:
1. Power Distribution within Panels:
    - a. Feeder Circuits:
      - i. One or more 120-vac, 60 Hz feeder circuits as shown on Drawings.
      - ii. Make provisions for feeder circuit conduit entry.
      - iii. Furnish terminal board for termination of wires.
    - b. Power Panel: Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
    - c. Locate to provide clear view of and access to breakers when door is open.
    - d. Breaker sizes: Coordinate such that fault in branch circuit will blow only branch fuse but not trip the main breaker.
    - e. Breaker Manufacturers and Products:  
Refer to Division 26 - Electrical.
    - f. Circuit Wiring: P&ID's and Interconnect and Loop Diagrams on Drawings show function only. Use following rules for actual circuit wiring:
      - i. Devices on Single Circuit: 20 devices maximum.
      - ii. Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.
      - iii. Branch Circuit Loading: 12-amperes continuous, maximum.
      - iv. Panel Lighting and Service Outlets: Put on separate 15 amp 120-vac branch circuit.
      - v. Provide separate 120-vac branch circuit plug mold for panel components with line cords.
  2. Signal Distribution:
    - a. Within Panels: 4 to 20 mA-dc signals (may be distributed as 1 to 5V dc with a precision 250 OHM resistor).

- b. Outside Panels: Isolated 4- to 20-mA-dc only.
  - c. All signal wiring shall be twisted, shielded pairs, minimum 18-AWG.
3. Signal Switching:
- a. Use dry circuit type relays or switches.
  - b. No interruption of 4- to 20-mA loops during switching.
  - c. Switching Transients in Associated Signal Circuit:
    - i. 4- to 20-mA dc Signals: 0.2 mA, maximum.
    - ii. 1 to 5V dc Signals: 0.05V, maximum.
4. Relays:
- a. General:
    - i. Relay Mounting: Plug-in type socket.
    - ii. Relay Enclosure: Furnish dust cover.
    - iii. Socket Type: Finger safe screw terminal interface for wiring.
    - iv. Socket Mounting: 35mm DIN Rail.
    - v. Provide hold-down clips.
    - vi. Manufacturer and Product: IDEC RH Series
5. Signal Switching Relay:
- i. Type: Dry circuit.
  - ii. Contact Arrangement: 4 Form C contacts.
  - iii. Contact Rating: 0 to 5 amps at 28V dc or 120-vac.
  - iv. Contact Material: Gold or silver.
  - v. Coil Voltage: As noted or shown.
  - vi. Coil Power: 0.9 watts (dc), 1.2VA (ac).
  - vii. Expected Mechanical Life: 10,000,000 operations.
  - viii. Expected Electrical Life at Rated Load: 100,000 operations.
  - ix. Indication Type: LED indicator lamp.
  - x. Seal Type: Hermetically sealed case.
  - xi. Manufacturer and Product: IDEC RY Series with finger safe DIN rail mount sockets.
6. Control Circuit Switching Relay, Non-latching:
- i. Type: Compact general-purpose plug-in.
  - ii. Contact Arrangement: 3 Form C contacts min.
  - iii. Contact Rating: 10A at 28V dc or 240-vac.
  - iv. Contact Material: Silver cadmium oxide alloy.
  - v. Coil Voltage: As noted or shown.
  - vi. Coil Power: 1.8 watts (dc), 2.7VA (ac).
  - vii. Expected Mechanical Life: 10,000,000 operations.
  - viii. Expected Electrical Life at Rated Load: 100,000 operations.
  - ix. Indication Type: Neon or LED indicator lamp.
  - x. Push to test button.
  - xi. Manufacturer and Product: IDEC RR Series.
7. Control Circuit Switching Relay, Latching:
- i. Type: Dual coil mechanical latching relay.
  - ii. Contact Arrangement: 2 Form C contacts.
  - iii. Contact Rating: 10A at 28V dc or 120-vac.
  - iv. Contact Material: Silver cadmium oxide alloy.

- v. Coil Voltage: As noted or shown.
- vi. Coil Power: 2.7 watts (dc), 5.3VA (ac).
- vii. Expected Mechanical Life: 500,000 operations.
- viii. Expected Electrical Life at Rated Load: 50,000 operations.
- ix. Manufacturer and Product: IDEC RR2KP Series.

8. Control Circuit Switching Relay, Time Delay:

- i. Type: Adjustable time delay relay.
- ii. Contact Arrangement: 2 Form C contacts.
- iii. Contact Rating: 10A at 240-vac.
- iv. Contact Material: Silver cadmium oxide alloy.
- v. Coil Voltage: As noted or shown.
- vi. Operating Temperature: Minus 10 to 55 degrees C.
- vii. Repeatability: Plus or minus 2 percent.
- viii. Delay Time Range: Select range such that time delay set point fall between 20 to 80 percent of range.
- ix. Time Delay Set Point: As noted or shown.
- x. Mode of Operation: As noted or shown.
- xi. Adjustment Type: Integral potentiometer with knob external to dust cover.
- xii. Manufacturer and Products: Potter and Brumfield; Series CB for 0.1 second to 100 minute delay time ranges, Series CK for 0.1 to 120 second delay time ranges; or Equal.

9. Centralized Power Supplies:

- i. Furnish as required to power instruments requiring external dc power, including two-wire transmitters and dc relays.
- ii. Convert 120-vac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
- iii. Furnish redundant dc power supplies connected in such a way that DC output power is uninterrupted when one power supply is removed or is not delivering the correct output voltage.
- iv. Provide a contact closure for alarm in case of dc power supply failure.
- v. Provide output over voltage and over current protective devices to:
  - Protect instruments from damage due to power supply failure.
  - Protect power supply from damage due to external failure.
- vi. Enclosures, DIN rail mounted in panels: NEMA 1.
- vii. Mount such that heat dissipated does not adversely affect other components.
- viii. Fuses: For each dc supply line to each individual two-wire transmitter.
- ix. Type: Indicating.
- x. DIN rail mount with terminal blocks supplying circuit for easy viewing and replacement.
- xi. Manufacturer and Products: Sola Heavy Duty, Phoenix Contact with Redundant modules, or Equal.

10. Internal Panel Lights for Freestanding Panels:

- i. Type: Switched LED enclosure lights.
- ii. Quantity: One (1)-light for every 4-feet of panel width.
- iii. Mounting: Inside and in the top of back-of-panel area.

iv. Protective metal shield for lights.

11. Service Outlets for Freestanding Panels:

- i. Type: Three-wire, 120-volt, 15-ampere, duplex receptacles.
- ii. Quantity: One (1)-for every 4-feet of panel width, two (2)-minimum per panel.
- iii. Mounting: Evenly spaced along back-of-panel area.

12. Internal Panel Lights and Service Outlets for Smaller Panels:

- i. Internal Panel Light: Switched 100-watt incandescent light.
- ii. Service Outlet: Breaker protected 120-vac, 15-amp, duplex receptacle:

13. Standard Pushbutton Colors and Inscriptions:

i. Use following color code and inscriptions for pushbuttons unless otherwise noted:

Tag Function	Inscription(s)	Color
OO	ON OFF	Red Green
OC	OPEN CLOSE	Red Green
OCA	OPEN CLOSE AUTO	Red Green Blue
OOA	ON OFF AUTO	Red Green Blue
MA	MANUAL AUTO	White Blue
SS	START STOP	Red Green
RESET	RESET	Red
EMERGENCY STOP	EMERGENCY STOP	Red
LOCAL	LOCAL	White

Table 40 70 00.2 Push Buttons Color Table List

- ii. Unused or Non-inscribed Buttons: Black.
- iii. Lettering Color:

Black on white and yellow buttons.

White on black, red and green buttons.

14. Standard Light Colors and Inscriptions:

Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in Instrument List:

Tag Function	Inscription(s)	Color
ON	ON	Red
OFF	OFF	Green
OPEN	OPEN	Red
CLOSED	CLOSED	Green
LOW	LOW	Red
FAIL	FAIL	Red

HIGH	HIGH	Red
AUTO	AUTO	Blue
MANUAL	MANUAL	White
LOCAL	LOCAL	White
REMOTE	REMOTE	Blue

Table 40 70 00.3 Status Indication/Light Table List

Lettering Color:

Black on white lenses.

White on red and green lenses.

F. Factory Finishing

1. Nonmetallic Panels: Not painted.

2. Steel Panels:

- i. Sand panel and remove all mill scale, rust, grease, and oil.
- ii. Fill all imperfections and sand smooth.
- iii. Paint (powder coat) panel interior surfaces with one (1)-coat of epoxy coating metal primer, two (2)-finish coats of two (2)-component type epoxy enamel, white. Exterior, light gray ANSI 61.

**2.04 SOURCE QUALITY CONTROL**

A. Factory Demonstration Tests: Demonstrate to City Representative that AS panels and assemblies included in these tests for conformance to related submittals and requirements specified.

**PART 3 – EXECUTION**

**3.01 GENERAL**

- A. Drawings for ICS Mechanical Systems are diagrammatic and not intended to specifically define element locations or piping and tubing run lengths. Material length and all other dimensions and installations shall be based on mechanical drawings and field measurements.
- B. Coordinate Work with Division 22 - Plumbing, Division 33, and Division 40 Process Piping.
- C. Wiring: Refer to Section 40 61 00 – Common Work Result of Control Systems (ICS) and Division 26 - Electrical.

**3.02 FIELD QUALITY CONTROL**

- A. Refer to Section 40 61 00 – Common Work Result of Control Systems (ICS) for the following:
  - 1. On-site services.
  - 2. Start-up and testing team.

- B. Operational Readiness and Functional Acceptance Tests: Refer to requirements in Section 40 61 00 – Common Work Result of Control System

### 3.03 TRAINING

- A. Operation: For Owner's operations personnel on operation of AS.
1. Training Session Duration: One (1) Instructor day.
  2. Number of Training Sessions: Two (2)
  3. Location: Project site.
  4. Content: Conduct training on loop-by-loop basis.
    - i. Loop Functions: Understanding of loop functions including interlocks for each loop.
    - ii. Loop Operation: For example, adjusting process variable set points, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
    - iii. Interfaces with ICS Subsystems.
- B. Maintenance Training
1. Training Session Duration: One (1) Instructor day.
  2. Number of Training Sessions: Two (2) Sessions
  3. Location: Project site.
  4. Content: Provide training for each type of component and function provided.
    - i. Loop Functions: Understanding details of each loop and how they function.
    - ii. Component calibration.
    - iii. Adjustments: For example, device setup parameters, controller tuning constants, current switch trip points, and similar items.
    - iv. Troubleshooting and diagnosis for and components.
    - v. Replacing lamps, chart paper, fuses.
    - vi. AS components removal and replacement.
    - vii. Periodic maintenance.

### 3.04 WARRANTY

- A. The Contractor shall provide a written warranty covering the performance, workmanship, and installation of all equipment furnished under this Section for a period of two (2)-years. The Contractor shall assume responsibility for all costs incurred in achieving satisfactory performance during the warranty period. Warranties shall be in accordance with Section 01 78 36 - Warranties.

### 3.05 SUPPLEMENTS

- A. Supplements listed below are part of this Specification.

1. Instrumentation Specifications.

(Remainder of the page intentionally left blank.)



**SECTION 40 70 00****SUPPLEMENTS****1. INSTRUMENTATION SPECIFICATIONS****A. LIQUID LEVEL INSTRUMENTS****i. Radar Level Measuring Systems**

The unit shall be non-contact, intrinsically safe 26 GHz pulse radar measuring device operating from a 24 VDC. The unit shall consist of a stainless steel 316L antenna suitable for the conditions of the wet well. The antenna shall be sized accordingly based on the factors as listed here:

- 1) Height of the wet well
- 2) Free space under the transmitter
- 3) Thickness of any surface foam and the dielectric of the liquid
- 4) Other conditions not listed here but communicated by PORT staff.

Cable length shall be able to accommodate the instrument location shown on the contract drawings. The system shall utilize the energy level on the transducer and shall be suitable for measuring solid, powders or liquid surface from one (1) to ninety-eight (98) feet below the transmitter, unless otherwise noted. The radar level transmitter shall have temperature compensation circuitry operable over the range of -60 degree C to +150 degree C and shall have an enclosure rating of IP67, NEMA 4X 316L stainless steel with silicone gasket. The transmitter shall have two (2) isolated 4-20 mA analog output. The entire system shall be accurate within +/- 3mm. The radar transmitter shall have a LCD display, showing level in feet or meters, and echo signal return curve. The unit shall have fail-safe diagnostics, with recognition, storage, and rejection of false echo signal return.

The radar liquid level transmitter shall be suitable for NEC Class I, Division 1 area. The unit shall be installed on the hinged transducer bracket and submergence shield shall be provided during flooding event.

Unit shall be EchoPro LR16 or approved equal. The radar liquid level transmitter shall be furnished and installed for this project.

**ii. Float Level Switch**

This flood level switch is a mechanically activated float switch designed based on differential level for level control. The float switch shall be suitable for NEC Class I, Division 1 area. The moving ballast causes a flipping action of the float and provides positive switching of the dry relay. There is one (1) SPDT contact. The float level switches are tied to the discharge pipes by cable ties.

Unit shall be Magnetrol model T10 or approved equal. The following flood switches shall be furnished and installed for this project in the wet well.

- (a) High-High Liquid Level Float Switch
- (b) Low-Low Liquid Level Float Switch

Additionally, two (2) spares float level switches shall be provided.

**END OF SECTION**



**SECTION 40 94 31**  
**CONTROL PANEL CONSTRUCTION**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Panel and enclosure requirements for Process Control System and package system.
- B. Item specified in this section shall conform to general requirements of Section 40 61 00 – Common Work Result for Control Systems

**1.02 MAINTENANCE / SPARE MATERIALS**

- A. Extra Materials:
  - 1. Provide minimum of 5 or 10%, whichever greater, of each type fuse used on project.
  - 2. Provide minimum of 5 or 10%, whichever greater, of each type bulb for pilot lights used on project.
  - 3. Provide minimum of 30% spare terminals, to be shown as such on panel drawings.

**PART 2 – PRODUCTS**

**2.01 GENERAL**

- A. All panel construction shall comply with the requirements specified herein, unless specifically specified differently or shown differently on Plans.
- B. Panels shall be constructed using factory-fabricated enclosures.
- C. Control panel shall comply with UL508A and have UL stamp.
- D. Install instruments and devices, plumb, and wire panels at panel shop or other facility prior to shipment to job-site.
- E. Wiring:
  - 1. In addition to NEC and NEMA requirements, wiring shall conform to following:
    - a. Power: 12-AWG stranded minimum, type MTW, 600-vac

- b. Control: 16-AWG stranded minimum, type MTW, 300-vac, Analog Signal: Twisted pair, 18-AWG, Belden 8760 or equal.
2. Wire color code:
- a. 480-vac hot conductor: Black; 480V-ac neutral: Grey.
  - b. Grounding conductor. Green.
  - c. 120-vac control conductor, powered from within panel: Red. 120-vac neutral: White.
  - d. 120-vac control conductor, powered from remote source: Yellow. 120-vac neutral: Grey.
  - e. DC (+) power conductor Blue.
  - f. DC (-) power conductor Blue.
  - g. DC control conductor: Blue.
  - h. Twisted pair cable (-) signal conductor: White.
  - i. Twisted pair cable (+) signal conductor: Black.
3. Design control panels to keep 480-vac power, 120-vac power, discrete signals, analog, and other low voltage signals separated
- a. Do not run 480-vac power, 120-vac power, discrete signals, analog, or other low voltage signals in the same conduit or wire-duct.
  - b. Where 480-vac power, 120-vac power, discrete signals, analog, or other low voltage signals must cross, they shall do so at right angles
4. Wiring within wire duct
- a. Wherever feasible, plastic wire duct with cover shall be used for routing of wire within control panel.
  - b. Size wire duct to be no more than 50% full.
  - c. Maintain 2-inch clearance between wire duct and terminals.
5. Wiring outside of wire duct
- a. Wiring outside of ducts shall be restrained by use of plastic wire-ties.
  - b. Restrain wiring a minimum of every six inches.
  - c. Provide abrasion protection for wires passing through holes or across abrasive metal edges.
  - d. Adhesive type wire fasteners shall not be used. Hard screw type shall be employed.

6. Wiring of RIO modules shall be through pre-wired cable assemblies as specified in Section 40 70 00 Instrumentation for Process Systems. Cable assemblies shall have RIO module-specific wiring arms on one end and cable ends tinned for terminus on terminal blocks on the other.

F. Terminations:

1. Wiring within control panel shall be continuous and terminated only at terminal blocks or equipment terminals. Splices or butt connectors shall not be used within panel.
2. No more than one wire shall be terminated at any one terminal.
3. Make external connections by way of numbered terminal blocks on numbered terminal strips.
4. When signals are powered from remote locations, switched terminal blocks shall be used for the powered conductor(s),
5. When signals are powered from within panel, fused terminal blocks shall be used for the powered conductor(s).
6. Provide integral bussing system on terminal block array where more than two terminations require common source or drain connection. Jumpered terminations shall not be acceptable.
7. Include provisions for grounding of shields on shielded twisted pair cables entering or leaving panel. Cable shields shall be grounded at terminal block end only.
8. Provide separate terminal strips for each of the following types of signals.
  - a. 480-vac power circuits.
  - b. 120-vac power circuits.
  - c. 120-vac discrete signals.
  - d. 24 -or 48-Vdc discrete signals.
  - e. Analog signals.
  - f. Serial or parallel digital communication signals.
  - g. Intrinsically safe circuits,

G. Power Distribution:

1. Panels having 480-vac power supply:
  - a. Provide internal main circuit breaker to isolate power to panel.
  - b. Provide circuit breakers for all motor starters provided.

- c. If panel includes separate 120-vac control power supply, provide auxiliary contact to isolate control power when main circuit breaker is opened.
    - d. 480-vac / 120-vac control power transformer requirements:
      - 1) Both primary leads shall be fused.
      - 2) First secondary lead shall be fused.
      - 3) Second secondary lead shall be grounded.
  2. Panels having 120-vac power supply:
    - a. Panels having 120-vac power supply:
  3. Provide separately fused power supply to each major panel component.
  4. Panels using modular or solid state I/O devices
    - a. Provide separately fused power circuit for panel powered I/O signals entering panel from field devices. Provide separate circuit for each module.
    - b. Include digital transient surge suppressor/varistor installed in parallel with output contact at terminal strip for each output signal driving an inductive load including:
      - 1) Relays.
      - 2) Solenoids.
      - 3) Motor starters.
      - 4) Motors.
- H. Labels and Nameplates:
  1. Panel Designation
    - a. Engraved with City's tag number and description shown on the P&IDs, drawing and in Specifications.
    - b. Laminated white plastic with 1/2-inch high black characters.
    - c. Fastened with stainless steel screws or self-tapping fasteners.
  2. Front of panel mounted devices
    - a. Provide nameplate for each front of panel device with descriptive phrase using nomenclature as listed in Specifications.
    - b. Laminated white plastic with 3/16-inch high black characters.
    - c. Fastened with stainless steel screws or self-tapping fasteners.
  3. Rear of panel mounted devices

- a. Provide nameplate for each rear of panel device with labels used on panel drawings.
  - b. Laminated white plastic with 1/8-inch high black characters.
  - c. Fastened with stainless steel screws or self-tapping fasteners.
4. Wiring
    - a. Each conductor or twisted pair cable shall be labeled near its termination point.
    - b. Color-coded multi-conductor cable or multi-pair cable shall be labeled on overall jacket near its point of fan-out. Each pair of a multi-pair cable, when not color-coded, shall be labeled at its termination point in addition to the overall jacket.
    - c. Labels shall be machine-printed wrap-around types with tag visible from front without removal of wire from termination.
- I. Panel Finish
    1. Remove mill scale, grease, and oil.
    2. Primer thickness shall be 0.8-mil.minimum.
    3. Finish coat shall be two-part epoxy or baked dry powder, 3-mil.minimum dry film thickness.
    4. Color: Selected by City Representative.
  - J. Conveniences
    1. Freestanding and floor mounted control panels shall be provided with door-activated, internal fluorescent panel lighting units. One (1)-unit shall be provided for every 3-feet of panel width and shall be mounted on the inside, top of the panel.
    2. Freestanding and floor mounted control panels shall be provided with 15-amp, 120-volt, service outlet circuits within the back-of-panel area. The circuits shall be provided with three (3)-wire, 120-volt, 15-ampere, duplex receptacles, one for every 3-feet of panel width and spaced evenly along the back-of-panel area.

## **2.02 PANEL CONSTRUCTION — INDOOR AND OUTDOOR ENCLOSURES**

- A. Indoor and Outdoor Enclosures shall conform to NEMA requirements as follows:
  1. NEMA 7 or NEMA 4X (Type 316 Stainless Steel) with purging system for Indoor or Outdoor Enclosures in Class I, Division 1 or 2 Hazardous (Classified) Locations.

2. NEMA 4X (Type 316 Stainless Steel) for Outdoor Enclosures and Indoor Enclosures in corrosive environments.
  3. NEMA 12 for indoor Enclosures not in Classified or corrosive environments.
- B. In addition to NEMA standards, conform to the following requirements:
1. Minimum metal thickness: 14-Gauge
  2. Indoor Enclosures: Equip with rubber-gasketed doors with continuous metal hinges. Equip doors with three (3)-point lockable latches.
  3. Outdoor Enclosures: Equip with hinged dead-front inner doors and rubber-gasketed, continuous metal hinged outer weather doors. Equip weather doors with three (3)-point lockable latches and gasketed, transparent panel for viewing of inner door mounted devices.
  4. Size to adequately dissipate heat generated by equipment mounted in or on panel. Heat dissipation shall be sufficient for internal panel temperature to not exceed temperature rating of internal panel components.
  5. Equip Outdoor Enclosures with thermostatically controlled heaters capable of maintaining internal panel temperature of 50 °F with 20-mph wind at ambient temperature of -20 °F. Heater shall operate at 110-vac, 60-Hz power.
- C. Prior to final fabrication of panels, verify layout of front-of-panel devices with respect to rear-of-panel devices. Maintain minimum of 3-inches clearance between door and sub-panel mounted devices

### 2.03 SOURCE QUALITY CONTROL

- A. In-Factory Inspection.
1. Verify following in accordance with accepted submittals:
    - a. Panel dimensions.
    - b. Equipment layout.
    - c. Wiring.
    - d. Wire and terminal identification.
  2. Verify proper access to equipment for maintenance.
  3. Verify proper access to field wire and fiber optic termination points.
  4. Inspect for neatness of wiring and wire harness construction.



**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. Install panels in locations indicated on Drawings and in accordance with System Integrator and manufacturer's written instructions and accepted submittals.
- B. Touch-up panel finish if marred during installation.

**END OF SECTION**

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**SECTION 40 94 45****PROGRAMMABLE LOGIC CONTROLLER WITH INTEGRATED HMI****PART 1 – GENERAL****1.01 SECTION INCLUDES**

- A. Programmable Logic Controller with Integrated HMI to be furnished, installed, and configured to interface with existing Port of San Francisco's SCADA to monitor devices connected to the programmable logic controller and expansion I/O modules.
- B. The expansion IO modules adapters provide additional I/O to the PLC and extend the monitoring and control capability of the PLC via a I/O expansion module.
- C. All I/O unit and associated power supplies shall be as indicated on the drawings and connected to the field mounted devices as shown in the interconnection diagrams in the contract document.

**1.02 RELATED SECTIONS**

- A. Section 40 61 00 Common Work Results for Control Systems
- B. Division 26 Electrical

**1.03 SUBMITTALS**

- A. In addition to the submittal requirements in accordance with Section 01 33 00, the following shall be provided to the City Representative for approval before fabrication and shipment or replacement:
  - 1. Catalog information, descriptive literature, wiring diagrams, and shop drawings for all components of the PLC system.
  - 2. Block diagram showing all major PLC components.
  - 3. Bill of materials: List of all Remote I/O components. Group components by type and include the following:
    - a. Component description
    - b. Manufacturer model number and part number.
    - c. Quantity supplied
    - d. Reference to component catalog information
- B. Interconnecting diagrams showing all PLC elements, interconnecting cables and wiring termination, power and grounding requirements, and all termination to interacting elements and subsystems.

- C. Outline drawings showing equipment external dimensions, internal dimension and installation requirements.
- D. Installation details of all equipment.
- E. Input/output (I/O) list showing all I/O points, I/O rack number, tag number of source or final control element, PLC module, I/O modules and termination identification, and I/O address. I/O status and function shall be listed for discrete points. Ranges and units shall be listed for analog points and alarm actuation values. All analog input/outputs configuration shall be floating points and reflect the actual engineering scaling/unit without any additional scaling from SCADA development.
- F. The registered addresses list for all I/O points by mapping to 0x format for DCS development.

#### **1.04 SOFTWARE SUBMITTALS:**

- A. Provide six (6) complete sets of standard user's manuals for software used to configure the Remote I/O system. These manuals shall cover all aspects of configuration programming, documenting, and implementation of process controls and related equipment as described on the Supplement of this Section and as indicated on the P&ID drawings.
- B. Submit the following material during program development stage. This submittal shall be reviewed by the City Representative prior to preliminary software development:
  - 1. An overview description of the PLC configuration; general programming methods and techniques used to implement the functional requirements.
  - 2. I/O logic listings: Each I/O point shall have a tag number and/or description. Provide the following additional information integral to the I/O listings to document the PLC configuration:
    - a. I/O point cross reference list.
    - b. Internal coil cross reference list.
    - c. Data register cross reference list.
    - d. Listing of all program special functions. Include descriptions and pertinent memory locations used, and programmed values.
  - 3. The registered addresses list for all I/O points by mapping to 0x format for DCS development.
    - a. Preliminary software standards used to implement the process interface.
    - b. Preliminary Software Documentation:

- c. Submit at least 4 weeks prior to Factory Demonstration Test. Include full detail version of all the material above.
    - d. Submit software printout and on CD.
  4. IP Settings by obtaining IP address from Port of San Francisco Engineering group through the City Representative.
  5. Final Software Documentation: Provide a final version of the material described above and all the PLC configuration on CD. All programming software shall be the original software licensed to the City and County of San Francisco and the program shall be unlocked to read. Submit software suppliers' letter of authenticity with the CD. Certificate shall authorize the City and County of San Francisco complete usage of the software including downloads to the Modular Active Ethernet Input/Output hardware and auxiliary systems.

## **1.05 TESTS**

- A. Tests and test procedures shall be coordinated and in accordance with Section 40 61 21 Process and Facility Control System Testing.

## **1.06 ONSITE SUPERVISION**

- A. Provide an onsite engineer to supervise and coordinate installation, adjustment, testing, and startup of the PLC and control system.

## **PART 2 – PRODUCTS**

### **2.01 PROGRAMMABLE LOGIC CONTROLLER WITH INTEGRATED HMI**

- A. General
  1. Function: Provide PLC Systems for this pump station for monitoring and control of sump pumps, dewatering pumps and miscellaneous sensors as shown on the drawing.
  2. Type: Standard vendor catalog item as tabulated on the drawings.
- B. PLC Processor and I/O Modules
  1. As shown on the contract drawings.
  2. Miscellaneous termination kits, and cabling required for the interconnection of the I/O modules, effect system performance including interfacing to the existing distributed control system not actually listed in the bill of material shall be furnished at no additional cost to the City.

3. I/O list are not separately provided for this project but indicated in the interconnection diagram including device tags for field and panel mounted instrument. System integrator shall use the device tags in the interconnection diagram for annotation and labels.
- C. Manufacturer: **Unitronics, model: Vision350 or approved equal.**
- D. PLC requirement for SCADA Communication:
1. Pumps running indicator
  2. Pumps stopped indicator
  3. Selector switch positions On/Off/Auto indicator
  4. Pumps amperage
  5. Pumps out of service due to overload indicator
  6. Pump out of service due to pump not starting
  7. Alternation On/Off indicator
  8. Lead Pump indicator
  9. Tank Fluid Level
  10. Start and Stop levels for the pumps
  11. Access to enter values from motor nameplate FLA HP and voltage
  12. PLC IP Address
  13. Transducer failure alarm
  14. High High alarm
  15. Low Low alarm
  16. Pump overload alarm
  17. Pump continuous run alarm
  18. Pump number of starts and reset
  19. Additional variable(s) per PORT standard

**PART 3 – EXECUTION****3.01 FIELD QUALITY CONTROL**

- A. Refer to Section 40 61 21, PROCESS AND FACILITY CONTROL SYSTEM TESTING and 01 75 60 TESTING COORDINATION AND START-UP TESTING for the following:
1. Onsite services.
  2. Startup and testing team.
  3. Operational Readiness Test.
  4. Functional Acceptance Test.
  5. Communication System Functional Test.

**END OF SECTION**

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