

## **SECTION 01 33 00**

### **SUBMITTAL PROCEDURES**

#### **PART 1 -- GENERAL**

##### **1.01 GENERAL REQUIREMENTS**

- A. Submittals include, but are not limited to, product data, shop drawings, test procedures, test results, annotated PLC program listings, AutoCAD® generated drawings, samples, requests for substitutions, descriptive data, certificates, methods, schedules, marked contract drawings and specifications, manufacturer's installation and other instructions, and miscellaneous work related items. Submittals also include all other information as may reasonably be required, in the opinion of the District Representative, to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the contract documents. Additional submittal requirements are specified in each individual section of the specifications. Items to be submitted are specified in these individual technical specification sections.
- B. All submittals will be submitted via the Project Controls System (PCS) as described in the ELECTRONIC COMMUNICATION PROTOCOLS Section (01 31 26). Minimum size lettering height on all submittals shall be 12 point font for text documents, 1/16 inch height for 8-1/2 by 11 inch and 11 by 17 inch documents and 1/8-inch height for documents larger than 11 by 17.
- C. The review of the Contractor's drawings or other descriptive material shall not relieve the Contractor of responsibility for any error or of any obligation for accuracy of dimensions and details, for agreement and conformity with the contract drawings and specifications, or responsibility to fulfill the contract as prescribed and required by the GENERAL CONDITIONS Section (00 72 00). If errors or omissions exist in the Contractor's submittals which are not noted by the District during the District's review, it shall be the Contractor's responsibility, at no additional cost to the District, to correct the errors and omissions, to correct field conditions, and to repair any damage inflicted to new or existing equipment and other improvements as a result of the errors or omissions.
- D. Where specified, the Contractor shall furnish submittals to the District Representative for information only. An electronic version and two hard copies these submittals, 1 full size reproducible on 20 lb. white bond for document/drawings larger than 11 by 17 inches shall be transmitted to the District Representative. Designation "For Information Only" does not preclude the District Representative from reviewing or commenting on the submittal contents as specified in this section.

- E. All other submittals shall be submitted by the Contractor to the District Representative for review and comment. An electronic version and two hard copies of these submittals, 1 full size reproducible on 20 lb. white bond for documents/drawings larger than 11 by 17 inches shall be transmitted to the District Representative.
- F. All submittal data including shop drawings will become part of the and O&M data and project records furnished under the PROJECT RECORD DOCUMENTS Section (01 78 39) and the OPERATION AND MAINTENANCE DATA Section (01 78 23). All changes or modifications during construction to original equipment submittals must be recorded and become part of the project record and O&M process as outlined in their respective sections.

## **1.02 DEFINITIONS**

### **A. GENERAL:**

- 1. The definitions of types of drawings, diagrams and other forms of submittal documents shall include the terms used in the following paragraphs. Whenever the following terms for drawings or other forms of submittal documents are used in submittal requirements, the definitions in the following paragraphs shall apply. The following set of definitions is not comprehensive. They are included to help clarify the meanings of certain terms applicable to mechanical, electrical, instrumentation and control system documents.

### **B. SINGLE-LINE DIAGRAMS:**

- 1. A single-line diagram shall show by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and components, devices, or parts used therein. Physical relationships are represented schematically.

### **C. ELEMENTARY OR SCHEMATIC DIAGRAM:**

- 1. An elementary or schematic diagram shall show all circuits and devices of a system, equipment item, or assembly, or any defined functional portion thereof. A system is defined as any assembly of electrical, electronic, mechanical, hydraulic, pneumatic, and other various types of components and devices and/or materials which are combined, connected, and integrated as necessary to perform some specific function. Such a diagram emphasizes the functional arrangement of system components and devices as opposed to their physical arrangement, and is intended to provide a functional understanding the operation of the system or circuit. "Elementary" and "schematic" are equivalent terms unless additional definitions or requirements are stated. However, the term "elementary" as used herein for electrical drawings generally refers to those drawings and diagrams which show the connection and control of electrical devices, whereas the term "schematic" generally refers to those drawings or diagrams which show the connection and application of electronic devices. (Note: Most elementary

diagrams provided in the contract drawings are located on "X" drawings titled "Control and Logic Diagrams.")

#### D. LOOP DIAGRAM:

1. Loop diagrams shall show a schematic representation of a complete hydraulic, electric and pneumatic circuit. Diagrams show all system devices with alphanumeric identification of each component in the loop. All connected equipment terminals are shown with manufacturer's identification markings. All interconnecting cables and pneumatic tubing are shown with color code and alphanumeric identification. The location of all devices in the loop are shown; for example, field, panel front, panel rear, termination cabinet, computer I/O cabinet, etc. Diagrams also show the process lines and equipment to which the devices in the loop are connected with a description of the controller actions. The loop diagrams also show references to all other applicable drawings. Loop diagrams have symbols and layout in conformance with ISA S5.1 and S5.4.

#### E. CONNECTION DIAGRAM:

1. Connection diagrams shall show the physical placement and wiring of devices and terminals in a panel, cabinet, console, assembly or system. Devices and terminals are shown arranged in the physical layout (not necessarily to scale) as they would appear to a person who is servicing the equipment.

#### F. INTERCONNECTION DIAGRAM:

1. Interconnection diagrams shall show the external wiring between terminals of associated equipment, control panels, motor control centers, area control centers, terminal boxes, field switches, and any other device, panel, or enclosure.

#### G. PANEL FABRICATION DRAWINGS:

1. Panel fabrication drawings are scaled drawings that shall show the physical dimensions, materials, and construction of panels, cabinets, terminal boards, consoles, or other electrical or mechanical equipment enclosures. These drawings show the physical arrangement and mounting of all components in or on a panel, terminal board, cabinet, console, or enclosure. These drawings show the physical dimensions, and the space and mounting requirements of mechanical, electrical, control and instrumentation devices or pieces of equipment. Other information provided may include ventilation requirements, locations of connections, weight, and paint color, material and dry film thickness.

#### H. ELECTRONIC ASSEMBLY DRAWINGS:

1. Electronic assembly diagrams shall document circuit board assemblies, enclosures, and associated devices. They include circuit schematics, circuit board assembly

drawings, and chassis layouts which show, locate, and identify all circuit assemblies, components, and component electrical connections and wiring.

**I. INSTRUMENT INSTALLATION DRAWINGS:**

1. Instrument installation drawings shall show the mounting and piping details of field mounted instruments and instrument racks.

**J. BILL OF MATERIALS:**

1. Materials identified on the drawing and listed by item number, a brief description, manufacturer, model number (and/or page number), serial number (if available), and quantity used. Associated equipment numbers must be shown. The items must match the field installation and the drawing.

**1.03 STANDARD COMPLIANCE**

- A. When materials or equipment are required to conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL), documents showing or proving conformance shall be submitted.
- B. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization which is competent to perform acceptable tests and is approved by the District's Representative. The certificate shall state that the item has been tested and found to be in conformance with the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for approval. The certificate shall identify the manufacturer, the product and the referenced standard and shall state that the manufacturer certifies that the product conforms to all requirements of the project specification and of the referenced standards listed.

**1.04 SUBMITTAL REVIEW**

- A. When review and comment is required of any drawing or information regarding materials and equipment, the Contractor shall post the submittal information to the Project Control System in accordance with the ELECTRONIC COMMUNICATION PROTOCOLS Section (01 31 26). Within a reasonable time as specified in this section after receipt of said submittal, the District Representative will return electronically one copy of the submittal documents indicating one of the following four actions by item number:

1. If review and comment indicates no exceptions, copies will be returned marked "NO EXCEPTIONS TAKEN". Work may begin immediately on incorporating the material and equipment covered by the submittal into the work.
  2. If review and comment indicates limited corrections are required, copies will be returned marked "MAKE CORRECTIONS NOTED". Work may begin immediately on incorporating the material and equipment covered by the submittal document into the work.
  3. If review and comment indicates insufficient or incorrect data has been submitted, copies will be returned marked "AMEND AND RESUBMIT." The Contractor is not authorized to begin incorporating the material and equipment covered by this submittal document into the work until the submittal document is revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".
  4. If review and comment indicates the material and equipment submittal is unacceptable, copies will be returned marked "REJECTED - SEE REMARKS". The Contractor is not authorized to begin incorporating the material and equipment covered by this submittal into the work until a new submittal is made, resubmitted, and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".
- B. When submittal documents are referred to in these specifications as "approved," "reviewed" or "accepted," this means that they are stamped as in case 1 or 2 above.
- C. Designation of submittal documents "for information only," does not preclude the District's Representative from reviewing or commenting on the submittal contents. Information only submittals returned to the Contractor marked "AMEND AND RESUBMIT" or "REJECTED - SEE REMARKS" shall be revised and resubmitted by the Contractor.

## **PART 2 -- PRODUCTS**

### **2.01 SHOP DRAWINGS**

#### **A. GENERAL:**

1. Shop drawings shall include data of all forms which have been custom prepared for this project. This includes detail drawings for structural, architectural, mechanical, piping, HVAC, electrical, logic diagrams, software programs, electronic, instrumentation, control, and communication equipment, assemblies, and systems which are installed or fabricated as a part of this project. All shop drawings shall be drawn in CAD format, as specified in this section, at an approved drawing scale. Also included are drawings and data which show fabrication, layout, setting or erection details. This includes any data which is prepared by the Contractor,

subcontractors, vendors, suppliers, manufacturers or their representatives, specifically for this project.

2. Shop drawings shall have drawing numbers, scale, revision date and number, Contractor name, subcontractor name, supplier name, name of detailer or engineer who prepared the document, relation to adjacent structures, materials, drawing cross references, standards references, Contractor's certification stamp, and registered engineer's stamp, if required, shown on them. Maximum sheet size shall be 22 inches by 34 inches. Minimum sheet size for drawings shall be 11 inches by 17 inches, except as allowed by the District Representative.
3. Shop drawings specifically prepared for this project shall be created in Computer-Aided Drawing (CAD) format, using the most current AutoCAD<sup>®</sup> software, by Autodesk, Inc.

#### B. CAD DRAWINGS:

1. All drawings shall be prepared in a CAD format, using the most current AutoCAD<sup>®</sup> software by Autodesk, Inc. The following drawings are specifically required in CAD format:
  - a. Panel drawings including area control centers (ACC), panel fabrication, layout and point-to-point wiring (connection diagrams).
  - b. Elementary diagrams (control and logic).
  - c. Electronic assembly drawings.
  - d. Terminal panels or terminal boxes.
  - e. Interconnect drawings.
  - f. Loop drawings (digital and discrete).
  - g. Custom created concrete products specifically prepared for this project.
  - h. Shop drawings which are specifically prepared for this project.
2. All CAD drawings shall comply with the United States National CAD Standard<sup>®</sup> (NCS). All Contractor submissions requiring CAD shall be in accordance with NCS Version 5.0, or the latest release, and the U.S. National BIM Standard (NBIMS). Additional information or clarification can be obtained from the United States National CAD Standard<sup>®</sup> (NCS) website at [www.nationalcadstandard.org/ncs5](http://www.nationalcadstandard.org/ncs5). The National Institute of Building Sciences owns the copyright to the work known as the United States National CAD Standard<sup>®</sup> (NCS) and reserves all rights to said work under United States and international law.

- a. Exceptions to the NCS are as follows:
  - 1) All annotation shall be capitalized.
  - 2) All annotation shall be a minimum 1/8-inch Arial for full size drawings and a minimum 1/16-inch Arial for half size drawings.
  - 3) All arrowheads shall match the font size (1/8-inch) of the annotation in the drawing.
3. The Contractor shall require that the CAD drawings prepared by all subcontractors or vendors meet the requirements of these standards.
4. The Contractor shall upload the submittal drawing files (in both native and pdf format) to the Program Controls System in accordance with the ELECTRONIC COMMUNICATION PROTOCOLS Section (01 31 26).

C. ELECTRICAL AND CONTROL DOCUMENT REQUIREMENTS:

1. GENERAL:
  - a. For each piece of mechanical equipment and for each process instrumentation and control loop, all applicable electrical and control documents specified herein shall be submitted as a package. If any of the electrical, control and instrumentation circuits of the subject mechanical equipment or process loop have an "interface" drawing on the "E" or "X" series contract drawings, the Contractor shall field verify the accuracy of the drawings and verify existing conditions. The "interface" drawings include the Interconnection Diagrams and Reconnection Diagrams on the "E" drawings, and the set of Interface and Demolition Diagrams on the "X" drawings. Demolition Interconnection Diagrams based on existing referenced drawings must be verified.
  - b. If the Contractor finds any errors or omissions on the interface drawings, they shall mark up two copies of the affected contract drawings and submit them to the District Representative for clarification. If the errors or omissions are confirmed by the District Representative, the affected contract drawings will be corrected and reissued through a contract change order.
  - c. The Contractor shall then prepare all detailed electrical and control documents required for the subject mechanical equipment or process loop or circuit and submit them for review. After successful completion of the review process, the Contractor shall then proceed with shop fabrication and field installation.
  - d. Additional electrical and control document requirements are specified in the technical specifications.
  - e. For each type of drawing specified in the following paragraphs, the Contractor shall submit at least two examples a minimum of 30 days prior to beginning the

preparation of any additional electrical and control documents. The purpose of this sample submittal is to allow the District Representative to perform a detailed review of the Contractor's drawings for compliance with contract requirements for format, content, and level of detail. These examples shall receive a "MAKE CORRECTIONS NOTED" or "NO EXCEPTIONS TAKEN" review before the Contractor proceeds with shop drawings which include these types of drawings.

2. **CUSTOM SOFTWARE DOCUMENTATION:** Unless otherwise specified, custom software prepared for this project shall be specially documented in accordance with the latest edition of one of the following formats: ISA S5.1, Instrumentation Symbols and Identification; ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems; the format and Symbols used in the contract drawings for Control and Logic Diagrams, "X-Series" drawings; or a format acceptable to and approved by the District Representative. Software documentation shall also include a complete listing of all application programs together with comments and annotations. Complete software documentation shall be submitted for all mechanical, electrical and control systems, subsystems, assemblies, parts, components, and equipment which incorporate programmable devices which are custom programmed/configured for this project. In addition, complete annotated program listings clearly indicating logic produced by the applicable programmable device or device programming unit shall be provided along with all applicable functional diagrams. All instructions, hardware, and machine-readable media necessary to load, store, modify, and activate the associated custom software source codes and programs shall be provided. Contractor shall submit annotated program listing on electronic media as appropriate.
3. **SINGLE-LINE DIAGRAMS:** Single-line diagrams shall be drawn to a format similar to the single-line diagrams in the contract documents. Single-line diagrams shall be prepared for all new 480 volt switchgear. Single-line diagrams shall be submitted along with other drawings and data specified in Division 26.
4. **ELEMENTARY DIAGRAMS:** Unless otherwise specified, electrical elementary diagrams shall be drawn in accordance with the latest issue of Joint Industrial Council (JIC) Electrical Standards for Mass Production Equipment (EMP-1). All circuits and devices of a system shall be shown. A written description of the sequence of operation of the circuit shall be included. Elementary diagrams shall be prepared and submitted for all assemblies and systems for which elementary diagrams have not been included on the contract drawings, or where only partial elementary diagrams have been included in the contract documents. Elementary diagrams shall be prepared using the format shown in the Control and Logic Diagrams in the Example Wiring Diagrams located in the Contract Drawings following the "X-series" drawings.



5. LOOP DIAGRAMS: Loop diagrams shall be prepared in compliance with ISA-S5.4 and using the format shown in the loop diagrams in the Example Wiring Diagrams located in the Contract Drawings following the "X"-series drawings. In the event of conflict between ISA-S5.4 and the Example Wiring Diagrams, the Example Wiring Diagrams shall govern. Loop diagrams shall show circuits and devices of a system. These diagrams shall be arranged to emphasize device elements and their functions as an aid to understanding the operation of a system and maintaining or troubleshooting that system. Loop diagrams shall also show cable numbers, wire numbers, input and output signals (e.g., 4-20 mA DC, 10-50 mA DC, 1-5V DC, 3-15 psig, 6-30 psig, etc.), power and instrument air supplies to devices (e.g., 120V AC, 65V DC, 24V DC, 80 psig, etc.), signal polarity, all wire and shield terminations, and terminal block numbers in physical order. Loop diagrams shall also show all pneumatic components of instrumentation loops. Loop diagrams shall be printed on 11-inch by 17-inch sheets. Loop diagrams shall be prepared and submitted for all electric and pneumatic, analog and discrete, instrumentation monitoring, control, and alarm circuits. Every 24 volt DC circuit shall be documented in a loop diagram. Only one circuit shall be shown on each drawing; multiple circuits on a single drawing with an application table are unacceptable. Loop diagrams will show references to the computer tie-in point with cabinet, row, column, and channel number. A list of existing tie-in points will be provided to the Contractor by the District.

6. CONNECTION DIAGRAMS:

a. Connection diagrams shall show the placement, labeling and wiring of components within MCC cubicles, panels, terminal boards, cabinets and consoles. Components shall be shown arranged in the physical layout as it would appear to a person servicing the equipment. Terminal blocks shall be shown in sequential physical order including all spares. Wires shall be shown as a continuous line between their termination points. The direction of entry to a wire bundle shall be shown. Wire lists and wireless diagrams are unacceptable. All additions and deletions of devices and wires in existing enclosures shall be clearly shown. Each wire label designation shall be shown. The wire label designations on each end of a single wire must be identical. All wire termination point numbers shall be shown. Each wire and cable size, color code, type and rating shall be shown. Signal and DC circuit polarities shall be shown. All jumper, shielding and grounding details shall be shown. Multiple conductor cables shall show all wires. All spare wires and spare termination points shall be shown.

b. Contractor shall submit connection diagrams for all new MCC cubicles, panels, terminal boards, cabinets and consoles. The Contractor shall also prepare and submit connection diagrams for existing panels, terminal boards, cabinets and consoles which are to be modified or refurbished. Connection diagrams shall be submitted along with associated elementary, loop, interconnection, and other associated panel submittal data as a complete package for review.

## 7. INTERCONNECTION DIAGRAMS:

- a. Interconnection diagrams shall show for each piece of equipment all wiring between all devices, panels, cabinets, consoles, terminal boxes, control equipment, motor control centers, area control centers and any other devices and equipment. Drawing references shall be shown to all diagrams which interface to the interconnection diagrams. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of individual wires clearly shown. Wireless diagrams and wire lists are unacceptable. Non-sequential terminals, on which wires are landed, shall be shown with gaps on the terminal block to depict they are not adjacent. Equipment terminal blocks shall be shown in the exact physical order (including spares) as they are installed. Each wire labeling code as actually installed shall be shown. The wire labeling code for each end of the same wire must be identical. All device and equipment labeling codes shall be shown. Terminal blocks within equipment with interconnection wiring connected shall be shown complete with labeling code and all termination point labeling codes shown. All jumper, shielding and grounding termination details not shown on the connection diagrams shall be shown on the interconnection diagrams. Each wire and cable size and color code shall be shown. Signal and DC circuit polarities shall be shown. Multiple conductor cables shall show all wires. Wire and cable routing through wireways, junction boxes, terminal boxes, manholes, handholes, and other electrical enclosures shall be shown with the appropriate equipment labels. Labeling codes for terminal blocks, terminals, wires, cables, panels, cabinets, instruments, devices, and equipment shall be shown. All spare wires and cables shall be shown. Examples of the required format for interconnection diagrams are contained in the Example Wiring Diagrams, located in the Contract Drawings following the "X-series" drawings. Additional information related to wire tagging which is required on interconnection diagrams is specified in the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00).
- b. Interconnection diagrams shall be submitted for each piece of equipment. The Contractor shall simultaneously submit in one package all backup material used to develop each interconnection diagram. This material includes current issues of panel schematics, connection diagrams, terminal block diagrams, submittals, contract drawings, vendor drawings and all other data used to develop the interconnection diagram. All interconnection diagrams shall be prepared under the supervision of or by a registered electrical engineer and shall bear that Engineer's professional stamp and signature. All deletions and additions of equipment, wires and cables shall be clearly shown. Interconnects shall include a list of all applicable reference drawings, requests for clarifications, field instructions and change orders.
- c. Cable shall not be pulled into raceway until the interconnection diagrams depicting the cable are approved.

8. **ELECTRONIC ASSEMBLY DIAGRAMS:** Electronic assembly diagrams shall document the design and wiring of circuit board assemblies, enclosures and electrical/electronic devices. Circuit board schematic and fabrication drawings, and chassis layout and wiring diagrams, shall be provided to show, locate and identify all circuit assemblies, components and component wiring. All chassis and circuit board components shall be identified by original manufacturer's name and part number. Component values, ratings and tolerances shall be shown. Adjustments, jumpers and switch positions shall be shown in the installed positions. Voltage and/or current levels, set points, and timing values shall be shown.
9. **INSTRUMENT INSTALLATION DRAWINGS:** Instrument installation drawings shall be drawn to an approved scale and shall show the mounting, piping, and wiring details for field and rack mounted instruments. Mounting dimensions, piping slopes, complete bill of material and installation notes shall be shown. Mounting heights, sense of line routing and process line tap heights relative to the instrument shall be shown. Viewing, adjustment, operation, and service access shall be shown. Groupings of instruments shall be drawn to an approved scale. Instrument installation drawings shall be submitted for all field mounted instruments and instrument racks. Installation drawings shall list all applicable equipment numbers.
10. **PANEL FABRICATION AND LAYOUT DRAWINGS:**
  - a. As a minimum, panel fabrication and layout drawings shall include a bill of materials; front, back, and section views; the locations of all components to be mounted in or on the panel, terminal boards, cabinet, console, enclosure or assembly; drawing scale; nameplate engraving schedule; and structural materials and supports. All drawings shall be drawn to an approved scale. Overall dimensions and minimum clearances shall be shown. Sufficient detail shall be included to demonstrate material choices, construction methods, and seismic force resistance. Panel drawings will show drawing references to appropriate connection diagrams, interconnects, and control and logic drawings.
  - b. Panel fabrication and layout drawings shall be submitted for all assemblies, panels, terminal boards, cabinets and consoles which contain mechanical, electrical, and electronic devices and equipment and for the systems which contain these assemblies, panels, cabinets, and consoles. Outline drawings for mechanical and electrical equipment (sometimes referred to as "dimension drawings") shall be drawn to an approved scale and include, as a minimum, overall dimensions in front, back and section view, complete mounting frame details and dimensions, the location and size of all conduit entrances, the location and dimensions of any mechanical connections, and the weight of the device or equipment.

## **2.02 MANUFACTURER'S PRODUCT DATA**

- A. Product data shall include data of all forms which define design, performance and function of manufactured products or materials. This includes all preprinted literature, performance specifications, drawings, instruction manuals, and data which are available from the original equipment manufacturer and/or supplier. Product data shall also include all software and firmware encoded on programmable device readable media. Specific Asset Attribute data related to the product data shall be submitted separately and is specified in the DESIGN DATA Section (01 33 16). Product data shall be submitted for all manufactured products and material as specified in this section and in the Technical Specifications, Divisions 03 through 50.

## **2.03 TEST PROCEDURES AND RESULTS**

- A. Refer to the individual technical specifications and the COMMISSIONING Section (01 91 00) for the submittal requirements of test procedures and results.

## **2.04 SAMPLES**

### **A. GENERAL:**

1. Samples shall include both fabricated and un-fabricated physical examples of materials, products and work, both as complete units and smaller portions of units of work. Mock-ups are special forms of samples. The electronic submittal for these items shall be processed concurrent with the submission of samples and mock-ups.
2. When specified, samples or test specimens of the materials proposed to be used shall be prepared at the expense of the Contractor and furnished in such quantities and sizes as may be required for proper examination and tests, with all freight charges prepaid, and with complete information as to the type, kind, or size of material, and its source. All samples shall be submitted in ample time to permit the making of proper tests, analyses, or examinations before the time at which it is desired to incorporate the materials into the work, and no materials shall be used in the work unless or until the submittal has been reviewed by the District's Representative. All tests of materials shall be made by the Engineer in accordance with recognized standard practice. The Contractor will pay the cost of the second test and any subsequent retest of any area or material which does not meet the specifications. Samples shall be supplied by the Contractor whenever deemed necessary by the District Representative to determine the quality of materials. The Contractor is required to give one working day advance notice for any requested on-site testing or inspection unless the nature of the work mandates shorter notice.
3. Provide units identical with the final condition of the materials or products proposed for the work. Include "range" samples (not less than three units) where variations occur, and identify each unit of each set. Provide a full set of optional samples where the District Representative selection is required. Prepare samples to

match the Engineer's sample where so indicated. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliances with standards. Samples are submitted for review and confirmation of color, pattern, texture and kind by the District Representative.

**B. SUBMITTAL:**

1. The Contractor may choose to provide a preliminary submittal of a single set of samples for review. Otherwise, the initial submittal is the final submittal unless it is rejected and/or requires re-submittal. Submit two sets of samples in the final submittal, one set will be returned.

**C. QUALITY CONTROL SET:**

1. The Contractor shall maintain the returned final set of samples at the project site, in suitable condition and available for quality control comparisons by the District Representative.

**D. REUSABLE SAMPLES:**

1. Samples which are intended or permitted to be returned and actually incorporated in the work are so indicated in the individual work sections, but must be in undamaged condition at the time of installation.

**2.05 MISCELLANEOUS SUBMITTALS**

- A. These include, but are not limited to, stormwater BMP plans and descriptions, warranties, guarantees, certifications, maintenance agreements, quality testing reports and similar information, devices and materials.

**2.06 PROJECT RECORD DRAWINGS AND DATA**

- A. Refer to the PROJECT RECORD DOCUMENTS Section (01 78 39) for the submittal requirements of as-built drawings and data.

**2.07 OPERATION AND MAINTENANCE INSTRUCTIONS**

- A. Refer to the OPERATION AND MAINTENANCE DATA Section (01 78 23) for the submittal requirements of operation and maintenance instructions. Operation and maintenance instructions will not be submitted until approved equipment or material submittals are received.

**2.08 BURIED UTILITIES**

- A. Plan and profile drawing shall be supplied for all outside underground utilities including, but not limited to, piping, electrical duct banks and cables. All plan and profile drawings shall be submitted for as-built review in accordance with the PROJECT RECORD DOCUMENTS Section (01 78 39).

## 2.09 SCHEDULE

- A. Refer to the CONSTRUCTION PROGRESS SCHEDULE Section (01 32 16) for submittal requirements for Schedules.

## PART 3 -- EXECUTION

### 3.01 SUBMITTAL REQUIREMENTS

#### A. GENERAL:

1. Submittals shall be reviewed and coordinated by the Contractor before transmittal to the District Representative in accordance with the QUALITY CONTROL Section (01 45 00). Submittals shall be complete and fully identified by the Contractor.

#### B. PREPARATION:

1. Each submittal shall contain documents which are related to only one material, product or system. Normally, a separate transmittal form shall be used for each specific item or class of material, equipment or system. Exceptions may be allowed only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates checking or review of the group or "package" as a whole. The Contractor shall mark each submittal document with the submittal number, letter suffix and item number.
2. Prior to preparation of each "major submittal package," the Contractor shall arrange for an 8-hour pre-submittal meeting, to be attended by the Contractor, District's Representative, and vendor(s) of the major submittal package. The purposes of the pre-submittal meeting will be to discuss how the submittal package will be organized, content of the submittal package, anticipated schedule for submittal and review, major features of the equipment/materials and basic compliance with specified equipment/materials, and coordination needed with related equipment/material submittals. Pre-submittal meetings shall be held for the following major submittal packages:

- a. *Note to Specifier: Enter applicable specification section number(s) and name(s).*

#### C. TRANSMITTAL FORM:

1. The District Representative will define a submittal numbering scheme which the Contractor shall use. Items omitted, or incorrectly or ambiguously listed on the transmittal form will be deemed to be not included in the submittal. Where items listed in the transmittal by equipment number conflicts with other descriptions contained in the submittal, the listed equipment numbers shall be deemed to be the intended scope. The Contractor shall bear all costs and damages sustained to the

District attributable to omitted, or incorrectly or ambiguously listed submitted items.

2. Submittals shall be transmitted by utilizing the District-furnished web based Project Controls System. Prior to the first submittal, the Contractor shall attend a submittal transmittal meeting to work out all compatibility requirements. Each transmittal shall contain the following information as a minimum:
  - a. Date
  - b. Submittal or re-submittal number
  - c. Contract title and number
  - d. Contractor's name and address
  - e. List of documents being submitted, by preparer, number and version
  - f. Contract documents references (including specific specification section and drawing numbers) for each submittal document
  - g. Plant system references for each submittal document
  - h. Previous submittal number and item number for each submittal document
  - i. Notification of deviation(s) from contract documents for each submittal document
  - j. Complete list of equipment numbers and auxiliaries included with each submittal document
  - k. Contractor's certification of having reviewed and coordinated the submittal
  - l. Description of intended use in this contract

**D. DOCUMENT IDENTIFICATION:**

1. If multiple items are included within a single submittal, each separate document within the submittal shall contain the following information:
  - a. Document (Item) number within this submittal
  - b. Identification of product or material
  - c. Manufacturer's name
  - d. Equipment number

E. RESUBMITTALS:

1. Revise returned submittal documents as indicated and as required. Resubmit using the same submittal procedure as for an initial submittal. All resubmittals shall use the previous submittal number with a letter suffix and shall refer to the previous item number.
2. Resubmittals shall address all comments from the District Representative. Partial re-submittals may be returned "REJECTED." The Contractor will be responsible for the District Representative's review costs for each re-submittal in excess of the first resubmittal. These costs will be back charged to the Contractor and will be deducted from progress payments.
3. Time extensions will not be granted for delays resulting from the necessity for the Contractor to provide resubmittals due to inaccurate, incomplete or rejected submittals.

F. COORDINATION AND SEQUENCING:

1. Review priority will be based on the schedule unless otherwise requested in writing by the Contractor. The Contractor in scheduling submittals shall submit no more than 10 per week. In the event the Contractor submits more than 10 per week, the District Representative's review time may exceed the review time outlined.
2. The Contractor shall coordinate submittals with the work so that work will not be delayed. Submittals shall be coordinated and scheduled into different categories, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with work related to a submittal until the submittal process is complete and the submittal document has been returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."
3. All submittals, including shop drawings, shall be submitted in sufficient time to allow the District Representative not less than 30 days for review of such submittals.
4. These review periods do not include any time that the District Representative cannot proceed further with the review because of having to wait for further information of clarification from the Contractor.
5. Normally, initial submittals will be returned to the Contractor within 30 days, and resubmittals will be returned within 20 days, exclusive of any time awaiting clarification or further information, and exclusive of "major submittals" as described above. However, the time for return will necessarily vary and may exceed the time described above depending upon the complexity of the submittal, the number of submittals, and the express needs of the Contractor.



6. Submittals for material or equipment which are not specified by name, and which are being submitted as an "or equal" to that specified and submittals for material or equipment with arrangements or requirements that are different than that shown in the contract documents, will normally require 42 days for the review process.

#### G. CONTRACTOR'S RESPONSIBILITIES:

1. The Contractor shall review submittals before they are transmitted to the District Representative to ensure that there are no conflicts with other submittals. The Contractor shall coordinate submittals from subcontractors and suppliers to ensure that they are complete and that there are no conflicts.
2. The Contractor is responsible for errors and omissions in submittals even though the District's Representative reviews the submittal.
3. The District Representative shall be notified in writing at the time the submittal is transmitted of deviations from the requirements of the contract documents. The Contractor is responsible for correcting deviations from the contract documents even though the District Representative has reviewed the submittal, unless the deviations are clearly described in writing in the submittal transmittal form.
4. The Contractor shall be responsible for distributing submittals which have been returned with the District's Representative's action to subcontractors and suppliers. Installation shall not be started until the submittal data with the "No Exceptions Taken" or "Make Corrections Noted" stamp is in the possession of the installer.
5. No changes shall be made by the Contractor in any submittal after it has been approved. The equipment or materials provided shall not deviate from the submittal documents which are stamped with the "No Exceptions Taken" or "Make Corrections Noted" stamp in any way except with written approval by the District Representative.
6. The Contractor shall certify on each submittal document that the submittal has been reviewed, field conditions have been verified and contract documents have been complied with.
7. The Contractor may authorize a material or equipment supplier to deal directly with the District Representative with regard to such submittals; however, ultimate responsibility for the accuracy and completeness of the information contained in the submittal shall remain with the Contractor.

#### H. REQUESTS FOR SUBSTITUTION:

1. The Contractor may offer to substitute material or equipment if permitted by the technical specifications. The District will consider offers for substitution only from the Contractor unless the substitution/or equal submission is made pre-bid as described in the GENERAL CONDITIONS Section (00 72 00). Post-bid the

District will not acknowledge or consider such offers from suppliers, distributors, manufacturers, or subcontractors.

2. The Contractor's offers of substitution shall be made in writing to the District Representative in ample time to permit review without delaying the work. Until and unless such substitutions are approved by the District Representative, no deviations from the specifications shall be allowed. Time extensions will not be granted for requests for substitution which are subsequently denied by the District Representative. Time extensions will not be granted for substitutions which are not submitted in a timely manner. Any request for substitutions shall include sufficient data to enable the District Representative to assess the acceptability of the material or equipment for the particular application and requirements.
3. The Contractor shall submit a brief description of the proposed substitution prior to preparing a detailed submittal. The brief description shall be submitted on a Request for Substitution/Construction Incentive Change Proposal (CICP) form. Within 15 working days, the District Representative will review the proposal in concept and respond. If the District Representative accepts the concept of the substitution, the Contractor may prepare a detailed submittal conforming to the requirements of this section.
4. Any cost differential associated with a request for substitution must be negotiated with the District Representative. These costs or savings must be covered by a change order which modifies the contract documents.

I. DRAWINGS FOR MODIFIED PANELS AND OTHER CONTROL SYSTEM COMPONENTS:

1. GENERAL: Where work is in existing panels, or otherwise interfaces with existing control system components, the Contractor shall prepare new connection, interconnection, loop elementary, CSA schematic and other drawings as necessary in CAD format to show all work and shall provide required submittals. If existing drawings are available in CAD format, the District will provide CAD copies of existing drawings within 14 days of receipt of a written request, except that no more than 75 drawings per week will be provided by the District. The written request must include the drawing numbers of the drawings requested, request date, requestor's name, and any other necessary information.
2. FORMAT: Contractor's submittals of modified District provided drawings shall clearly delineate new work as shown in the Example Wiring Diagrams. New items shall be drawn with lines thicker than the existing lines, deletions shall be made by removing the item from the drawing (cross outs are not acceptable). All new work shall be outlined with a "cloud" of connected half circles. Clouds shall be drawn in pencil on the back of the drawings so that they may be easily erased by the District in the future. Entries shall be made in the revision blocks giving the date and a brief description of the revisions.

3. SIGNAL CIRCUITS: Modifications to all existing signal circuits shall be shown on existing loop drawings.
4. EQUIPMENT: For all equipment requiring modifications to existing control circuits and/or power circuits feeding the equipment, modifications shall be shown on existing interconnection drawings.
5. ACC PANELS: Modifications to existing ACC control panels shall be shown on existing panel layout drawings, connection diagrams, and CSA schematics.
6. OTHER PANELS: Modifications to all panels except ACC control panels shall be shown on existing panel layout drawings and connection diagrams.

### **3.02 PROPRIETARY INFORMATION**

- A. All of the information required herein shall be provided even though it may be considered to be proprietary. If any of the information required herein is considered to be proprietary, the District's standard proprietary agreement as found in the PROPRIETARY INFORMATION AGREEMENT Section (00 62 05) shall be executed between the District and the Contractor, prior to contract award, stipulating that all such information will be supplied by the Contractor and kept confidential by the District.
- B. Not more than 90 percent of all work shall be paid for until all proprietary information has been submitted and approved. Proprietary information shall describe the final as-built work. No part of the work covered by the proprietary agreement shall be modified after proprietary submittal acceptance until after updated proprietary information has been submitted by the Contractor and accepted by the District. Updated proprietary information shall fully document all modifications to be implemented. All proprietary data shall be marked "PROPRIETARY" by the Contractor.

### **3.03 MANAGEMENT OF THE SUBMITTAL PROCESS**

- A. The Contractor shall develop with assistance of the District Representative and Design Engineer a comprehensive management plan for all submittals required for the project. The intent of the management plan shall be to provide an orderly and timely process for the submission and review of submittals. The submittal management plan shall be developed and implemented within 60 days following Notice to Proceed. The submittal management plan shall incorporate the following elements:
  1. The Contractor shall submit a list of submittals which require review within the first 120 days of the project, within 10 days following the Notice to Proceed.
  2. The Contractor shall develop a comprehensive Master Submittal List of all specified submittals. The list shall be serially numbered in accordance with the appropriate specification section. The list shall be developed and submitted to the

District Representative for review within 21 days following the Notice to Proceed. The District Representative will conduct a meeting to review the Master Submittal List with the Contractor within 3 working days following receipt of the list.

3. The Contractor shall develop a schedule for the submission and review of all specified submittals for the project. The schedule shall be developed in accordance with the CONSTRUCTION PROGRESS SCHEDULE Section (01 32 16). The schedule shall include individual activities for submission and review (and fabrication and delivery for equipment and material) for each submittal. The submittal schedule shall be a separate subnet of the master CPM construction schedule with each submittal activity linked to the appropriate construction activity. Every projected submittal shall be listed and incorporated into the schedule.
  4. The Contractor shall meet at least once per month with the District Representative to review the status of all submittals. In addition, the Contractor shall develop and transmit monthly, a written list of the submittals which require review within the following 90 days. The list of projected submittals shall include the estimated date of submission for each submittal and a reference Master Submittal List for each item to be included in the submittal.
- B. This section shall not supersede or modify any specific requirements for submittals or the submittal process described elsewhere in these specifications, but shall be a supplement to the existing requirements.

**\*\*END OF SECTION\*\***

## **SECTION 01 57 19**

### **TEMPORARY ENVIRONMENTAL CONTROLS**

#### **PART 1 -- GENERAL**

##### **1.01 HOUSEKEEPING**

- A. Throughout the construction period, Contractor shall keep the site of the work in a presentable condition, shall dispose of any surplus materials appropriately, clean out all drainage ditches and structures, and repair any fences or other property damaged during the progress of the work, to the satisfaction of the District Representative.
- B. Upon completion of the work, and prior to requesting final inspection, Contractor shall thoroughly clean the site of the work of all rubbish, excess material, and equipment, and all portions of the work shall be left in a neat and orderly condition. The final inspection will not be made until this has been accomplished.

##### **1.02 TEMPORARY DAMS**

- A. Except in time of emergency, earth dams are not acceptable at catch basin openings, local depressions, or elsewhere. Temporary dams of sand bags, asphaltic concrete, or other acceptable material will be permitted when necessary to protect the work, provided their use does not create a hazard or nuisance to the public. Such dams shall be removed from the site as soon as they are no longer necessary.

##### **1.03 AIR POLLUTION CONTROL**

- A. Contractor shall comply with all air pollution control rules, regulations, ordinances, and statutes which apply to any work performed pursuant to the contract, including any air pollution control rules, regulations, ordinances, and statutes, specified in Section 11017 of the Government Code.

##### **1.04 SOUND CONTROL REQUIREMENTS**

- A. Contractor shall comply with all local sound control and noise level rules, regulations, and ordinances which apply to any work performed pursuant to the contract.
- B. Each internal combustion engine shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated without said muffler.
- C. No internal combustion engine shall be operated in the tunnel system or enclosed below grade spaces or HVAC air intakes.

## **1.05 WATER POLLUTION AND SOIL CONTAMINATION**

- A. Contractor shall comply with all federal state, and local rules, regulations, ordinances, and statutes which apply to water pollution and soil contamination, including the TEMPORARY STORM WATER POLLUTION CONTROL Section (01 57 23).
- B. In order to minimize the possibility of water or soil contamination due to spills of crankcase oil, gasoline and other fuels, Contractor shall designate an area for the storage and handling of lubricants, fuels and other supplies which is acceptable to the District Representative.

## **1.06 HAZARDOUS MATERIALS**

- A. Contractor shall comply with all applicable federal environmental regulations by the U.S. Environmental Protection Agency (US EPA), United States Department of Transportation (US DOT), Occupational Safety and Health Administration (OSHA), the Resource Conservation and Recovery Act (RCRA), state environmental regulations and local environmental regulations and ordinances for hazardous waste/materials management.
- B. Contractor shall develop and submit a Hazardous Material Plan (HMP) for hazardous materials anticipated during the project to the regulating authority (Sacramento County's Environmental Management Department has been designated as the Sacramento region's Certified Unified Program Agency (CUPA) by Cal EPA). A HMP is mandated when hazardous material/waste is stored in the reportable quantities:
  - 1. Liquid: 55 gallons or greater
  - 2. Solid: 500 pounds or greater
  - 3. Gas: 200 cubic feet (at standard temperature and pressure) or greater

Note: A reportable quantity is the aggregate of all similar materials and accounts for the capacity to store. Example: 15 gallons of a hazardous waste stored in a 55 gallon container must be reported. The District will require any material meeting or exceeding the reportable quantity to be reported.
- C. Contractors shall obtain a permit from Cosumnes Fire Department (Administration Section) for tanks that contain hazardous materials greater than 125 gallons that will be stored on District property. The Cosumnes Fire Department has permit requirements for the following hazardous materials and tanks:
  - 1. Above-ground flammable/combustible liquid tank/cylinders; and
  - 2. Above-ground hazardous material tank(s).
- D. Contractor is required to secure all required regulatory permits and licenses necessary prior to performing all aspects of the work in accordance with the PERMIT REQUIREMENTS Section (01 41 26). A copy of the HMP, HMP amendments,

permits, licenses, clearances or authorizations obtained by the Contractor shall be provided to the District Representative prior to bringing or storing hazardous materials on site.

- E. Contractor shall be responsible for ensuring that Contractor personnel including subcontractors are adequately trained and understand how to handle, store, transport and dispose of waste per this specification. Contractor shall further ensure that personnel involved in the work area are aware of the spill prevention and containment responsibilities.
- F. Contractor shall comply with all Federal and State laws for employee right-to-know in association with the use and storage of hazardous substances on-site. Contractor to have on the project site the Material Safety Data Sheets (MSDS)/Safety Data Sheets for all hazardous substances stored or used on-site, readily available to employees and inspectors at all times. Contractor is responsible for the removal and disposition of all surplus chemicals (e.g., paints, lubricants, and cleaning products) that they bring onsite as part of the work.
- G. Contractor shall provide immediate notice to the District Representative in the event of a spill. Any release or threatened release on land or in watercourses, regardless of quantity, shall be cleaned up immediately.
- H. The Contractor shall furnish certified copies of manifests (interim storage and final disposal) within regulatory requirements. Within 180 days from the acceptance of the waste by the disposal facility, the Contractor shall provide the District Representative with the Certificate of Disposal documentation.
- I. Only Contractors licensed to transport hazardous materials/waste (under EPA and US DOT) shall be permitted to transport hazardous materials/waste. Transportation of hazardous material shall be conducted in accordance with all applicable regulations for proper packaging, marking/labeling, handling, and documenting. Contractors are responsible for ensuring that personnel preparing the shipment are properly trained and that proper shipping papers accompany shipments of hazardous materials.
- J. Contractor shall be responsible and fully bear costs incurred by the District as a result of violations with applicable Federal, State and local Agencies for spills, unauthorized releases, and discharge, including but not limited to penalties assessed or levied, third party claims, citizen suites, labor materials, laboratory analyses, and handling and disposal of waste. Fines shall be deducted from contract payments specified in the PROGRESS PAYMENT PROCEDURES Section (01 29 76).

#### **1.07 PETROLEUM POLLUTION PREVENTION**

- A. Contractor shall comply with petroleum pollution prevention measures in accordance with the United States Environmental Protection Agency regulations contained in Title 40, Code of Federal Regulations, Part 112, the California Aboveground Petroleum Storage Act (APSA), and the California Health and Safety Code (Section 25270.4.5).

Additionally, all fuel stored on site shall be stored in compliance with the Uniform Fire Code, NFPA standards, and all other applicable laws.

- B. If above-ground fuel storage will exceed 55 gallons per container or 1,320 gallons aggregate, Contractor shall develop and submit a Spill Prevention, Control, and Countermeasure (SPCC) Plan as required by 40 CFR 112 Oil Pollution Prevention. The SPCC plan requirement is in addition to the requirements specified in the TEMPORARY STORM WATER POLLUTION CONTROL Section (01 57 23).
- C. The SPCC plan shall be prepared and certified by a registered Professional Engineer. Maintain a certified copy of the SPCC plan on-site at all times during construction activities that is readily available to Contractor personnel, inspectors, and regulators. A copy of the SPCC and all amendments shall be submitted to the District Representative for review.

**\*\*END OF SECTION\*\***



## SECTION 01 57 23

### TEMPORARY STORM WATER POLLUTION CONTROL

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

- A. This section specifies the requirements for Stormwater Pollution Prevention which includes a Water Pollution Control Plan (WPCP) for a project resulting in less than one acre of soil disturbance, any size project fully within the Sacramento Regional Wastewater Treatment Plant (SRWTP) process area, or any project that is not otherwise subject to the requirements of the State Water Resources Control Board (SWRCB), Water Quality Order No. 2009-009-DWQ, National Pollutant Discharge Elimination System (NPDES), General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Storm Water Runoff Associated with Construction Activity (Construction General Permit) to control storm water discharges from construction sites.
- B. Contractor may opt to implement a more restrictive program than that which is required. The Contractor must then conform to all requirements of both the minimum applicable program and the more restrictive program.
- C. Contractor shall implement Best Management Practices (BMPs) including good housekeeping practices and erosion and sediment control, to prevent the direct and indirect contribution of any contaminants into the storm drain system or waters of the United States.
- D. BMPs shall be implemented according to the California Stormwater BMP Handbook – Construction (2009) with updated 2011 BMP fact sheets. Non-structural and structural BMPs shall be acceptable to the District Representative and instituted or placed, as appropriate, before commencement of each phase of clearing, grading, excavation, trenching, or staging of materials that may be potential pollutants.
- E. Furnish all labor, materials, equipment, and incidentals necessary to perform all installation, maintenance, removal, and area cleanup related to erosion and sediment control BMPs necessary to prevent the movement of sediment from the construction site to off-site areas including roadways, surface waters, storm drains, disposal locations, and flood control facilities.
- F. Contractor shall be responsible and fully bear costs incurred by the District as a result of violations under the Federal Clean Water Act, the State Porter-Cologne Water Quality Control Act, or for unauthorized release or discharge from the work including but not limited to penalties assessed or levied, third party claims, citizen suits, labor, materials,

analytical analyses, and handling of waste. Fines shall be deducted from contract payments specified in the PROGRESS PAYMENT PROCEDURES Section (01 29 76).

## 1.02 REFERENCES

- A. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of the referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall govern.

<u>Reference</u>	<u>Title</u>
California Stormwater Quality Association (CASQA)	California Stormwater BMP Handbook – Construction

## 1.03 SUBMITTALS

- A. The following information shall be submitted for review and approval in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviation.
  2. The Contractor shall designate a Storm Water Pollution Prevention Coordinator. This person shall have previous experience in erosion and sediment control with similar type and size projects and shall submit a resume to the District Representative for approval. This person will be responsible for preparing and implementing the WPCP.
  3. The WPCP shall be submitted to the District within 10 days of the NTP and prior to the commencement of the Work.
  4. Completed inspection and maintenance reports within 3 working days of preparation.
  5. Upon completion of the project, submit the complete WPCP and relevant documents and amendments to the District Representative.

## **PART 2 -- PRODUCTS (NOT USED)**

## **PART 3 -- EXECUTION**

### **3.01 GENERAL**

- A. The Contractor shall assume responsibility for stormwater runoff management and erosion and sediment control at the project site during construction. Fully comply with all applicable state and local regulations, and requirements related to stormwater management, erosion and sediment control.
- B. Prior to commencement of any land disturbing activity, the contractor shall submit the WPCP to the District Representative. No activity having the potential to cause water pollution, as determined by the District Representative, shall be performed until the District Representative has approved the WPCP and appropriate BMPs have been installed by the Contractor.

### **3.02 WATER POLLUTION CONTROL PLAN**

- A. Develop a Water Pollution Control Plan (WPCP) to identify potential pollutants associated with each phase of construction activity and non-structural and structural BMPs appropriate to each phase of the work. The WPCP shall detail the following, if applicable:
  - Schedule
  - Location of soil stockpiles
  - Location of solid waste containers
  - Vehicle and equipment fueling, servicing, cleaning and storage areas
  - Material storage areas
  - Chemicals, potential pollutants and hazardous materials to be used and methods for safekeeping
  - Site drainage during execution of the Work
  - Stabilization of vehicle access to site
  - De-watering operations
  - Methods for spill prevention and control
  - Secondary containment

- Handling and disposal of solid waste
  - Storage and dispensing of fuel and lubricants
  - Clean out and disposal of ready mix concrete
  - Sanitation provisions
  - Disposal location for excess excavated material
  - Haul Routes
- B. The WPCP shall include BMPs to prevent an unauthorized release or discharge of pollutants, contaminants, chemicals, hazardous substances or materials. The BMPs will be described in both narrative form and proper placement illustrated on figures.
- C. Maintain one copy of the WPCP and amendments at the project site. The WPCP shall be made available upon request by a representative of the Regional Water Quality Control Board (RWQCB), State Water Resources Control Board (SWRCB), United States Environmental Protection Agency (USEPA), or the local stormwater management agency. Requests by the public shall be directed to the District Representative. At completion of construction, submit the complete WPCP, amendments, inspection and maintenance records, and any other relevant documents to the District's Representative.

### **3.03 INSPECTIONS AND MAINTENANCE**

- A. Make a visual inspection of all BMPs as necessary to ensure proper operation but not less than once per week. For rain events predicted at a 50 percent (50%) chance or higher (as reported [at www.srh.noaa.gov](http://www.srh.noaa.gov)), inspections are to be conducted within 48 hours before. For rain events measuring 0.50 inches or greater (as reported at [www.srh.noaa.gov](http://www.srh.noaa.gov)), inspections are to be conducted at least every 48 hours during and within 48 hours after. If such inspection reveals that existing measures are damaged or that additional measures are needed to prevent movement of sediment to off-site areas, promptly repair, replace or install additional devices as needed within 24 hours of notification. Sediment controls in need of maintenance shall be repaired within 24 hours of notification.
- B. Maintenance of BMPs shall be per the Construction BMP Handbook. Perform routine maintenance consisting of debris removal, silt/sediment removal, clearing of vegetation around flow control devices to prevent clogging, and maintenance of healthy vegetative cover.
- C. The Contractor shall be responsible for preparing and maintaining inspection and maintenance records. Inspection and maintenance reports are to be submitted to the District Representative within 3 working days.

### **3.04 DISPOSAL OF EXCESS EXCAVATED MATERIAL**

- A. Excess excavated material is defined as material from onsite excavations that are beyond the volumes necessary to meet the finish grades shown on the Contract Documents.
- B. The Contractor shall be responsible for the disposal of excess excavated material. The Contractor shall be responsible for hauling excess excavated material offsite in accordance with laws and regulations regarding disposal of such material.

### **3.05 NOTIFICATION AND REPORTING**

- A. The Contractor is responsible for identifying and bringing to the attention of the District's Representative all activities that may result in a non-stormwater discharge prior to commencing with such work. Any uncontrolled non-stormwater discharge shall be reported to the District Representative immediately.

### **3.06 REMOVAL AND FINAL CLEANUP**

- A. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner.
- B. Provide post-construction erosion controls, including soil stabilization, in accordance with the Contract Documents. Materials subject to degradability shall have a minimal functional longevity of 12-months.

**\*\*END OF SECTION\*\***

**NOTES TO SPECIFIER:**

This Stormwater Pollution Prevention Specification Section has been developed to address stormwater requirements for all projects not subject to the General Stormwater Permit. A Water Pollution Control Plan (WPCP) will be required for project with the following conditions:

- Any project fully located within the SRWTP process area; or
- Any project located outside the SRWTP process area boundary which disturbs one acre or less of soil during construction, including the construction laydown area, and parking.

The specifier is to coordinate the WPCP requirements with Section 00 41 00 – Bid Forms. A line item shall be inserted to for the line cost (Lump Sum) to prepare and maintain the WPCP.

## **SECTION 03 30 00**

### **CAST-IN-PLACE CONCRETE**

#### **PART 1 -- GENERAL**

##### **1.01 GENERAL REQUIREMENTS**

###### **A. SCOPE:**

1. This section specifies cast-in-place concrete produced at a ready-mixed plant and truck-mixed or produced on-site which consists of furnishing all material, mixing and transporting equipment, and performing all labor for the proportioning, mixing, transporting, placing, consolidating, finishing and curing of concrete.

###### **B. QUALITY ASSURANCE:**

###### **1. QUALITY CONTROL BY DISTRICT:**

- a. Special Inspection of concrete work shall be performed by the Special Inspector under contract with the District and in conformance with the CBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the District in their sole discretion. Special Inspection of concrete is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.
- b. All structural concrete work shall receive Special Inspection in accordance with CBC Chapter 17. Structural concrete includes all elements which resist code-defined loads and whose failure would impact life safety. Non-structural site work concrete does not require Special Inspection. Anchor bolts and anchors installed in hardened concrete require Special Inspection.
- c. District provided testing shall be in accordance with the QUALITY CONTROL Section (01 45 00).

###### **2. QUALITY CONTROL BY CONTRACTOR:**

- a. Where required to demonstrate conformance with the specified requirements for cast-in-place concrete, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test concrete materials as specified in paragraphs 2.01-B, 2.03-C, and 3.09-A of this specification section. Costs of testing laboratory services shall be borne by the Contractor.

3. BASIS FOR QUALITY:

- a. Cast-in-place concrete shall conform to the requirements of ACI 301, except as modified herein.

**1.02 REFERENCES**

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

AMERICAN CONCRETE INSTITUTE (ACI):

<b>REFEREN CE</b>	<b>TITLE</b>
<b>211.1</b>	<b>PRACTICE FOR SELECTING PROPORTIONS FOR NORMAL, HEAVYWEIGHT, AND MASS CONCRETE</b>
<b>301</b>	<b>STRUCTURAL CONCRETE FOR BUILDINGS</b>
<b>304</b>	<b>GUIDE FOR MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE</b>
<b>305.1</b>	<b>HOT WEATHER CONCRETING</b>
<b>306.1</b>	<b>COLD WEATHER CONCRETING</b>
<b>309</b>	<b>GUIDE FOR CONSOLIDATION OF CONCRETE</b>
<b>318</b>	<b>BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE</b>
<b>350</b>	<b>CODE REQUIREMENTS FOR ENVIRONMENTAL DISTRICTING CONCRETE STRUCTURES</b>
<b>350.1</b>	<b>TIGHTNESS TESTING OF ENVIRONMENTAL DISTRICTING CONCRETE STRUCTURES</b>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO):



<b>REFEREN CE</b>	<b>TITLE</b>
<b>M251</b>	<b>PLAIN AND LAMINATED ELASTOMERIC BRIDGE BEARINGS</b>
<b>T210</b>	<b>METHOD OF TEST FOR AGGREGATE DURABILITY INDEX</b>

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

<b>REFEREN CE</b>	<b>TITLE</b>
<b>C31</b>	<b>PRACTICE FOR MAKING AND CURING CONCRETE TEST SPECIMENS IN THE FIELD</b>
<b>C33</b>	<b>CONCRETE AGGREGATES</b>
<b>C39</b>	<b>TEST METHOD FOR COMPRESSIVE STRENGTH OF CYLINDRICAL CONCRETE SPECIMENS</b>
<b>C42</b>	<b>TEST METHOD FOR OBTAINING AND TESTING DRILLED CORES AND SAWED BEAMS OF CONCRETE</b>
<b>C88</b>	<b>TEST METHOD FOR SOUNDNESS OF AGGREGATES BY USE OF SODIUM SULFATE OR MAGNESIUM SULFATE</b>
<b>C94</b>	<b>READY-MIXED CONCRETE</b>
<b>C117</b>	<b>TEST METHOD FOR MATERIALS FINER THAN 75-MICROMETER (NO. 200) SIEVE IN MINERAL AGGREGATES BY WASHING</b>
<b>C131</b>	<b>TEST METHOD FOR RESISTANCE TO DEGRADATION OF SMALL SIZE COARSE AGGREGATE BY ABRASION AND IMPACT IN THE LOS ANGELES MACHINE</b>
<b>C136</b>	<b>METHOD FOR SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES</b>
<b>C142</b>	<b>TEST METHOD FOR CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES</b>
<b>C143</b>	<b>TEST METHOD FOR SLUMP OF HYDRAULIC CEMENT CONCRETE</b>
<b>C150</b>	<b>PORTLAND CEMENT</b>
<b>C156</b>	<b>WATER RETENTION BY CONCRETE CURING MATERIALS</b>
<b>C157</b>	<b>TEST METHOD FOR LENGTH CHANGE OF HARDENED HYDRAULIC CEMENT MORTAR AND CONCRETE</b>
<b>C172</b>	<b>PRACTICE FOR SAMPLING FRESHLY MIXED CONCRETE</b>
<b>C192</b>	<b>MAKING AND CURING CONCRETE TEST SPECIMENS IN THE LABORATORY</b>

<b>REFEREN CE</b>	<b>TITLE</b>
<b>C231</b>	<b>TEST METHOD FOR AIR CONTENT OF FRESHLY MIXED CONCRETE BY THE PRESSURE METHOD</b>
<b>C260</b>	<b>AIR ENTRAINING ADMIXTURES FOR CONCRETE</b>
<b>C289</b>	<b>TEST METHOD FOR POTENTIAL REACTIVITY OF AGGREGATES (CHEMICAL METHOD)</b>
<b>C309</b>	<b>LIQUID MEMBRANE FORMING COMPOUNDS FOR CURING CONCRETE</b>
<b>C494</b>	<b>CHEMICAL ADMIXTURES FOR CONCRETE</b>
<b>C595</b>	<b>BLENDED HYDRAULIC CEMENTS</b>
<b>C618</b>	<b>FLY ASH AND RAW OR CALCINED NATURAL POZZOLAN FOR USE AS A MINERAL ADMIXTURE IN PORTLAND CEMENT CONCRETE</b>
<b>C989</b>	<b>SLAG CEMENT FOR USE IN CONCRETE AND MORTARS</b>
<b>C1240</b>	<b>SILICA FUME USED IN CEMENTITIOUS MIXTURES</b>
<b>D75</b>	<b>PRACTICE FOR SAMPLING AGGREGATES</b>
<b>D2419</b>	<b>TEST METHOD FOR SAND EQUIVALENT VALUE OF SOILS AND FINE AGGREGATE</b>

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION  
(CALTRANS):

<b>REFEREN CE</b>	<b>TITLE</b>
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**STANDARD SPECIFICATIONS**

ARMY CORPS OF ENGINEERS SPECIFICATION:

**REFEREN    TITLE**  
**CE**

**CRD-C572    WATERSTOPS**

FEDERAL SPECIFICATIONS

**REFEREN    TITLE**  
**CE**

**FEDSPEC    BUILDING PAPER, VEGETABLE FIBER (KRAFT,**  
**UU-B-790A    WATERPROOFED, WATER REPELLENT, AND FIRE**  
**RESISTANT)**

B. DEFINITIONS: (Not Used)

### **1.03 SUBMITTALS**

A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):

1. A copy of this specification section, with addenda updates, with each paragraph check-marked to show specification compliance or marked to show deviations.
2. Each proposed mix design showing:
  - a. The expected strength at 28 days,
  - b. Corresponding slump before and after the introduction of high-range water-reducing admixtures,
  - c. Water/cement ratios,
  - d. Weights and test results of the ingredients,
  - e. Aggregate gradation,
  - f. Test results of mix design prepared by an independent testing laboratory, and
  - g. Other physical properties necessary to review each mix design for conformance with these specifications.
  - h. If a special mix design is being used to combat chloride ions in the environment, including but not limited to the use of a corrosion inhibitor admixture, submit a letter that describes the anticipated time to initiation of corrosion of concrete-embedded metal based on the mix design, concrete clear cover, and chloride

concentration in the environment. The report is to be written by a professional corrosion engineer licensed in the state of California, an NACE International certified corrosion specialist, or an NACE International certified cathodic protection specialist.

3. Test results from concrete mix trial batch testing.
4. Product literature and technical data for aggregates, cement and pozzolan.
5. Manufacturer's product data and installation instructions for:
  - a. Bonding compounds
  - b. Retardants
  - c. Surface hardener
  - d. Curing compounds
  - e. Evaporation reducer
  - f. Shrinkage reducing admixtures
  - g. Corrosion inhibitors
6. Procedures for hot and cold weather placement and curing methods.
7. Samples of concrete panels when indicated herein.

#### **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

### **PART 2 -- PRODUCTS**

#### **2.01 MATERIALS**

##### **A. CEMENT:**

1. Portland cement shall be ASTM C150, Type II (general use).
2. Type V, (high sulfate resistance) low alkali, containing less than 0.60 percent by weight of alkalis.
3. Dual rated Type II/V.
4. Portland pozzolan cement shall be ASTM C595, Type IP(MS), interground, low alkali.

##### **B. AGGREGATES:**

1. GENERAL:

- a. Except as modified herein, fine and coarse aggregates shall conform to ASTM C33.
- b. Fine and coarse aggregates shall be regarded as separate ingredients. Aggregates shall be nonreactive and shall be washed before use.
- c. Make tests for size and grading of the fine and coarse aggregates in accordance with ASTM C136.
- d. Keep fine and coarse aggregates separate prior to their admission into the concrete mixer, and clean and free from foreign substances. Use methods in piling and handling of aggregates such as to prevent the segregation of the several sizes of particles.
- e. When aggregates which are satisfactory to the District have been selected, secure the entire supply of each material from the same source so as to maintain the same quality and grading throughout the work. Should it become necessary to change the source or characteristic of the materials used, this will only be done as additional proportioning and other tests have been completed for the new materials, and subject to such safeguards as the District may impose for the maintenance of the quality of the aggregate herein specified.
- f. The tests specified shall be performed prior to commencing concrete work.

2. FINE AGGREGATE:

- a. Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof.
- b. Gradation of fine aggregate shall conform to ASTM C33 when tested in accordance with ASTM C136.
- c. Fine aggregate shall not exceed 40 percent or 43 percent for pumping by weight of combined aggregate total, except for concrete with coarse aggregate of less than maximum size 1/2 inch.

- d. Other tests shall be in accordance with Table A:

**TABLE A**

<b>TEST</b>	<b>TEST METHOD</b>	<b>REQUIREMENTS</b>
<b>AMOUNT OF MATERIAL PASSING NO. 200 SIEVE</b>	<b>ASTM C117</b>	<b>3 PERCENT MAXIMUM BY WEIGHT</b>
<b>REACTIVITY WITH ALKALIES IN CEMENT</b>	<b>ASTM C289</b>	<b>INNOCUOUS</b>
<b>SAND EQUIVALENT</b>	<b>ASTM D2419</b>	<b>MINIMUM 75</b>

3. COARSE AGGREGATE:

- a. Coarse aggregate shall be hard, dense and durable gravel or crushed rock free from injurious amounts of soft and friable particles, alkali, and organic matter. Other deleterious substances shall not exceed the limits listed in ASTM C33, Table 3.
- b. Use coarse aggregate for concrete classes specified herein that shall be well graded between the limits as described in ASTM C33, Table 2, unless otherwise specified. During progress of the work, variations from the specified gradations will be acceptable in individual tests if the average of three consecutive tests is within the specified limits.
- c. Other tests shall be in accordance with Table B:

Table B

<b>Test</b>	<b>Test Method</b>	<b>Requirements</b>
Durability index	AASHTO T210	Minimum 75
Soundness maximum loss	ASTM C88	10 percent with sodium sulfate
Amount of material passing No. 200 sieve	ASTM C117	1.0 percent maximum by weight
Abrasion	ASTM C131	35 percent maximum loss after 500 revolutions in a Los Angeles Abrasion Machine

Table B

<b>Test</b>	<b>Test Method</b>	<b>Requirements</b>
Clay lumps and friable particles	ASTM C142	1.5 percent maximum by weight
Reactivity	ASTM C289	Innocuous



#### C. POZZOLAN:

1. Pozzolan shall be Class N, natural pozzolan, or Class F, fly ash, conforming to ASTM C618. Fly ash pozzolan shall contain less than 1 percent by weight carbon and less than 3 percent by weight sulfur trioxide. Pozzolan supplied during the life of the project shall have been formed at the same single source, manufacturer and quarry. The pozzolan color shall not substantially alter the resulting concrete from the normal gray color and appearance.
2. If specified, pozzolan shall be silica fume conforming to the requirements of ASTM C 1240. Silica fume may be added up to a maximum of 12 percent by weight of minimum quantities of Portland cement. A high-range water-reducing admixture shall be used to maintain the water-cement ratio

#### D. ADMIXTURES:

1. **GENERAL:** Admixtures shall be compatible with the concrete. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix.
2. **WATER REDUCING RETARDER:** Water reducing retarder shall be ASTM C494, Type D, and shall be BASF, Pozzolith 322-N; Sika Chemical Corp., Plastocrete 161; or equal.
  - a. The water reducing retarder shall reduce the water required at least 8 percent for a given concrete consistency and shall comply with the water/cement ratio standards of ACI 211.1.
3. **HIGH RANGE WATER REDUCING ADMIXTURES:** High range water reducing (superplasticizing) admixtures shall conform to ASTM C494, Type F. Acceptable products include: BASF "Glenium 3000NS"; Sika Chemical Corp. "Sikament FF or 686"; Euclid Chemical Co. "Eucon 37"; W.R. Grace "ADVA 195"; or equal.
4. **HIGH RANGE WATER REDUCING AND RETARDING ADMIXTURES:** High range water reducing and retarding admixtures shall conform to ASTM C494, Type G. Acceptable products include: W.R. Grace "Daracem 100"; Euclid Chemical Co. "Eucon 537"; or equal.
5. **AIR ENTRAINING AGENT:** Air entraining agent shall be BASF, MB-AE90; or equal. For concrete that will not be treated with surface hardener, the air entraining agent added shall produce an entrained air content between 3 and 5 percent, in accordance with ASTM C260. Entrained air shall be less than or equal to 3 percent where surface hardener is required.
6. **WATER REDUCING ACCELERATOR:** Not permitted.

7. SHRINKAGE REDUCING ADMIXTURE: Select shrinkage reducing admixture for compatibility with air entrainment admixture and other ingredients of the concrete mix. Acceptable products include: BASF “Tetraguard AS20” and Grace “Eclipse 4500”.
8. GROUND GRANULATED BLAST-FURNACE SLAG (GGBFS) ADMIXTURE: GGBFS shall conform to requirements of ASTM C 989, Grade 100 or 120. GGBFS may replace Portland cement at a ratio of 1.0 pound GGBFS for each pound of Portland cement replaced. A maximum of 70 percent by weight of cement may be replaced with GGBFS.
9. CALCIUM NITRATE CORROSION INHIBITOR ADMIXTURE: Calcium nitrate based corrosion inhibitor shall contain 30 percent, plus or minus 2 percent, calcium nitrate by weight. Calcium nitrate based corrosion inhibitor shall be added at a rate of 1.0 to 6.0 gallons per cubic yard of concrete to achieve the desired level of corrosion mitigation. Calcium nitrate based corrosion inhibitor shall be Master Builders/BASF Rheocrete CN1, Grace Construction Products DC1, or equal.

E. WATER:

1. Water for washing aggregate, mixing, wetting forms, and curing shall be clean potable water free from injurious amounts of oil, alkalies, organic materials and other deleterious substances.

## 2.02 CONCRETE PRODUCED ON-SITE

A. DELIVERY AND STORAGE

1. CEMENT:

Cement shall be stored immediately upon receipt. Cement in bags shall be stored in a weatherproof structure which shall be as airtight as practicable. Floors shall be elevated above the ground a distance sufficient to prevent the absorption of moisture. Bags shall be stacked close together to reduce circulation of air but shall not be stacked against outside walls. The manner of storage shall permit easy access for inspection and identification of each shipment.

Bulk cement shall be transferred to elevated airtight and weatherproof bins. At the time of use, cement shall be free flowing and free of lumps. Cement which has been in storage longer than 6 months shall not be used.

2. AGGREGATES:

Aggregates shall be stored on areas covered with tightly laid wood planks, sheet metal, or other hard and clean surfaces in a manner that will prevent the inclusion of foreign material. Aggregates of different sizes shall be stored in separate piles. Stock piles of coarse aggregate shall be built in horizontal layers exceeding 4 feet in depth to minimize segregation. Segregated aggregates shall be remixed to conform to the grading requirements.

### 3. ADMIXTURES:

Admixtures shall be stored in such a manner that they will not be damaged in the containers. Air-entraining admixtures which have been in storage for longer than 6 months or which have been subjected to freezing shall not be used.

### 4. POZZOLAN:

Pozzolan shall be delivered and stored in the same manner as cement."

## 2.03 CONCRETE CHARACTERISTICS

### A. MIX PROPORTIONING:

1. An approved laboratory shall design all mixes. Comply with ACI 211.1 and ACI 304R to produce plastic, workable mixture suitable for concrete work indicated, which will develop required compressive strengths indicated.
2. Normal weight concrete shall be composed of specified cement, pozzolan, admixtures, aggregates and water proportioned and mixed to produce a workable, strong, dense, and impermeable concrete. The Contractor may substitute interground portland-pozzolan cement conforming to ASTM C595, containing the specified amount of pozzolan in lieu of portland cement and pozzolan.
3. Concrete classes shall be provided in accordance with Table C:

Table C – Concrete Classes

Concrete Class	ASTM C33 Coarse Aggregate Size Number	Nominal Size Laboratory Sieve	Minimum Cementitious Material Content (pounds/cuyd concrete)	Pozzolan, Percent by Weight of Portland Cement <sup>a</sup>	Air Entrain-ing Agent	Water Reducing Retarder	Water Reducing Accelerator	Minimum 28-day Compressive Strength <sup>b</sup>
1	57	1" x No.4	560	15-20	yes	yes	no	4500 psi
2	67	¾" x No.4	560	15-20	yes	yes	no	4500 psi
4	57	1" x No.4	420	0	yes	no	no	3000 psi
5 <sup>c</sup>	57	1" x No.4	375	15-20	yes	no	no	2000 psi

Notes for table:

<sup>1</sup> Cement can be replaced by pozzolan pound per pound, up to 15 to 20 percent of total weight.

<sup>2</sup> Compressive strength shall be determined at the end of 28 days based on test cylinders made and tested in accordance with ASTM C39. Maximum water/cement ratio shall not exceed 0.40 by weight for compressive strength of 4500 psi or higher, 0.45 for compressive strength of 3000 psi, and 0.65 for other strength concrete. Maximum water/cement ratio shall not exceed 0.38 for concrete containing high range water reducing admixtures. Water/cement ratio is based on the combined amount of cement and pozzolan.

<sup>3</sup> Concrete encasement for electrical and signal conduit shall contain 2 pounds of red oxide per sack of cement.

**B. USE:**

1. Concrete shall be provided by class for the corresponding use as listed in Table D:

Table D

<b>Type of Use</b>	<b>Class of Concrete</b>	<b>Working Slump (Inches) [+/- 1]</b>
Mass concrete Foundation footings and slabs 24 inches thick or more Piers and cussions	1	4
Foundation footings and slabs 24 inches thick or less Floor and roof slabs and beams	1 or 2	4
Walls and columns in non-liquid retaining structures	1 or 2	5
Walls and columns in liquid retaining structures	1 or 2	4
Substructure walls	1 or 2	4
Site pavement, sidewalks and curbs	4	4
Pipe encasement and electrical or signal ductbanks	5	6
Protective cover of dowels intended for future construction	5	4
Concrete fill	5	6
Concrete with high range water reducing admixtures	1 or 2	8

**C. MIX ACCEPTANCE:**

1. **GENERAL:** Before beginning concrete work, the Contractor shall determine the proper proportions of materials for each class of concrete. The mix shall consist of specified cement, pozzolan, admixtures, aggregate and water. Methods for selecting and adjusting proportions of the ingredients shall be in accordance with ACI 211.1. Verification of mix characteristics for submittal may be achieved using either the Trial Mix Design method or Field Experience method. Concrete shall not be placed in the field until the submitted mix design and trial batch mix test results, as applicable, have been accepted by the District.
2. **TRIAL MIX DESIGN**
  - a. **CLASS 1 AND 2 CONCRETE:**
    - 1) The Contractor shall submit mix designs to the District for approval. The mix design shall include:
    - 2) Concrete supplier's mix number with proportions of materials per cubic yard.

- 3) Supplier certifications for cement, pozzolan, and aggregate.
  - 4) Product data for admixtures.
- b. Upon approval of the submitted concrete mix designs, the Contractor shall make arrangements for field trial batches with the supplier and the District. The District shall be notified 1 week in advance of trial batch mix work. Trial batch mix work shall be performed with representatives of the District and Contractor's testing laboratory being present. Sampling and testing of concrete shall be done by the Contractor's testing laboratory. Certified copies of the laboratory test results shall be submitted to the District. The District reserves the right to sample and test the trial batches.
- c. The trial batches shall establish field proportions for mixes which may contain minor adjustments to the submitted mix design. Trial batches shall be tested for compressive strength and drying shrinkage.
- 1) **COMPRESSIVE STRENGTH:** Eight standard test cylinders, prepared in accordance with ASTM C31, shall be obtained from each trial batch. Slump shall be measured in accordance with ASTM C143. Cylinders shall be tested in compression in accordance with ASTM C39. Four test cylinders shall be tested at 7 days and the remaining four at 28 days. The ratio of average 7-day and 28-day strength shall be established. The average compressive strength of the four test cylinders tested at 28 days shall be equal to or greater than the required average compressive strength ( $f'_{cr}$ ) on which the mix design is based. The required average compressive strength ( $f'_{cr}$ ) shall be calculated as specified strength ( $f'_c$ ) plus 1200 psi.
  - 2) **DRYING SHRINKAGE:** Drying shrinkage specimens shall be prepared from the same trial mix concrete used for preparing compression test cylinders. From each mix, three specimens shall be prepared. The drying shrinkage specimens shall be 4 x 4 x 11 inch prisms with an effective gage length of 10 inches, prepared, cured, dried and measured in accordance with ASTM C157 and as modified herein. Specimens shall be removed from molds at an age of  $23 \pm 1$  hour after batching and shall be placed immediately in water at  $73 \pm 3$  degrees F. Expansion, expressed as a percentage of original length, shall be measured at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations. Specimens shall then be stored immediately in a humidity control room maintained at  $73 \pm 3$  degrees F and  $50 \pm 4$  percent relative humidity for the remainder of the test. Measurement, to determine the drying shrinkage, expressed as percentage of base length, shall be made and reported separately for 7, 14, 21 and 28 days of drying after 7 days of moist curing. The average drying shrinkage of each group of the test specimens after 28 days of drying shall not exceed 0.048 percent. Liquid containing structures using Class 1 or 2 concrete are intended to be watertight. When used for liquid containing structures, the

average drying shrinkage shall not exceed 0.040 percent in the laboratory at 35 days (7 days moist cure and 28 days drying) as tested by ASTM C157.

d. CLASS 4 AND 5 CONCRETE:

- 1) The Contractor shall submit mix designs to the District for approval. The mix design shall include:
    - a) Concrete supplier's mix number with concrete proportions per cubic yard
    - b) Certifications for cement, pozzolan, and aggregate
    - c) Product data for admixtures
    - d) Historical compressive strength test results for same mix number used on other projects within the last 12 calendar months. Test records shall represent materials, quality control procedures, and conditions expected to apply to this work. At least 30 consecutive tests or two groups of consecutive tests totaling at least 30 tests shall be used to establish a standard deviation and a required average compressive strength ( $f'_{cr}$ ), as described in ACI 318, Part 3, Chapter 5. The arithmetic average of at least 10 consecutive test results, not used in calculating the standard deviation, shall exceed  $f'_{cr}$ .
  - 2) If there is insufficient historical compressive strength data for the submitted mix design, then the mix design shall undergo trial batch testing as described for Class 1 and 2 concrete.
3. FIELD EXPERIENCE DATA: When sufficient test data for a particular mix design is available which is identical or substantially similar to that proposed for use, Contractor may substitute use of this data in lieu of a trial mix design. Field data, reports, and analysis shall conform to ACI 318 Section 5.3, except as modified herein. Use of historical mix design data does not allow modification of the project mix specifications herein without the express review and acceptance of the District.
- a. Historical mix design proportions for which data are submitted may vary from the specified mix within the following limits:
    - 1)  $f'_{c}$  as specified or up to 500 psi above;
    - 2) w/cm ratio as specified or lower;
    - 3) Pozzolan content within 5 percent of that specified;
    - 4) Maximum coarse aggregate size may not vary smaller, but gradation of coarse aggregate may vary;

- 5) Fine aggregate fraction within +0/ 5 percent of that specified; and
- 6) Slump after introduction of admixtures +0/-1 inch.

## **2.04 WATERSTOPS**

- A. Waterstops shall be in accordance with the WATERSTOPS Section (03 15 13).

## **2.05 JOINT SEALERS**

- A. Joint sealers shall be as specified in the JOINT SEALANTS Section (07 92 00).

## **2.06 PREFORMED JOINT FILLERS**

- A. Preformed joint fillers shall be as specified in the PREFORMED JOINT SEALS Section (07 91 00).

## **2.07 BONDING COMPOUNDS**

- A. Epoxy resin bonding compounds shall be used for wet areas.
  1. Sika Chemical Corporation, Sikadur 35 hi-mod LV, 32 hi-mod, 32 hi-mod LTL, 31 hi-mod gel as applicable; or equal by Master Builders Technologies; or equal.
- B. Nonepoxy bonding compounds shall be used for areas not classified as wet areas.
  1. Burke Acrylic Bondcrete; Imperial Chemical Industrial Inc. Thoro System Products Division, Acryl 60 or Thorobond; or equal.

## **2.08 RETARDANT**

- A. Retardant for exposing aggregates for nonformed surfaces in construction joints shall be Sika Rugasol-S, Horn Aggretex-H, or Burke True Etch Surface Retarder, or equal. Retardant shall be applied in accordance with manufacturer's instructions sufficient to assure a minimum penetration of 1/8 inch.

## **2.09 SURFACE HARDENER**

- A. Surface hardener shall be premixed, noncolored, nonmetallic, and dry shake applied.
  1. Mastercron by Master Builders Technologies; Burke Non Metallic Hardener; or equal.

## 2.10 CURING MATERIALS

### A. LIQUID MEMBRANE-FORMING COMPOUNDS:

#### 1. CURING COMPOUNDS:

a. Curing compounds shall conform to ASTM C309.

1) Burke Wax Emulsion Clear; Burke Aqua Resin Cure; W.R. Meadows Sealtight 1300-Clear; or equal.

b. Curing compound shall be of the dissipating-resin type in applications where concrete finishes (such as waterproofing, coatings and floor coverings) may require removal of curing compound prior to application of finish.

1) Burke Res X, All Resin Cure VOC; W.R. Meadows Sealtight 1100-Clear; or equal.

#### 2. CURING AND SEALING COMPOUNDS:

a. Curing and sealing compounds shall conform to ASTM C309, Type 1, and shall be suitable for interior and exterior concrete use.

b. Masterseal by Master Builders Technologies; W.R. Meadows Sealtight VOCOMP-20; or equal.

### B. SHEETING:

1. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.

#### 2. WATERPROOF PAPER AND PLASTIC:

a. Polyethylene-coated waterproof paper-sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (Int. Amd. 1). The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.

b. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C156 shall not exceed 0.055 gram per square centimeter of surface.



3. Curing rugs for use in water curing, as specified herein, shall be heavy shag rugs or carpets or cotton mats that weigh a minimum of 12 ounces per square yard when dry.

## **2.11 EVAPORATION REDUCER**

- A. Evaporation reducer shall reduce surface moisture evaporation by forming a monomolecular film when sprayed on concrete surfaces.
  1. Confilm by Master Builders Technologies; Eucobar by Euclid Chemical Co.; or equal.

## **2.12 SAMPLES OF CONCRETE FLOOR AND WALL FINISHES**

- A. A sample concrete panel, representative of the workmanship and finish required, shall be prepared. Panel dimensions shall be 2 feet by 2 feet by 3 inches thick, unless prior arrangements have been made with the District to incorporate the sample panel within the completed work. Sample concrete panels are required for the following finishes, as defined in Part 3:
  1. Smooth Rubbed Finish
  2. Grout Cleaned Finish (Sacking)
  3. Sandblast Finish
  4. Float Finish
  5. Steel Trowel Finish
  6. Broom Finish
- B. The District shall approve the sample prior to use.

## **PART 3 -- EXECUTION**

### **3.01 GENERAL**

- A. The District is defining in this part the quality of cast-in-place concrete by specifying some of the methods, techniques, sequences and procedures for construction of cast-in-place concrete. The Contractor, without relinquishing authority and responsibility for supervision and direction of the work, agrees to follow the specified methods, techniques, sequences and procedures.
- B. The District will conduct field quality assurance tests for concrete strength. The testing laboratory may be the Public Works Materials Testing Laboratory. The Contractor shall notify the District Representative at least 48 hours in advance whenever a sample and test of concrete materials is required by these specifications.

### **3.02 FORMWORK**

- A. Formwork shall conform to the CONCRETE FORMING Section (03 11 00) and as specified herein. All forms shall be sealed and watertight. The Contractor shall design and construct all formwork systems to provide only those lines and delineations indicated, unless otherwise approved by the District. Formwork, shall be constructed to allow erection in proper sequence and to permit removal without damage to the finished concrete surfaces.
- B. The Contractor shall design, construct, and erect all forms for reuse; withdraw projecting nails or other objects from contact surfaces before reusing; clean and completely recondition all forms prior to reuse; and repair any damage to forming surfaces caused during previous usage. Approval shall be required for each reuse. Formwork with patches or repairs affecting appearance of the concrete surfaces shall not be permitted. The Contractor is responsible for the strength and suitability of the formwork.
- C. Dimensional tolerances in finished concrete construction, removal of forms and supports, shoring and reshoring of multistory structures shall conform to the CONCRETE FORMING Section (03 11 00). Prior to placing concrete, wet wood forms sufficiently to tighten up cracks. Wet all other materials sufficiently to reduce suction and maintain concrete workability.

### **3.03 CONCRETE REINFORCEMENT**

- A. Concrete reinforcement shall conform to the CONCRETE REINFORCING Section (03 20 00).

### **3.04 CONSTRUCTION JOINTS**

#### **A. GENERAL:**

- 1. Concrete in each unit of construction shall be placed continuously. Before new concrete is placed on or against concrete which has set, forms shall be retightened and the surface of the set concrete shall be rough and clean. Concrete surfaces on which new concrete is placed shall not be wetted. Waterstops shall be provided in construction joints where specified and in accordance with the WATERSTOPS Section (03 15 13).

#### **B. LOCATIONS:**

- 1. Unless otherwise shown on the drawings, construction joint locations shall be as follows:
  - a. Walls exceeding 50 feet in length shall be cast in panels not to exceed 30 feet in length. Where the number of panels is three or more, the panels shall be cast in an alternating pattern, unless 5 days have elapsed between casting of adjoining

panels. Joints are not allowed within the lesser of 10 feet or 25 percent of the wall length from any corner unless specifically detailed on the drawings.

- b. Joints in beams or girders shall be located at or near the midpoint between supports.
- c. Joints in floors shall be located within the middle third of spans of slabs, beams, and girders. Joints in girders shall be offset a minimum distance of two times the width of intersecting beams.
- d. Joints in walls and columns shall be at the underside of floors, slabs, beams or girders and at the tops of footings or floor slabs. Joints in columns shall be perpendicular to the axis. Beams, girders, or slabs supported by columns or walls shall not be cast or erected until concrete in the vertical support members is no longer plastic.
- e. Beams, girders, haunches, drop panels, and capitals shall be placed monolithically as part of a slab system, unless otherwise shown in contract documents.
- f. Slabs shall be cast in strips not to exceed 40 feet in width and not to exceed 900 square feet in area, with maximum 1 ½ to 1 ratio of side lengths. Contraction joints shall be placed transverse to the length of the strip. Spacing of contraction joints shall be approximately equal to the width of the strip. Minimum lapsed time between placing adjacent strips shall be 72 hours. The requirements for size of slab panels may be waived if joints are specifically located on the Drawings.

#### C. CONSTRUCTION:

1. Construction joints shall be formed as specified. A rough surface of exposed concrete aggregates shall be produced using a surface retardant or sandblasting at construction joints, including joints between slab and topping concrete. The limit of the roughened surfaces shall be 1 inch away from the joint edges.
  - a. When using surface retardant, surface mortar shall be removed within 24 hours after placing by high pressure water jetting, stiff brushing, or combination of both to expose coarse aggregate. Exposed surface shall be cleaned.
  - b. When sandblasting, remove 1/8 inch of laitance film and expose coarse aggregate. Exposed surface shall be cleaned.
2. Reinforcing steel and welded wire fabric shall be continued across construction joints. Joints shall be perpendicular to the main reinforcement.
3. Beams, girders, and floor slabs shall not be cast until concrete in supporting walls and columns is no longer plastic.

4. No joint will be allowed between a slab and a beam or girder unless otherwise shown on the drawings.
5. Vertical construction joints shall be chamfered at exposed faces. Joints subjected to wetting or weather shall be caulked with joint sealer as specified in the JOINT SEALANTS Section (07 92 00).

### **3.05 EXPANSION JOINTS**

- A. Expansion joints shall be as shown on the drawings. Reinforcement or other embedded metal items bonded to the concrete shall not extend through expansion joints. Waterstops shall be provided in expansion joints for water-containing structures and as indicated on the drawings.
- B. Expansion joints shall be caulked with joint sealer as specified in the JOINT SEALANTS Section (07 92 00).

### **3.06 WATERSTOPS**

- A. Shall be in accordance with the WATERSTOPS Section (03 15 13).

### **3.07 INSERTS AND EMBEDMENTS**

- A. Inserts and embedments shall include such items as pipes, castings, conduits, sleeves, anchor bolts, or other miscellaneous metal parts that pass through or are embedded in concrete. Nailing blocks, plugs, strips, and similar items necessary for the attachment of trim, finish, or similar work shall also be embedded.
- B. Aluminum items shall not be embedded in concrete unless effectively coated to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
- C. All inserts and embedded items shall be positioned accurately and supported against displacement. Install ties and supports necessary to keep items in place. Anchor bolts shall be positioned using templates.
- D. Inserts and embedments shall not interfere with clearance and alignment of steel reinforcement, or concrete cover. Additional reinforcement shall be provided around large openings as shown on the drawings.
- E. Voids in sleeves and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.
- F. Prior to placing concrete, inserts and embedments shall be cleaned, inspected, and approved.

### 3.08 CONCRETE MIXING AND TRANSPORTING

- A. Concrete shall be truck-mixed, ready-mixed concrete conforming to the applicable portions of ASTM C94. Materials shall be proportioned by weighing. Pozzolan shall be introduced into the mixer with cement and other components of the concrete mix; pozzolan shall not be introduced into a wet mixer ahead of other materials or with mixing water. Water shall be introduced at the time of charging the mixer; additional water may be introduced within 45 minutes from charging the mixer, provided the specified slump is not exceeded.
- B. Each load of ready-mixed concrete delivered to the job site shall be accompanied by a batch ticket and weigh ticket showing the information listed in ASTM C94, Section 16.

### 3.09 BATCHING AND MIXING CONCRETE PRODUCED ON SITE

#### A. BATCHING:

1. **GENERAL:** Concrete shall be batched only from a plant with a current National Ready Mix Concrete Association Certificate of Compliance. The Contractor shall provide and maintain such means and equipment as are required to accurately determine and control the relative amounts of the various materials, including water, cement, pozzolan, admixtures, sand and each individual size of coarse aggregate used in the concrete. Concrete batches shall be proportioned on the basis of integral sacks of cement unless the cement is weighed. Pozzolan shall be introduced into the mixture only with cement and other dry components of the concrete mix. Pozzolan shall not be introduced into wet mixer ahead of other materials or with mixing water. The amounts of sand and coarse aggregate required for each batch of concrete shall be determined by weighing, and the required water by either weighing or metering.

Aggregates shall be deposited in the batch bins directly over the discharge gates. Coarse aggregate shall be deposited in the batch bins through effective rock ladders when the free drop of the aggregate exceeds 4 feet. Equipment for conveying batch materials from the weighing and batching hoppers shall be constructed, maintained, and operated so that there shall be no spillage of the batched materials or overlapping of batches.

The Contractor shall provide sufficient trucks of adequate size to continuously deliver batched material. Each truck shall carry a delivery ticket showing the mix number, size of batch, and the time water was added to the batch.

2. **WEIGHING AND METERING EQUIPMENT:** Weighing and metering equipment shall be sealed by the state agency having authority over weights and measures and shall be capable of ready adjustment for compensating for the varying weights and moisture changes which affect the concrete mix proportions and concrete consistencies. Batching equipment shall be constructed and operated so that when the entire plant is running the combined inaccuracies in feeding and measuring materials will not exceed 1 percent for water or cement and pozzolan, 2 percent for any size of aggregate, and 1 1/2 percent for the total aggregate in any batch. Equipment shall be designed for convenient confirmation of the

accuracy required for each batch. The equipment for measuring water shall be such that leakage will not occur when the valves are closed.

The Contractor shall provide standard test weights and other auxiliary equipment required for checking the operating performance of each scale or meter and shall make tests at intervals of not more than 6 months in the presence of the state inspector. The Contractor shall provide copies of the complete results of check tests made, and shall make such adjustments, repairs, or replacements as necessary to secure satisfactory performance.

Where the batching plant involves the use of storage bins and weighing hoppers, each weighing unit shall include a visible springless dial or equally suitable device which will register the scale load at any stage of the weighing operation from zero to full capacity. The weighing hoppers shall be constructed to permit the convenient removal of overweight material in excess of the prescribed tolerances. Each dial and water-measuring device shall be in full view of the operator and, if practicable, the weighing equipment shall be arranged so that the operator may conveniently observe the operation of the bin gates and also the materials discharged into the mixer hopper.

Batching equipment in automatic plants shall be interlocked so that:

1. A new weighing cycle cannot be started until the batchers are emptied and the dispatcher discharge gates and valves are closed.
2. The batcher discharge gate cannot be opened until the correct weights of the materials are in the batching hoppers and the scales in balance.
3. The discharge gates cannot be closed until materials are entirely discharged from the hopper and are back in balance.
4. The water batcher discharge valve cannot be opened until the filling valve is closed. The admixture dispenser shall be interlocked to operate with the water batcher.

Dispensers for admixtures shall have sufficient capacity to measure at one time the full quantity of properly prepared solution required for each batch. These admixtures shall be added to premeasured water for the batch, or their discharge into the batch shall be arranged to flow uniformly into the water stream for the batch from beginning to end of its flow into the mixer. Dosages of admixtures shall not vary from the required dosage by more than 5 percent.

**B. MIXING:**

The concrete ingredients shall be mixed in batch mixers until the mixture is homogeneous and uniform in consistency. The mixing of each batch shall continue for at least 1 1/2 minutes for concrete not containing pozzolan and for at least 2 minutes for concrete containing pozzolan after all the ingredients, except the full amount of water, are in the mixer. The minimum mixing period specified is predicated on proper control of the speed of rotation of

the mixer and of the introduction of the materials, including water, into the mixer. Water shall be added prior to, during, and following the mixer charging operations. Excessive mixing time requiring the addition of water (retempering) to preserve and secure the required concrete consistency is not acceptable.

Mixers shall not be loaded in excess of their rated capacity. Each mixer shall be equipped with a satisfactory mechanically operated timing and signaling (or locking) and metering device for indicating and assuring the completion of the required mixing period and for counting the batches.

### **3.10 CONVEYING AND PLACING CONCRETE**

#### **A. CONVEYING CONCRETE:**

1. Concrete shall be conveyed from the mixer to the forms in accordance with ACI 301, Chapter 8. Concrete which has segregated in conveying shall be removed from the site of the work.

#### **B. PLACING CONCRETE:**

##### **1. GENERAL:**

- a. Concrete shall be placed in accordance with ACI 301.
- b. Limit free drop of concrete to 6 feet, except for walls and columns where the limit shall be 3 feet.
- c. Concrete shall be placed at or near its final position. Do not use vibrators for extensive shifting of fresh concrete.
- d. Deposit concrete in horizontal layers not more than 18 inches deep and continue pouring until section is completed. Control rate of pouring and depth of layers so that each layer will be covered within one hour after it is poured.
- e. Where horizontal or vertical pour joints are indicated in concrete, they shall be as shown on the coordination (lift) drawings. Place concrete continuously between pour joints. Concrete discharge shall be completed within 90 minutes after introduction of the water to the mixture.

##### **2. FOUNDATION, FOOTINGS, AND SLAB-ON-GRADE:**

- a. Concrete foundation, footings, and slab-on-grade shall be placed only upon surfaces that are free from frost, ice, mud, loose or unsound rock, and other detrimental substances.
- b. Place concrete only after subgrade for footings, forms and reinforcement have been approved by the District.

3. ELEVATED SLABS:

- a. Concrete shall not be placed until shoring, bracing, and falsework has been inspected per the CONCRETE FORMING Section (03 11 00).
- b. Concrete for horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections has been consolidated and settlement due to bleeding has occurred.

4. WALLS AND COLUMNS:

- a. Limit free vertical drop in concrete walls or columns to 3 feet.
- b. Pour walls and columns at a rate that will not displace the forms. Tell-tale devices shall be used to ensure that forms remain true and plumb.

C. PLACING CONCRETE BY PUMPING:

1. CONCRETE PUMP:

- a. Use only piston type pumps that are reversible.
- b. Do not use aluminum or aluminum lined pipe, or aluminum fittings.
- c. A standby pump of no less capacity than that in operation at the job shall be available within one hour's notice.

2. PUMP PRIMING:

- a. Before starting each pumping operation, the pump and line shall be primed with a cement slurry to lubricate the system. Cement slurry shall be wasted outside the forms.

3. SLUMP:

- a. Water shall not be added after 45 minutes from the time of initial mixing at the batch plant. Within 45 minutes from the time of initial mixing at the batch plant, water may be added to achieve the slump limits specified in Table D.
- b. Slump adjustment—when concrete slump test results are below the required slump, the slump may be adjusted by adding water up to the amount allowed in the accepted mixture proportions. Addition of water shall be in accordance with ASTM C94/C94M. Do not exceed the specified water/cement ratio or slump. Do not add water to concrete delivered in equipment not acceptable for mixing. After plasticizing or high-range water-reducing admixtures are added to the concrete at the site to achieve flowable concrete, do not add water to the concrete. Measure slump and air content of air-entrained concrete after slump adjustment to verify compliance with specified requirements.



- c. Slump may be measured at the transit mix truck or hose discharge at the discretion of the District. Slump loss in pumping, measured between the pumping unit inlet hopper and the hose discharge, shall not exceed 1 inch.
- d. The mix design entered on delivery ticket shall comply with that ordered.

**D. TEMPERATURE OF CONCRETE:**

- 1. The temperature of concrete when it is being placed shall not be less than 50 degrees F. For sections less than 24 inches thick, the temperature of concrete shall not exceed 90 degrees F. For sections 24 to 36 inches thick, the temperature of concrete shall not exceed 80 degrees F. For sections greater than 36 inches thick, the temperature of concrete shall not exceed 75 degrees F. The Contractor shall employ effective means, such as using ice or hot water, placing at night, or other means as necessary to maintain the temperature of the concrete within the required temperature range.

**E. COLD WEATHER PLACEMENT:**

- 1. Remove snow, ice, and frost from all surfaces, including reinforcement against which concrete is to be placed. Embedded items shall be warmed to above 32 degrees F. Concrete shall not be placed when ambient temperature is below 40 degrees F unless provisions are made, in accordance with cold weather curing and sealing provisions of this specification, to keep the concrete and immediate surroundings at or above 50 degrees F for 72 hours after placement.

**3.11 CONSOLIDATING CONCRETE**

- A. Concrete shall be consolidated in accordance with ACI 309R.
- B. Vibration and tamping operations shall conform to ACI 309R. As concrete is placed in forms, work concrete around reinforcing steel, embedded items and into corners and angles. Extra care shall be given to work concrete around inserts, reveals, quirks, corners and plastic cones of ties to preclude rock pockets, air pockets, and other defects. Each 18-inch layer shall be compacted by mechanical internal vibrating equipment within 5 minutes of being placed supplemented by hand spading, tamping, and rodding.
- C. Vibrators shall not be used to transport concrete inside forms. The use of form vibrators will not be permitted. Internal vibrators shall maintain a speed of not less than 7,000 impulses per minute when submerged in the concrete. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing objectionable segregation. Vibrators shall be applied at uniformly spaced points not farther apart than the visible effectiveness of the machine. Insert vibrator into previous unset layer to prevent cold joints. Supplement vibration by suitable methods to eliminate voids along forms for full depth of layer. Do not allow vibrators to strike overlaid plywood surfaces.

D. Keep at least one spare vibrator on job at all times while concrete is being placed.

### **3.12 FLOOR AND SLAB FINISHES**

#### **A. GENERAL:**

1. The finishes specified herein include surface finishes, treatments and toppings for floors and slabs. Floors shall be sloped to drain uniformly. Unless otherwise specified, slope shall be minimum 1/8 inch per foot towards nearest drain. Dry cement shall not be used on fresh concrete surfaces to absorb excess moisture. Edges shall be rounded to a radius of 1/2 inch. Control joints shall be provided on single mat reinforcement slabs only and shall be grooved or sawcut to a depth of 1/4 of the slab thickness, unless otherwise shown on the drawings. Control joints shall be located at discontinuities and at 30 feet maximum spacing, unless otherwise specified or shown on the drawings.
2. The surfaces of pavements and sidewalks shall be screeded to grade and sloped to drain. Sidewalk cross slopes shall be 1/8 inch per foot minimum. The surface shall receive a broom finish. Edges and expansion joints shall be rounded to a radius of 1/2 inch. Control joints shall be grooved or sawcut to a depth of 1/4 of the slab thickness. Expansion joints shall be provided at maximum spacing of 20 feet; control joints shall be provided at maximum spacing of 5 feet for sidewalks, unless otherwise specified or shown on the drawings.

#### **B. FLOAT FINISH:**

1. Float finish shall conform to ACI 301, Chapter 11. Floating shall be performed with a hand or power-driven float. Floating shall compact and smooth the surface and close any cracks.
2. All slabs shall be float finished, as a minimum, unless otherwise specified in this Specification Section or when required by equipment manufacturer.

#### **C. STEEL TROWEL FINISH:**

1. Steel trowel finish shall conform to ACI 301, Chapter 11. Immediately after final troweling, the surface shall be cured and protected as specified in this section.
2. Steel trowel finish shall be provided on floors unless specified otherwise.
3. Surface hardener shall be troweled into the finished surface where specified. Surface hardener shall be applied in two applications with the second application perpendicular to the first.

#### **D. BROOM FINISH:**

1. Broom finish shall conform to ACI 301, Chapter 11.

2. Broom finish shall be provided for sidewalks, walkways, decks, slabs on grade with exterior exposure, and where otherwise indicated or specified.

### **3.13 FORMED SURFACE FINISHES**

#### **A. GENERAL:**

1. After removal of forms, the surfaces of formed concrete shall be given a finish as specified below.

#### **B. ROUGH FORM FINISH:**

1. Rough form finish shall conform to ACI 301, Chapter 10, except as modified herein. Tie holes shall be patched. Holes, depressions, bulges, or other defects 3/8 inch or larger shall be patched. Fins exceeding 1/4 inch shall be chipped off or rubbed off. Unsound concrete in rock pockets shall be removed, and the void patched.
2. Unless otherwise specified in the specifications or shown on the drawings, rough form finish shall be used on concrete surfaces buried below grade; interior surfaces of wet wells; and tanks and channels from 1 foot below minimum water surfaces to the bottom, except at filter cells walls which should have smooth rubbed finish as described below.

#### **C. SMOOTH FORM FINISH:**

1. A smooth form finish shall consist of finishing the surfaces as necessary to produce smooth, even surfaces of uniform texture and appearance, free of bulges, depressions, and other imperfections. Tie holes and defects shall be patched. All fins shall be removed. Subcategories of smooth form finish include:

##### **a. SMOOTH RUBBED FINISH:**

- 1) Smooth rubbed finish shall be produced on newly hardened concrete no later than the day following form removal. Surfaces shall be wetted and rubbed with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process.
- 2) Smooth rubbed finish shall be used as shown on the drawings.

##### **b. GROUT CLEANED FINISH (SACKING):**

- 1) Grout cleaned finish requires a sound, clean, dry substrate. Grind surface, including seams, bumps, and imperfections smooth and flat. Remove form release agent, laitance and curing compound, if present. Wet a small area of concrete to be sacked and rub a slurry of gray concrete, white concrete (to match existing color), and fine sand into the surface with a sponge float. Non-epoxy acrylic bonding compound may be used in the slurry or mix water. Let

dry a few minutes and scrape off excess slurry with the edge of a steel trowel. Rub area lightly with clean burlap until uniform in appearance.

- 2) If submitted and approved in advance, a commercial cementitious mortar compound may be used in lieu of field-mixed slurry in the grout cleaned finish. The compound shall be applied to smooth concrete surface per manufacturer's recommendations.
- 3) Grout cleaned finish shall be provided for painted and unpainted surfaces; surfaces of stair wells; interior surfaces of equipment rooms, galleries and tunnels; exposed pipe chases; operations areas; channels and tanks from 1 foot below minimum water surfaces to the top; and permanently exposed vertical and sloped surfaces.

#### D. SANDBLAST FINISH:

1. Unless otherwise specified on the drawings, the degree of sandblasting shall be light. Light sandblasting is sufficient to expose fine aggregate with occasional exposure of coarse aggregate. Exposed coarse aggregate shall not project more than 1/16 inch from the matrix.
2. A sample panel shall be submitted and approved prior to full-scale sandblasting operations in the field.
3. Sandblast finish shall be used for external concrete surfaces of structures identified on the drawings.

### 3.14 RELATED SURFACE FINISHES

#### A. MONOLITHIC SURFACING:

1. Monolithic surfacing shall be provided on floor areas as specified. Monolithic surfacing shall consist of a steel trowel finish hardened with a surface hardener as specified in this Section. Surface hardener shall be applied in accordance with the manufacturer's recommendations and directions.

#### B. STAIR TREAD:

1. Stair tread shall be constructed with nonskid nosing as specified in Section 05530. Tread shall have a steel trowel finish and shall have a slope of 1/8 inch per foot toward the front. Ends of treads shall have a 1/16- to 1/8-inch cut between concrete and metal tread to allow for expansion.

#### C. FINISHING OF UNFORMED SURFACES:

1. Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture consistent with that of the adjacent formed

surfaces. Final treatment of formed surfaces shall continue uniformly across the unformed surfaces.

### **3.15 CURING AND SEALING**

#### **A. GENERAL:**

1. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury, and shall be maintained with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of cement and hardening of concrete.
2. Concrete temperature shall be maintained between 50 and 90 degrees F during the curing period.

#### **B. CURING OF CONCRETE:**

1. Unless otherwise specified in this Section, curing shall be continued for at least 7 days.
2. Moisture retention measures for concrete surfaces not in contact with forms shall be provided by one of the following methods:
  - a. Complete and continuous application of water which does not contain deleterious compounds harmful to the concrete.
  - b. Use of curing rugs or blankets kept continuously wet.
  - c. Use of waterproof paper or plastic.
  - d. Application of liquid membrane forming compound applied per manufacturer's recommendations.
3. Moisture loss from concrete surfaces placed against wooden or metal forms shall be minimized by keeping the forms wet until they can be safely removed. As soon as can be done without damaging the concrete, the forms shall be loosened, and water shall run down inside of them. After form removal, the concrete shall be cured using one of the methods above for the duration of the curing period.
4. Curing compound shall not be used on concrete surfaces to be coated, waterproofed, moistureproofed, tiled, roofed or where other coverings are to be bonded, unless the curing compound is compatible with the final finish covering or it is removed prior to covering.
5. Steel troweled finish concrete floors which are not to receive tile, roofing, grout, terrazzo or other bonded coverings shall be cured with a curing and sealing compound. It shall be applied as soon as the concrete has set sufficiently so it is not marred by the application. Preparation of surfaces, quantities used, application

procedures and installation precautions shall be followed in strict compliance with the manufacturer's instructions.

6. High-early-strength concrete shall be cured for at least 3 days, and shall be cured with methods that use water during the curing period. Application of liquid membrane forming compound is not acceptable.

**C. ADDITIONAL REQUIREMENTS FOR CURING DURING COLD WEATHER:**

1. When the mean daily outdoor temperature is less than 40 degrees F, provisions shall be made, as necessary, for heating, covering, insulating, or housing the concrete to maintain concrete temperature within the specified range. The use of combustion heaters shall be controlled in order to avoid damaging the concrete due to concentration of heat.

**D. ADDITIONAL REQUIREMENTS FOR CURING DURING HOT WEATHER:**

1. Hot weather is any condition or combination of conditions that accelerate the rate of moisture loss and/or rate of cement hydration. These conditions include high ambient heat (above 90 degrees F), high concrete temperature, low relative humidity, and/or wind velocity. During hot weather, provisions shall be made, as necessary, for windbreaks, shading, fog spraying, continuous sprinkling, or wet coverings. Such protective measures shall be taken as quickly as concrete hardening and finishing operations allow.

### **3.16 PROTECTION**

- A. Concrete shall be protected from injurious action by sun, rain, flowing water, frost, freezing, and mechanical injury.
- B. Do not place concrete during rainy weather unless approved measures are taken to prevent damage to concrete.
- C. Protect concrete placed during periods of drying winds, low humidity, high temperatures and other conditions that may cause rapid drying. Apply a fine spray of water applied immediately after finishing and continue until final curing operations have begun.
- D. Slabs in areas subject to construction traffic shall be protected with 6-mil kraft paper or polyethylene membrane for at least 2 weeks after placement.

### **3.17 CONCRETE REPAIRS AND MODIFICATION OF EXISTING CONCRETE**

**A. REPAIR OF SURFACE DEFECTS:**

1. Surface defects, including tie holes, rock pockets, honeycombing or otherwise defective concrete shall be repaired immediately following form removal. Excessive cracking or leaking cracks shall be repaired in accordance with this Specification Section.

2. Defective areas shall be chipped or cut back to solid concrete to a depth of at least 1 inch. Where half or more of the rebar circumference is exposed, remove concrete a minimum of 1" around the rebar. The edges of the cut shall be perpendicular to the surface of the concrete. Feathered edges shall not be permitted. The areas to be patched shall be cleaned by abrasive blasting or high pressure water jetting. Concrete substrate shall be free of any deleterious materials, and shall have a roughened surface with a minimum amplitude of 1/4 inch. Presoak concrete substrate to saturated surface dry condition immediately prior to application of bond coat for concrete repair material.
3. Portland cement mortar patching material shall be a mixture of the same materials and of approximately the same proportions as used for the concrete, except that coarse aggregate shall be omitted. Brush cement slurry bond coat into the surfaces. Before bond coat dries, apply dry pack and consolidate into place. Curing for the patched area shall be as specified for the concrete. As an alternative to field-mixed Portland cement mortar patching material, a commercial patching compound may be used per manufacturer's recommendations, if submitted and approved in advance of concrete repair work.
4. Repaired area shall be equal in color, workmanship, texture and general appearance to that of the adjacent concrete.

#### B. ACCEPTANCE OF CONCRETE:

1. Completed cast-in-place concrete work shall conform to the applicable requirements of ACI 301 and the Contract Documents. Concrete work that fails to meet the requirements of ACI 301 or the Contract Documents shall be repaired as approved by the District to bring the concrete into compliance. Concrete that cannot be brought into compliance by approved repair methods will be rejected. Rejected concrete work shall be removed and replaced. Repair methods shall be in accordance with ACI standards and are subject to the approval of the District. The cost of repairs and replacement of defective concrete shall be borne by the Contractor.

#### C. REPAIR METHODS:

1. Damaged or excessively cracked concrete, as determined by the District in their sole discretion, shall be repaired by one of the following methods as approved by the District:
  - a. REPAIR METHOD 1: Fill the joint or crack by drilling holes to the affected area, install injection ports and force epoxy or chemical grout (expanding urethane) into the joint under pressure. The material type, whether epoxy or chemical grout shall be approved by the District. After injection and curing, ports, sealing mix and surface generally shall be cleaned and worked to match the specified finish.

- b. REPAIR METHOD 2: Fill cracks with low viscosity epoxy, applied by pouring/flooding crack zone until cracks are filled. Prepare surface, install, and cure according to manufacturer's recommendations. At a minimum, prepare surface to result in a clean, dry surface and with no visible detrimental material in cracks to be filled. Conform to temperature limitations for epoxy to be used. Finish to match adjacent areas.
- c. REPAIR METHOD 3: Cut a bevel groove 3/8 to 1/2 inch in width and depth, and caulk with sealant in accordance with manufacturer's instructions. This repair method is only to be used where expressly allowed by the District. Groove and caulk shall be applied on wet or hydrostatic pressure side of surface where occurs.

## 2. REPAIR METHOD USE:

- a. Repair Method 1 shall be used for all cracks in walls, surfaces sloped 1:1 or greater, beams, columns, slabs, overhead surfaces and generally for liquid retaining surfaces. Need for repair depends upon crack width, location, and surface conditions under service conditions. Epoxy grout shall be used for repair of structural cracks and chemical grout (expanding urethane) shall be used for repair of non-structural cracks at liquid-containing structures. The District shall determine whether a crack is classified as structural or non-structural.
- b. Repair Method 2 may be utilized in lieu of Method 1 for slabs which receive a raked finish. Method 2 may also be used with Construction Manager's approval for exposed trowelled and broom finishes after review of conditions, degree of exposure to public, and proposed repair product and installation. Finish shall substantially match adjacent surfaces.
- c. Repair Method 3 shall be limited to dry-surface slabs, walls subject to less than three feet of liquid pressure, or as specifically directed by the District. Method 3 is not an equivalent repair method to Methods 1 or 2, which shall be considered the standards.

## D. MODIFICATION OF EXISTING CONCRETE:

- 1. Existing concrete shall be removed and the remaining surfaces prepared as specified. The remaining concrete shall be protected from damage.
- 2. Where possible, clean lines shall be made by sawing through the existing concrete. The concrete may be broken out after initial saw cuts in the event thickness prevents cutting through, or where existing reinforcing steel is specified to be exposed and utilized. Where it is not possible to use a saw, the initial cuts shall be made with chipping hammers. These cuts shall be sufficient to prevent damage to the remaining concrete.



3. In general, an opening in existing concrete shall be oversized 2 inches on all sides and built back to the correct dimension with an epoxy grout. Where oversized openings cannot be made, the concrete shall be cut to the correct dimension, with the exposed reinforcing cut or burned back 1 inch and the resulting hole filled with epoxy grout. Cut or broken concrete surfaces shall be repaired as specified in this section.
4. Where new concrete adjoins existing concrete surfaces or surfaces which have been cut, such surfaces shall be cleaned by sandblasting to remove laitance, loose coatings and foreign materials, and coated with the bonding compound just prior to the placement of the new concrete. Bonding compounds shall be as specified in this section.
5. Unless otherwise specified or shown on the drawings, continuity of reinforcing steel shall be obtained across the joint either by exposing existing bars to provide sufficient laps with new bars or by welding existing bars with new bars as per the CONCRETE REINFORCING Section (03 20 00) or by using mechanical connectors conforming to ACI. Where shown on the drawings, dowels shall be drilled and set with epoxy grout into existing concrete.

### **3.18 FIELD SAMPLING AND TESTS**

#### **A. GENERAL:**

1. The District will conduct field sampling and tests to assure the quality of the materials and work used throughout the project. The District laboratory will provide the necessary labor, materials and facilities for sampling the aggregate, and for casting, handling and storing the concrete samples at the site of work. Aggregate will be sampled at the batch plant not less than 30 days prior to the use of such aggregate in the work, and at least weekly during concrete operations. Concrete will be sampled at the time of placement.

#### **B. SAMPLING:**

##### **1. AGGREGATES:**

- a. **GENERAL:** Fine and coarse aggregates shall be sampled in accordance with ASTM D75. Samples shall be obtained from the concrete batch plant at the discharge gates of the bins feeding the weigh hopper or belt samples. The Contractor shall provide safe and suitable facilities for obtaining samples. Sampling shall be repeated when the source of material is changed or when unacceptable deficiencies or variations from the specified requirements of materials are found in testing. Aggregate samples shall be tagged and their sources identified.
- b. **COARSE AGGREGATE:** A sample weighing between 50 and 60 pounds shall be taken after the batch plant is brought up to full operation. The samples shall

be taken so that a uniform cross section, accurately representing the materials on the belt or in the bins, is obtained.

- c. FINE AGGREGATE: Samples shall be taken as specified for coarse aggregate. Samples of sand shall be taken when the sand is moist.
2. CONCRETE: Samples of freshly mixed concrete shall be obtained in accordance with ASTM C172. At the discretion of the District, samples of concrete may be taken at the transit mix truck chute, the pump hopper, or the hose discharge point.

#### C. TESTING:

1. AGGREGATE: A minimum of one test of coarse aggregate per 400 cubic yards of concrete and a minimum of one test of fine aggregate per 200 cubic yards of concrete used shall be made to confirm continuing conformance with specifications for gradation, specific gravity, cleanliness, and sand equivalent, as applicable.
2. CONCRETE:
  - a. STRENGTH TESTS: Verification of mix design strength shall be accomplished by testing standard cylinders of concrete samples taken at the job site. Standard cylinders shall represent the concrete placed in the forms. One set of five standard cylinders shall be cast of each class of concrete for each 100 cubic yards or less in each separate structure. Casting, handling and curing of cylinders shall be in accordance with ASTM C31. Additional cylinders shall be provided when an error in batching is suspected. For the first 24 hours after casting, the cylinders shall be kept moist and measures taken so that air temperature will be between 60 and 80 degrees F. At the end of 24 hours, the cylinders shall be transported to the testing laboratory.
    - 1) Testing of specimens for compressive strength shall be in accordance with ASTM C39. Tests shall be made at 7 and 28 days from time of casting. One test cylinder from each group of five shall be tested at the end of 7 days and two shall be tested at the end of 28 days. The fourth and fifth cylinder shall be tested only when the strength test fails to meet the required compressive test at 28 days.
    - 2) Each strength test result shall be the average of the strengths of two test cylinders at 28 days. However, if one cylinder in the set of two shows evidence of low strength due to improper sampling, casting, handling or curing, the result from the fourth cylinder shall be used.
    - 3) The average of any three consecutive 28-day strength test results of the cylinders representing each class of concrete for each structure shall be equal to or greater than the specified strength and not more than 10 percent of the strength test results shall have values less than the specified 28-day strength

for the total concrete placement. No individual strength test results shall be less than the specified strength by more than 500 pounds per square inch.

- 4) If the 28-day test results fall below the specified compressive strength for the class of concrete required for any portion of the work, adjustment in the proportions, water content, or both, shall be made as necessary at the Contractor's expense. Changes and adjustments shall be submitted to the District for approval.
  - 5) If compressive test results indicate concrete in place may not meet structural requirements, tests shall be made to determine if the structure or portion thereof is structurally sound. Tests may include, but not be limited to, cores in accordance with ASTM C42 and any other analyses or load tests acceptable to the District. Costs of such tests shall be borne by the Contractor.
- b. TESTS FOR CONSISTENCY OF CONCRETE: The slump shall be as specified when measured in accordance with ASTM C143. Samples for slump determination shall be taken from the concrete during placing. Tests shall be made at the beginning of concrete placement operation and at subsequent intervals to ensure that the specification requirements are met. Slump tests shall also be performed whenever standard cylinders are cast.
  - c. TESTS FOR TEMPERATURE AND AIR CONTENT: Temperature tests shall be made at frequent intervals during hot or cold weather conditions until satisfactory temperature control is established. Whenever standard cylinders are cast, temperature tests shall be performed. Air content shall be as specified when measured in accordance with ASTM C231. Air content shall be measured whenever standard cylinders are cast.

### **3.19 WATERTIGHTNESS, TESTING AND REPAIR**

#### **A. WATER RETAINING CONCRETE TANKS AND CHANNELS:**

1. Concrete tanks, basins, reservoirs and channels which have walls or slabs subjected to hydrostatic pressure shall be tested for watertightness. The tests shall be made after the structure is complete and the concrete has achieved its specified 28-day strength, but prior to application of waterproofing coating or backfilling. Filling of the tank for the watertightness test shall not exceed a rate of 4 feet per hour. Filling with water at this maximum rate shall continue to the maximum operating water surface. The water shall be kept at this level for at least 72 hours and then the dry sides of all walls and the base perimeter of the slab shall be visually inspected for evidence of leakage. Damp spots, leakage, or seepage revealed by the test, including those caused by shrinkage of concrete, honeycombed areas, construction joints, or other sources shall be repaired by Method 1, as described in paragraph 3.17-C.1a of this specification section. Damp spots are defined as spots from which water that can be picked up on dry hand.

2. The Contractor shall re-test tanks or channels which have been repaired to check the suitability of repairs. Water required for testing and re-testing shall be provided by the Contractor and disposed of so as not to create a nuisance.
3. All liquid retaining or conveying concrete structures must also meet maximum leakage criteria set forth in ACI 350.1 as follows:

<b>Structure Type</b>	<b>ACI 350.1 Designation</b>	<b>Tightness Criterion</b>
Cylindrical water and wastewater storage tanks and reservoirs other than digesters	HST-025	0.025% per day
Digesters	SHT-050	0.050% per day (surcharged hydrostatic test)
Rectangular basins and tanks	HST-050	0.050% per day
Concrete paved reservoirs and channels	HST-100	0.10% per day

Note: All damp spots on or leakage through walls or wall-to-slab joints shall be repaired as described above. Leakage equal to or less than the values shown in the table above is permitted only through the base slab or mat foundation.

4. Volume loss shall be calculated by measuring the vertical distance from the water surface to a fixed point on the tank above the water surface taking into account evaporation from open surfaces. If the drop in water surface in the 24-hour period exceeds the values given in the table above, exclusive of evaporation, the leakage shall be considered excessive and shall be remedied. The Contractor shall retest structures which have been repaired to check the suitability of repairs. Water required for the testing and retesting shall be provided by the Contractor and disposed so as not to create a nuisance.

### **3.20 CLEANUP**

- A. Upon completion of the work and prior to final inspection, the Contractor shall clean all concrete surfaces as follows:
  1. **FLOORS:** After sweeping with an ordinary broom to remove the loose dirt, the finish shall be wetted with soapsuds and rubbed with a scrubbing machine fitted with a wire brush or fine steel wool. The suds shall be mopped up, and the surface shall be flushed with clean water. Final scrubbing by hand or machine shall follow.
  2. **FLOORS WITH CURING AND SEALING COMPOUNDS:** Cleaned of loose dirt and debris by sweeping with ordinary brooms, then washed and mopped with clean water. Finally, one additional coat of the same initial curing and sealing compound shall be applied per manufacturer's recommendations. The Contractor shall receive approval from the District prior to application of the final coat.

3. SIDEWALKS AND PAVED AREAS: Cleaned of loose dirt and debris by sweeping with ordinary brooms, then washed with clean water.

**\*\*END OF SECTION\*\***

## **Notes to Designers**

1. This specification assumes that all construction joints are to be watertight; therefore, waterstops are to be provided at all construction joints.
2. If permitted, the Designer shall provide detail of openings in concrete for subsequent insertion of inserts and/or embedments. The preference is that all inserts and embedments be cast-in-place.
3. Specify on the drawings or modify the specifications to describe where smooth rubbed finish is to be used on the project.
4. Check concrete admixture, hardener, curing products etc. carefully as companies appear to frequently merge and change product availability.

## SECTION 03 34 13

### CONTROLLED LOW STRENGTH CONCRETE

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies controlled low strength concrete (CLSC) which is a self-compacting, cementitious fill material. This section consists of furnishing all material, mixing and transporting equipment, and performing all labor for the proportioning, mixing, transporting, placing, consolidating, finishing and curing of CLSC.
2. CLSC shall not be used in lieu of concrete for pipe encasement or electrical duct banks.

###### B. QUALITY ASSURANCE:

###### 1. GENERAL:

- a. All testing during the work will be done by a testing laboratory of the District's choice at the District's expense except as otherwise noted in the specifications.
- b. In case the tests of the CLSC show noncompliance with the specifications, the Contractor shall accomplish such remedy as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the District and shall be at the Contractor's expense.
- c. The sampling of freshly mixed CLSC delivered to the project site shall be in accordance with ASTM D5971.

###### 2. CONSISTENCY, UNIT WEIGHT, AND COMPRESSIVE STRENGTH:

- a. Consistency of CLSC shall be determined in accordance with ASTM C143.
- b. Unit weight of CLSC shall be determined in accordance with ASTM D6023.
- c. The compressive strength shall be determined in accordance with ASTM D4832.

## 1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed standards, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM C33	Specification for Concrete Aggregate
ASTM C94	Specifications for Ready-Mixed Concrete
ASTM C143	Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Specification for Portland Cement
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C494	Specification for Chemical Admixtures for Concrete
ASTM C618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Filler in Portland Cement Concrete
ASTM D4832	Preparation and Testing of Soil-Cement Slurry Test Cylinders
ASTM D5971	Sampling Freshly Mixed Controlled Low Strength Material
ASTM D6023	Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Controlled Low Strength Material

- B. DEFINITIONS: (Not Used)

## 1.03 SUBMITTALS

- A. The following information shall be submitted for review in accordance with SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. CLSC mix designs that show the proportions of all materials proposed for each class of CLSC specified. Mix design shall also include gradations and certifications of all materials.
  3. An independent testing laboratory shall test the mix designs for properties specified. Results from previous projects may be submitted as long as the mix proportions and materials are the same.



## **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

### **PART 2 -- PRODUCTS**

#### **2.01 MATERIALS**

##### **A. GENERAL:**

1. CLSC shall be an excavatable mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water which has been mixed in accordance with ASTM C94.
2. The actual mix proportion, slump, and admixtures shall be determined by the Contractor to meet the uses specified herein. The entrained air content shall be a minimum of 6 percent and a maximum of 20 percent.

##### **B. CEMENT:**

1. Cement shall be Type II or V in accordance with the requirements of ASTM C150.

##### **C. POZZOLAN:**

1. Pozzolan shall be added to improve the flowability and shall be Type F in accordance with the requirements of ASTM C618.

##### **D. AGGREGATE:**

1. Coarse aggregate shall consist of a well-graded mixture of gravel, crushed rock, or pea gravel with a maximum size aggregate of 3/8 inch. Coarse aggregate shall in accordance with the requirements of ASTM C33.
2. Fine aggregate shall be in accordance with the requirements of ASTM C33.
3. All material shall be free from organic matter and not contain more alkali, sulfates, or salts than the native materials at the site work.

##### **E. ADMIXTURES:**

1. Air entraining admixture shall be added to improve the flowability and shall be in accordance with the requirements of ASTM C260.
2. Water reducing agent shall be added to improve the workability and shall be in accordance with the requirements of ASTM C494.

F. WATER:

1. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities.

**PART 3 -- EXECUTION**

**3.01 GENERAL**

- A. The District is defining the quality of CLSC by specifying in this part some of the means, methods, techniques, sequences and procedures for installation of CLSC. The Contractor, without relinquishing authority and responsibility for supervision and direction of the work, agrees to follow the specified means, methods, techniques, sequences and procedures.
- B. The District will conduct field quality control tests for CLSC strength. The Contractor shall notify the District at least 2 days in advance whenever a sample and test of CLSC materials is required by these specifications.
- C. CLSC with a non-segregating consistency that readily flows shall be used as follows:

Use	28-day Compressive Strength (ASTM D4832)	Slump (ASTM C143)	Unit weight (ASTM D6023)
Bedding & initial backfill at: Exposed existing utilities Utility crossings Stacked utilities	50 to 150 psi	6 to 8 inches	115 to 145 pcf
Filling of abandoned underground structures	100 to 300 psi	6 to 8 inches	115 to 145 pcf
Structural fills	300 to 1200 psi	4 to 6 inches	115 to 145 pcf
Pavement bases	400 to 1200 psi	4 to 6 inches	115 to 145 pcf

**3.02 INSTALLATION**

A. PREPARING PLACEMENT FOR CLSC:

1. The subgrade, compacted fill and/or trench to receive CLSC shall be complete and acceptable in accordance with the EARTH MOVING Section (31 20 00).

B. MIXING AND DELIVERING CLSC:

1. CLSC shall be batched by a ready-mix batching plant.

2. CLSC shall be delivered to the work in standard transit mix trucks.

C. PLACING CLSC:

1. CLSC shall be delivered in place by means of tailgate discharge, conveyor belts, pump, chute, or other means acceptable to the District.
2. For pipe bedding and initial backfill, measures shall be taken to prevent CLSC from floating the pipe. Measures may include, placing CLSC in lifts with sufficient set-up time between lifts, sandbags placed over the pipe, straps around the pipe anchored into the soil, or other methods approved by the District. For flexible wall pipes, CLSC shall be placed in lifts so that lateral support can develop along the side of the pipe before CLSC is placed over the pipe.
3. For trench backfill, bulkheads shall be provided to contain long open-ended segments.
4. For structural fills, CLSC shall be placed in lifts with sufficient set-up time between lifts to prevent overloading retaining structures.
5. Where fresh CLSC must be placed against existing CLSC, the placement shall be clean of all loose and foreign material. The surface of existing control density shall be soaked with water before placing new control density. No standing water will be allowed before starting placement of fresh CLSC.
6. CLSC shall be directed in place by means of a vibrator to ensure that all voids, crevices, and pockets are filled.

D. FINISHING CLSC:

1. The finish surface of CLSC shall be smooth and to the grade shown on the drawings or directed by the District. Finishing by wood float, steel trowel, or other similar methods is not required.

E. PROTECTING CLSC:

1. CLSC shall be protected from running water, rain, freezing, or other conditions that could damage the material.
2. In order to avoid a quick-sand type hazard, CLSC shall be covered or otherwise protected until hardening occurs.
3. No equipment, traffic, or backfill shall be allowed on the CLSC until the surface of the CLSC is able to withstand a 20 psi load without displacement or damage. If necessary, the Contractor shall provide steel trench plates that span the trench until the CLSC has reached the required strength.

**3.03 TESTING (NOT USED)**

**3.04 TRAINING (NOT USED)**

**\*\*END OF SECTION\*\***

## SECTION 31 10 00

### SITE CLEARING

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies site preparation which consists of clearing, grubbing, stripping, demolition, weed control, protection, restoration, disposal, and dust control. The Contractor shall determine the field condition of the site as it affects this portion of work and incorporate all costs thereof in his bid.

##### 1.02 REFERENCES

- A. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
CASQA	California Stormwater Quality Association California Stormwater BMP Handbook – Construction
SACSPEC	County of Sacramento Standard Construction Specifications
Guidelines for the Use of Reclaimed Water	State of California, Department of Health Services, Environmental Management Branch -- Guidelines for the Use of Reclaimed Water for Construction Purposes

##### 1.03 SUBMITTALS

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
  1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. Information on herbicides used for weed control including product labeling, product material safety data sheet, and application rate.

## **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

## **PART 2 -- PRODUCTS (NOT USED)**

## **PART 3 -- EXECUTION**

### **3.01 GENERAL**

- A. The Contractor shall notify the District Representative when site preparation is complete. Further work shall not be started until all site preparation is completed to the satisfaction of the District Representative.

### **3.02 INSTALLATION (NOT USED)**

### **3.03 TESTING (NOT USED)**

### **3.04 TRAINING (NOT USED)**

### **3.05 RESTORATION**

- A. Unless otherwise shown on the drawings, site preparation shall not damage structures, pavement, walkways, piping, and all other existing improvements, landscaping or vegetation adjacent to the site. The Contractor shall repair, or replace, any damaged property to its pre-existing condition.

### **3.06 CLEARING AND GRUBBING**

- A. Unless otherwise shown on the drawings, the Contractor shall completely remove objectionable materials and obstructions such as brush, trees, logs, stumps, roots, heavy sod, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement, debris, and structures where the completion of the work require their removal.
- B. Grubbing shall consist of the complete removal of stumps and roots to a depth of 3 feet below natural ground.
- C. Material removed from clearing and grubbing operations shall not be incorporated in fills and backfill.
- D. The Contractor shall save and protect all trees located on District property not specifically identified in the contract for removal. No trees shall be removed without approval of the District Representative.

### **3.07 STRIPPING**

- A. Unless otherwise shown on the drawings, stripping shall consist of removing at a minimum the top 12 inches of soil. The District will pay for material that the Contractor is directed to remove as stripping below 12 inches in depth.
- B. Stripped material is not suitable for fill material, and shall be stockpiled in a separate location prior to being hauled offsite.

### **3.08 DEMOLITION AND REMOVAL**

#### **A. STRUCTURES AND PIPES:**

- 1. Demolition and removal of structures and pipes consist of removal of abandoned superstructures, foundation walls, footings, compacted granular backfill, slabs, buried pipes and any other structures except as otherwise shown on the drawings. Excavations caused by removal and disposal of existing structures and pipes shall be cleared of waste, debris and loose soil, and backfilled as specified in the EARTH MOVING Section (31 20 00).
- 2. Pipes to be abandoned in-place shall be plugged with concrete or capped in accordance with the drawings.

#### **B. PAVEMENT:**

- 1. When portions of asphalt pavements and concrete pads are to be removed and the remaining portions are to be connected to new construction, edges shall be saw cut, on a neat line at right angles to the curb, concrete or pavement face.

#### **C. EQUIPMENT, MATERIAL, PIPING, CONDUIT AND WIRE:**

- 1. Existing equipment, material, piping, conduit, wire, etc. shall be abandoned, demolished, or removed in accordance with the contract documents.
- 2. The District Representative may direct the Contractor to demolish and remove existing work not identified in the contract documents and will be paid for as extra work.

#### **D. SALVAGE:**

- 1. The District has the right to salvage items scheduled for removal. The Contractor shall notify the District Representative five days prior to any salvage or demolition work. The District will mark items to be salvaged. Contractor shall be responsible for such items to be disconnected at flange connections, bolted connections or wire terminals, where practical, removed from their foundations, flushed, and placed at a location on the plant site as directed by the District Representative.

**E. PROTECTION OF EXISTING WORK:**

1. Before beginning any cutting or demolition work, the Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent of the work. The Contractor shall take all necessary precautions to ensure against damage to existing work to remain in place. Any damage to such work shall be repaired or replaced as approved by the District Representative at no additional cost. The Contractor shall carefully coordinate the work of this section with all other work and construct and maintain shoring, bracing and supports, as required.

**3.09 WEED CONTROL**

- A. Project site weed control shall be the responsibility of the Contractor. Weed control may consist of mechanical control measures or the application of herbicides. Herbicide application and mechanical control measures such as mowing, disking, or blading shall conform to all other contract specifications and environmental mitigation measures.
- B. Contractor shall provide written notice to the District Representative no less than 48 hours prior to the intended weed control operations. If herbicide application is involved, written notice shall include approved herbicide submittal and description of the area to receive application. If mechanical control measures are involved, written notice shall include description of proposed methods and area to receive treatment. If Contractor is unable to perform weed control operations on or within seven days following the intended date, the Contractor shall resubmit advance written notice.
- C. The Contractor shall ensure that all herbicide applications are conducted in accordance with the product labeling and conform to all Federal and State laws and regulations set by the California Department of Pesticide Regulation (DPR) as well as by the Sacramento County Agricultural Commission. District approval of an herbicide application does not supersede nor circumvent Federal and State laws and local regulations governing the use of herbicides. All herbicide use reporting to the Sacramento County Agricultural Commission shall be the responsibility of the Contractor.
- D. Contractor shall be responsible for the safety of their employees and the protection of their equipment and belongings prior to, during, and after application of herbicides.

**3.10 PROTECTION**

- A. The Contractor shall provide temporary protection devices, including barricades, fencing, guardrails, warning signs, lights and other devices necessary to ensure the security of, and safety within, the project site during all of the work. Contractor shall comply with the standards specified by SACSPEC.



### **3.11 DISPOSAL**

- A. All material that results from clearing, grubbing, stripping, and demolition shall become the property of the Contractor and shall be removed from the plant site and lawfully disposed of by the Contractor at his expense.

### **3.12 DUST CONTROL**

- A. Contractor shall provide dust control for the duration of construction operations. The Contractor shall water areas prior to starting work. The amount of dust control shall be as directed by the District Representative.
- B. Non-potable water sources suitable for dust control are listed in the TEMPORARY UTILITIES Section (01 51 00).
- C. Controls on hauling and use of reclaimed water for construction purposes shall comply with guidelines established by the State of California, Department of Health Services

**\*\*END OF SECTION\*\***

#### Notes to Specifiers:

1. Coordinate depth of stripping with Paragraph 3.07 and the drawings.
2. All permits, mitigation measures, and requirements regarding environmentally sensitive impacts shall be clearly addressed in a separate section of the specifications.

## SECTION 31 20 00

### EARTH MOVING

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies earthwork which consists of all labor, materials, equipment and incidentals necessary to perform excavation, backfill, structure backfill, grading, compaction, dewatering, dust control and disposal of unsuitable and excess material.

##### 1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

1. American Society of Testing Materials (ASTM)

<u>Reference</u>	<u>Title</u>
C136	Method for Sieve Analysis of Fine and Coarse Aggregates
D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
D2216	Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
D6938-10	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

2. State of California - Department of Transportation (Caltrans)

<u>Reference</u>	<u>Title</u>
Caltrans	Standard Specifications
CTM 231	Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregate

3. County of Sacramento - Public Works

<u>Reference</u>	<u>Title</u>
SACSPEC	Standard Construction Specifications

4. American Association of Highway and Transportation Officials (AASHTO)

<u>Reference</u>	<u>Title</u>
T88	Method of Test for Particle Size Analysis of Soils

5. California Building Code (CBC)

<u>Reference</u>	<u>Title</u>
Chapter 18	Soils and Foundations

B. DEFINITIONS:

1. **BEDDING:** The material that extends below the pipe barrel to the bottom of trench.
2. **COMPACTION:** The degree of compaction is specified as percent compaction or relative compaction and refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil determined in accordance with the specified test method. Optimum moisture content is the water content (percentage by weight) corresponding to the maximum dry density. Relative compaction shall be determined in accordance with test methods specified herein.
3. **EMBANKMENT SLOPE:** An inclined surface formed by placement of material above existing grade.
4. **EXCAVATION SLOPE:** A sloped surface formed by removing material from below existing grade.
5. **INITIAL BACKFILL:** The material placed from the top of the bedding to a point 6 inches above the top of the pipe and pipe bell.
6. **STRUCTURE BACKFILL:** Backfill material placed against the outside of structure within a distance of one-half the maximum depth of fill.

7. **SUBSEQUENT BACKFILL:** The material placed from top of initial backfill to roadway or structure subgrade. Where subgrade is not present, place material to finish grade.

### **1.03 SUBMITTALS**

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
  1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. One sample of each imported fill material to be used shall be submitted 60 days in advance of use. Each sample shall consist of 0.5 cubic feet of each type of material.
  3. A dewatering plan to control water in excavations.
  4. A detailed Trench Excavation Plan in accordance with governing state and federal requirements, describing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of any trench five feet or more in depth. Shoring plans shall be prepared and signed by a civil engineer registered in the State of California.
  5. Daily field and laboratory compaction test results.
  6. A compaction report, upon completion of backfill and grading operations.
  7. A Construction Traffic Control Plan as referenced in the TRAFFIC CONTROL Section (01 55 26).

### **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

## **PART 2 -- MATERIALS**

### **2.01 FILL MATERIALS**

#### **A. GENERAL:**

1. Fill materials include native and import types. Import materials, if required, shall meet the specified requirements stated herein for each type of material or requirement for use. Native materials (Type B, Type C and Type K) shall be removed from excavations and stockpiled in separate areas as shown in the Excess Fill Disposal Area and as directed by the District Representative. The Contractor's geotechnical engineer shall classify native material prior to use as fill material.

B. TYPE B:

1. Type B material is native material which is highly expansive clay. Type B material is unsuitable for structure backfill.
2. Material properties shall be based on ASTM D4318. Material shall be classified by the Unified Soil Classification System and ASTM D2487.
  - a. Plasticity index: greater than 15.
  - b. Classification: CL-CH

C. TYPE C:

1. Type C material is native material which shall be free from organic peat, wood, roots, bark, debris, garbage, rubbish or other extraneous material which may be compressible or which cannot be properly compacted. The maximum size of stone shall not exceed 2 inches.
2. If the material excavated from the site meets these requirements, it may be classified as Type C. Use of Type C material for fill must first be accepted in writing by the District Representative.

D. TYPE D:

1. Type D material shall be granular material commonly known as pea gravel (which is smooth and free of fractured faces) and shall conform to the following gradation:

<u>U.S. standard Sieve size</u>	<u>Percent by weight passing</u>
1/2 inch	100
3/8 inch	90-100 or 95-100
No. 4	0-4
No. 8	0-2

E. TYPE E:

1. Type E material shall be free draining, clean crushed rock commonly known as drain rock and shall conform to the following gradation:

<u>U.S. standard Sieve size</u>	<u>Percent by Weight passing</u>
1 inch	100
3/4 inch	80-90
1/2 inch	15-30
3/8 inch	0-10
No. 4	0-5

2. Type E material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65. At least 50% of material retained on the 3/8 inch sieve shall have three or more fractured faces.

F. TYPE F:

1. Type F material shall be Class 2 aggregate base per Caltrans Standard Specifications and shall conform to the 3/4-inch gradation (operating range).

G. TYPE G:

1. Type G material shall be unwashed river sand, clean and free of trash, peat, organics or other objectionable material and shall conform to the following gradation:

<u>U.S. standard</u> <u>Sieve size</u>	<u>Percent by</u> <u>weight passing</u>
No. 4	100
No. 8	80-100
No. 100	0-35
No. 200	0-8

H. TYPE H:

1. Type H material shall be 6-inch riprap. Riprap shall be graded rock having a range of individual rock weights as follows:

<u>Weight of stone</u>	<u>Percent smaller</u> <u>by weight</u>
10 pounds	100
5 pounds	80-100
2 pounds	45-80
1 pound	15-45
1/2 pound	5-15
Below 1/2 pound	0-5

2. Specific gravity shall be between 2.5 and 2.82 and all rocks shall have three or more fractured faces.

I. TYPE I:

1. Type I material shall be 12-inch riprap. Riprap shall be graded rock having a range of individual rock weights as follows:

<u>Weight of stone</u>	<u>Percent smaller by weight</u>
160 pounds	100
100 pounds	80-100
50 pounds	45-80
20 pounds	15-45
5 pounds	5-15
1 pound	0-5

2. Specific gravity shall be between 2.5 and 2.82 and all rocks shall have three or more fractured faces.

J. TYPE J:

1. Type J material shall be controlled low strength material in accordance with the requirements of the CONTROLLED LOW-STRENGTH CONCRETE Section (03 34 13).

K. TYPE K:

1. Type K material shall be very low to medium expansive soil per Chapter 18 of the Unified Soils Classification System.
2. Type K material shall be native or import material.
3. Material properties shall be based on ASTM D4318 and AASHTO T88. Material shall be classified by the Unified Soil Classification System and ASTM D2487.
  - a. Plasticity index: 15 or less
  - b. Expansion index: 30 or less
  - c. Clay content: less than 15 percent
  - d. Classification: SM or SC
4. If the material excavated from the site meets these requirements, it may be classified as Type K. The material to be used as fill must first be accepted in writing by the District Representative.

L. TYPE L:

1. Type L material shall be clean aggregate consisting of broken stone, crushed gravel, natural rough surfaced gravel, and sand conforming to CalTrans Standard Specification Section 25.

## M. UNSUITABLE MATERIAL:

1. Unsuitable materials include:
  - a. Soils which, when classified under ASTM D 2487 fall in the classifications of Pt, OH, CH, MH, or OL.
  - b. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.
  - c. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing on-site soils.
  - d. Topsoil, except as required for topsoil replacement in agricultural and easement areas.
  - e. Saturated native materials which are over optimum moisture content shall not be considered "unsuitable" simply because they are too wet for proper compaction. The Contractor shall at his cost dry wet materials, mix native materials with suitable imported backfill material, or selected drier material from elsewhere onsite. All mixing shall be performed at approved lay down areas.

## PART 3 -- EXECUTION

### 3.01 GENERAL

#### A. CONTROL OF WATER:

1. The Contractor shall prepare and submit a dewatering plan prior to any excavation that has the potential to encounter water. The Contractor shall keep excavations free from water during construction. Water shall be controlled to prevent softening of the bottom of excavations, or formation of "quick" conditions. Dewatering systems shall not remove natural soils. Groundwater shall be controlled to prevent disturbance of the natural foundation soils or compacted fill and to prevent flotation or movement of structures or pipelines.
2. The Contractor shall be or shall employ a specialty dewatering Contractor with experience in the field of dewatering system design, installation, operation and maintenance. The Contractor shall document successful completion of at least three (3) projects in soils and groundwater conditions similar to the project.
3. Dewatering system shall be designed by a California registered Civil Engineer experienced in the design, installation, and operation of dewatering system.



4. Groundwater discharge shall be based on approved discharge permits. Unless indicated to be provided by the District, Contractor shall obtain all necessary permits and associated costs.
5. The Contractor shall provide, install, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry conditions and prevent hydraulic heave. Control groundwater table at least 3 feet below the bottom of any excavation at all times.
6. Dewatering equipment may include the combination of sump pumps, eductors, well point system, temporary pipelines for water disposal, rock or gravel placement, holding basins, sediment traps, settling tanks and/or other means. Standby pumping equipment including self-contained emergency power generators shall be maintained on the Project site at all times.
  - a. Sump pumps in the pipe trench shall not be the primary means of dewatering. Sump pumps will be allowed in situations only to remove small quantities of accumulated seepage and stormwater run-off. Discharge of any sump pump shall be subject to all the provisions of dewatering permits and plans.
7. System redundancy shall be provided as required to keep excavation free of water in event of failure of well point, pump, eductor, or other component. Contractor shall promptly repair failed equipment and groundwater pipelines. Under no circumstances shall the groundwater be allowed to rise above the bottom of the excavation.
8. Install groundwater monitoring wells as necessary. After work has been completed, wells shall be properly abandoned in accordance with State or local Health Department regulations.
9. In the event that failure of dewatering system caused pipe to rise from the intended grade contractor shall remove and reinstall the pipe, regrade the trench subgrade.
10. If groundwater contaminated with hazardous materials is encountered, the Contractor shall stop dewatering operations and report to the District Representative immediately. Dewatering operations shall not resume until approved by the District Representative.
11. Install and maintain storm water pollution prevention measures in accordance with the approved Storm Water Pollution Prevention Plan (SWPPP) or Water Pollution Control Plan (WPCP), as appropriate.
12. Keep dewatering system in operation until pipe is properly backfilled.
13. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.

14. Cost of groundwater dewatering shall be included in the bid price of the pipe installation.
15. The Contractor shall be fully and solely responsible and liable for all damages which may result from failure to adequately keep excavations dewatered. The Contractor is required to pay all costs associated with damage or delay in schedule that water imposes on the project.
16. The Contractor shall repair without additional cost to the District any damage due to cracking or settlement that may result from his negligence, inadequate or improper installation, maintenance, or operation of the dewatering system, including but not limited to mechanical or electrical failures.
17. Contractor shall be responsible for monitoring settlement of adjacent property resulting from lowering groundwater table. Contractor shall be responsible for property damages due to dewatering operation.

18. PERMITTING:

- a. Contractor shall remain in compliance with approved disposal methods and disposal locations as specified in the National Pollution Discharge Elimination System (NPDES) requirements, Blanket Low Threat Discharge Permit, and Storm Water Pollution Prevention Plan (SWPPP) or Water Pollution Control Plan (WPCP), as appropriate.
- b. Prior to start of work in waters, including wetlands or other jurisdictional lands, or dewatering, Contractor must ensure that all environmental related permits have been secured and are in place.
- c. Removal of sediment through ponds and filters, and testing for contaminants shall be in compliance with the appropriate permits and/or other requirements for disposal.
- d. Contractor shall dispose of water in accordance with permit conditions and without causing damage to adjacent property.

19. DISPOSAL OF WATER:

- a. No dewatering flows from the Project may be discharged to any local drainage ditches, storm drains, or sanitary sewer prior to obtaining a discharge permit from the relevant agency depending on the intended point of discharge or as specified by the District Representative.
- b. All dewatering water shall be desilted through adequately sized desilting tanks prior to discharge.
- c. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent property. No water shall be drained into work built or under

construction without prior written authorization of the District Representative. Water shall be filtered using a method to remove sand and fine-sized soil particles before disposal into any drainage system.

- d. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
  - e. The Contractor shall obtain approval from the District Representative prior to disposing of water into the plant's stormwater or process system. Disposal of water shall not damage property or create a public nuisance.
20. Dewatering system shall be designed to prevent excessive draw down of groundwater table which may cause settlement at neighboring properties.
21. To reduce the migration of water along the pipeline through relatively porous pipe bedding, seepage barriers shall be placed at no more than 1,000-ft intervals along the constructed pipeline. Seepage barriers shall be constructed a minimum of 3-ft from any pipe joints and as shown on the Plans.

**B. OVEREXCAVATION:**

1. Where the undisturbed condition of natural soils is inadequate for support of the planned construction, the District Representative will direct the Contractor to overexcavate to adequate supporting soils.
2. The overexcavated space shall be filled to the specified elevation with backfill.
3. The type, quantity and placement of such material will be paid for as extra work.

**C. SURPLUS MATERIAL:**

1. Surplus materials, resulting from excavations or trenching operations that are not required for backfill or embankment construction as set forth on the plans and specifications, are the property of the District and shall be segregated and disposed at the designated Excess Fill Disposal Area and as directed by the District Representative.
2. Material shall not be stockpiled to a depth greater than 5 feet above finished grade within 25 feet of any excavation or structure. Within 25 feet of any excavation or structure, the depth of stockpiled material shall be as specified. The Contractor shall maintain stability of the soil adjacent to any excavation.

D. SURVEY MONUMENTS:

1. Survey monuments have been or will be set by the District as references for vertical and horizontal control at the locations indicated on the drawings. Survey monuments set by the District shall be carefully preserved by the Contractor. In case such survey monuments are destroyed or damaged, they will be replaced by the District at the Contractor's expense.
2. The Contractor shall be responsible for setting all additional stakes or marks required for the completion of the work indicated on the drawings and in these specifications.

E. HAULING:

1. When hauling is done over existing SRWTP roads, highways or city streets, the loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading. The loads shall be watered after trimming to eliminate dust. Any spilled material shall be immediately cleaned-up.

F. FINISH GRADING:

1. Finished surfaces shall be smooth, compacted and free from irregularities.
2. Finished grade shall be as specified by the contours plus or minus 0.05 foot except where a local change in elevation is required to match sidewalks, curbs, manholes and catch basins, or to ensure proper drainage.
3. When the work is at an intermediate stage of completion, the lines and grades shall be sufficient to provide adequate drainage.

G. CONTROL OF EROSION:

1. The Contractor shall maintain earthwork surfaces true and smooth and protected from erosion in conformance with the approved SWPPP or WPCP, as appropriate.

H. MISCELLANEOUS:

1. For miscellaneous earthwork items not covered in this specification refer to SACSPEC.

**3.02 INSTALLATION (NOT USED)**

**3.03 CLASSIFICATION OF FILL**

- A. Unless otherwise shown on the drawings, fill classes shall be used where specified in Table A under General Application.

**Table A, Fill Classifications**

<b>Fill Class</b>	<b>Material type</b>	<b>Maximum uncompressed layer depth, inches</b>	<b>Minimum relative, compaction, percent</b>	<b>General Application</b>
B1	B	8	90	Subsequent trench backfill not under improvements
C1	C	8	95	<ol style="list-style-type: none"> <li>1. Site fill not under structures, equipment pads, pavement or any improvement</li> <li>2. Embankments</li> <li>3. Subsequent trench backfill not under improvements</li> <li>4. Backfill over pipes and electrical ductbanks encased in concrete and not under improvements</li> <li>5. Backfill outside a horizontal distance equal to one half the total depth of fill from structures</li> </ol>
D1	D	8	N/A	--
E1	E	6	N/A	<ol style="list-style-type: none"> <li>1. Fill under slabs for structures with pressure relief valves</li> <li>2. Bedding and initial pipeline backfill for SD and STD piping systems &lt; 48 inches in diameter. Completely encase bedding and initial backfill with geotextile fabric with a minimum overlap of 18 inches.</li> </ol>
F1	F	8	95	<ol style="list-style-type: none"> <li>1. Top 6 inches of fill under slab-on-grade and foundations for structures</li> <li>2. Asphalt paving aggregate base</li> <li>3. Structure backfill.</li> <li>4. Bedding for precast concrete, underground structures.</li> <li>5. No recycled/reclaimed asphalt will be allowed where exposure to groundwater may occur.</li> </ol>
G1	G	8	95	Bedding and initial pipeline backfill for all pipelines <u>except</u> SD and STD piping systems
H1	H	N/A	N/A	RIPRAP SHALL BE PLACED WHERE SHOWN OR SPECIFIED
I1	I	N/A	N/A	RIPRAP SHALL BE PLACED WHERE SHOWN OR SPECIFIED

<b>Fill Class</b>	<b>Material type</b>	<b>Maximum uncompressed layer depth, inches</b>	<b>Minimum relative, compaction, percent</b>	<b>General Application</b>
J1	J	N/A	N/A	<ol style="list-style-type: none"> <li>1. Bedding and initial backfill under exposed existing utilities</li> <li>2. Bedding and initial backfill at utility crossings or where utilities are stacked</li> <li>3. Bedding and backfill up to springline for reinforced concrete pipe &gt; 48 inches diameter</li> </ol>
K1	K	8	95	<ol style="list-style-type: none"> <li>1. Fill below top 6 inches of Class F1 fill under structures</li> <li>2. Structure backfill</li> <li>3. Subsequent trench backfill</li> </ol>
K2	K	8	97	Embankments

### **3.04 EARTHWORK FOR STRUCTURES**

#### **A. STRUCTURE EXCAVATION:**

1. The bottom shall not be more than 0.15 foot below the lines and grades specified. If the elevation of structure excavation is not specified, the excavation shall be not more than 0.15 foot above or below the elevation specified for fill material below the structure.
2. Should the excavation be carried below the lines and grades specified on the drawings or should the bottom of the excavation be disturbed because of the Contractor's operations and require overexcavation and backfill, the Contractor shall backfill such excavated space to the proper elevation in accordance with the procedure specified for structure backfill. The cost of such work shall be borne by the Contractor.
3. Excavations shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is specified to be placed directly against excavated surfaces.
4. Whenever any structure excavation is substantially completed to grade, the Contractor shall notify the District Representative who will make an inspection of the subgrade.

#### **B. FOUNDATION TREATMENT:**

1. The subgrade of structural excavations shall be compacted to the minimum relative compaction shown in Table A. No Type F material, concrete or masonry shall be

placed until the subgrade has been inspected and approved by the District Representative.

2. All footings, foundations, slabs-on-grade, and asphalt paving shall be underlaid with a minimum of 6 inches of Type F fill. This minimum 6 inches of Type F fill shall be provided whether indicated on the plans or not.
3. When footings are to be supported on piles or piers, excavations shall be completed to the bottom of the footings before any piles or piers are installed. When swell or subsidence results from driving piles, the Contractor shall excavate, or backfill, the footing area to the grade of the bottom of the footing.
4. If material under footings is such that it would not support the weight of the fluid concrete, the Contractor shall replace the material, or otherwise provide a suitable platform on which to cast the footing as directed by the District Representative. This will be paid for as extra work.

**C. STRUCTURE BACKFILL:**

1. After completion of construction below the elevation of the final grade, and prior to backfilling, forms shall be removed and the excavation shall be cleaned of debris.
2. Structure backfill shall not be placed until the at-grade decks and subgrade portions of the structure have been inspected and approved by the District Representative.
3. No backfill material shall be deposited against concrete structures until the concrete has developed a compressive strength of at least 3000 pounds per square inch and the concrete has been in place for at least 7 days.
4. Backfill material shall be brought up uniformly on all sides of the structure.
5. Compaction shall be accomplished by mechanical equipment such as tamping rollers, sheepsfoot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical tampers suitable for the work.
6. Light hand-operated tampers shall be used within 1 foot of structures to minimize the possibility of overstressing structure walls. Maximum uncompressed layer depth shall be 4 inch lifts.
7. Compaction by ponding and jetting shall not be permitted.

**3.05 EARTHWORK FOR PIPELINES**

**A. GENERAL:**

1. Pipelines shall be installed in trenches.

2. Backfill around and above pipelines within the excavation of any structure shall be the same as that specified for structures.
3. Perform dewatering prior to excavation.
4. Excavation support: Install and maintain trench excavation support system as specified.
5. Do not over-excavate without written authorization of the District Representative.

#### B. TRENCH EXCAVATION

1. Trench excavation shall include the removal of all materials or obstructions of any nature.
2. Before excavation of the pipe trench in fill areas or roadway embankments, the fill area or embankment shall be completed to a height above the pipe invert grade line of not less than 12 inches above the top of the pipe or as recommended by the pipe manufacturer, whichever is greater.
3. When the trench is in an existing paved area, the pavement shall be saw cut on neat lines parallel and equidistant from the trench centerline. Pavement between the lines shall be broken and removed immediately ahead of the trenching operations. The width of pavement removed shall be sufficient that the trenching operation does not damage the edges of the pavement left in place.
  - a. When the existing pavement is concrete, it shall be removed to a neat line a minimum of 6 inches wider on each side than the actual trench width.
  - b. When the existing pavement is asphalt concrete, it shall be removed to a neat line a minimum of 12 inches wider on each side than the actual trench width.
4. The fill area or embankment shall be compacted to a minimum relative compaction of 95 percent for a distance on each side of the pipe equal to at least two pipe diameters. Prior to excavation contact Underground Services Alert (USA) to mark underground utilities.
5. Where the existing utility piping is expected, hand dig (pothole) the area to expose the existing utilities and survey the utility piping size and elevation prior to trench excavation.
6. Install traffic control devices in accordance with approved traffic control plan as required.



7. Excavate trenches per approved Trench Excavation Plan:
  - a. Excavate trench to lines and grades shown or as established by the District Representative with proper allowance for pipe wall thickness and bedding.
  - b. Support existing piping where proposed utility line crosses at a lower elevation. Exposed existing piping shall be supported and braced against seismic forces.
  - c. Stabilize excavation to prevent undermining of existing structures, utilities and piping.
  - d. Install trench shield or sheeting/shoring system in accordance with the approved Trench Excavation Plan.
8. Open trench outside buildings, units, and structures:
  - a. No more than the distance between two manholes, structures, units, or 300 lineal feet, whichever is less.
  - b. Field adjust limitations as weather conditions dictate.
  - c. Cover open trench with H-20 traffic rated steel plates at the end of each working day.
9. Trenching within buildings, units, or structures:
  - a. No more than 100 lineal feet at any one time.
10. Any trench or portion of trench, which is opened and remains idle for 7 calendar days, or longer, as determined by the District Representative, may be directed to be immediately refilled, without completion of work, at no additional cost to District.
  - a. Said trench may not be reopened until the District Representative is satisfied that work associated with trench will be prosecuted with dispatch.
11. Trench width for pipelines:
  - a. Unless otherwise shown on the drawings, minimum trench width for piping shall be the outside diameter of the piping plus 12 inches.
  - b. Maximum trench widths at the top of the pipe shall be as shown on the plans for the designated type bedding.
  - c. For drainage pipe, if no maximum is shown, the Contractor shall limit top trench widths to pipe outside diameter plus 16 inches for pipe 33 inches or smaller, and pipe outside diameter plus 24 inches for pipe 36 inches and larger, except upon a specific approval of the District Representative.

12. Observe following trenching criteria:

- a. Excavate width to accommodate free working space for joint installation and soil compaction.
- b. With the exception of pipe joints where trench width and depth should be increased to allow joint installations, maximum trench width at top of pipe or conduit may not exceed outside diameter of pipe by more than 36 inches:
- c. If a movable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls.
- d. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring.
- e. Cut trench walls vertically from bottom of trench to 1 foot above top of pipe, conduit, or utility service.
- f. Keep trenches free of surface water runoff. Include cost in Bid. No separate payment for surface water runoff pumping will be made.

13. Whenever the bottom of the trench is soft or rocky, or, in the opinion of the District Representative, otherwise unsuitable as a foundation for the pipe the unsuitable material shall be removed and replaced with suitable material to provide a stable and satisfactory base. This will be paid for as extra work.

C. PIPE BEDDING AND INITIAL BACKFILL:

1. All loose material shall be removed from the trench bottom before placing the bedding material.
2. The pipe shall be placed on a bed of imported materials. The pipe shall be bedded uniformly throughout its length. Bedding shall extend at least 4 inches below the pipe barrel and 1-1/2 inches below the pipe joint bell.
3. No wedging or blocking of the pipe will be permitted to remain permanently in place. The bearing shall be achieved by shaping the bedding or by lightly "bouncing" the pipe to set it into the bedding.
4. The Contractor shall then place backfill material to the spring line of the pipe, thoroughly compacting it by shovel slicing and tamping to provide proper support under the pipe haunches. Care shall be used not to disturb or displace the pipe.
5. Initial backfill shall be carefully placed evenly on both sides of the pipe so as not to disturb or damage the pipe, and compacted to the specified compaction. Jetting will not be allowed.

6. Compaction of layers shall be accomplished with a minimum two passes of light hand-operated equipment with complete coverage across the width of the field.
7. Type D material shall be vibrated under and around pipe with a high cycle concrete vibrator.

**D. TRENCH BACKFILL:**

1. Subsequent trench backfill above the initial backfill shall be placed and compacted to obtain 6-inch layers. Machine-placed backfill material shall not be allowed to "free-fall" more than 2 feet, until the total backfill above the top of the pipe exceeds 3 feet.
2. If the excavation is through an area used for horticulture, lawns or other cultivated areas, the final 12 inches of backfill shall be the original topsoil which shall have been removed and stockpiled separately. The backfill shall be thoroughly compacted by wheel rolling, then refilled with topsoil as necessary to bring the trench up to the level higher than the surrounding ground.
3. Compaction shall be accomplished by mechanical equipment such as tamping rollers, sheepsfoot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical equipment suitable for the work.
4. Light hand-operated tampers shall be used within 1 foot of structures to minimize the possibility of overstressing structure walls.
5. Compacting by flooding or jetting will not be allowed.

**3.06 EARTHWORK FOR ELECTRICAL CONDUIT DUCT BANKS**

**A. GENERAL:**

1. Duct banks shall be installed in trenches.
2. Backfill around and above duct banks within the excavation of any structure shall be the same as that specified for structures.

**B. TRENCH EXCAVATION:**

1. Trench excavation shall include the removal of all materials or obstructions of any nature.
2. When the trench is in an existing paved area, the pavement shall be saw cut on neat lines parallel and equidistant from the trench centerline. Pavement between the lines shall be broken and removed immediately ahead of the trenching operations. The width of pavement removed shall be sufficient that the trenching operation does not damage the edges of the pavement left in place.

- a. When the existing pavement is concrete, it shall be removed to a neat line a minimum of 6 inches wider on each side than the actual trench width.
  - b. When the existing pavement is asphalt concrete, it shall be removed to a neat line a minimum of 12 inches wider on each side than the actual trench width.
3. Trench width of duct banks:
- a. For reinforced concrete duct banks, the trench width shall provide a minimum of 3 inch clear from edge of trench to reinforcing steel.
  - b. For unreinforced concrete duct banks, the minimum trench width shall be 6 inches wider than the outside dimension of the conduit ducts.
4. Whenever the bottom of the trench is soft or rocky, or, in the opinion of the District Representative, otherwise unsuitable as a foundation for the duct bank the unsuitable material shall be removed and replaced with suitable material to provide a stable and satisfactory base. This will be paid for as extra work.

**C. TRENCH BACKFILL:**

1. Trench backfill shall not be placed until the duct bank concrete has been in place for 48 hours.
2. Trench backfill shall be placed and compacted to obtain 6-inch layers.
3. If the excavation is through an area used for horticulture, lawns or other cultivated areas, the final 12 inches of backfill shall be the original topsoil which shall have been removed and stockpiled separately. The backfill shall be thoroughly compacted by wheel rolling, then refilled with topsoil as necessary to bring the trench up to the level higher than the surrounding ground.
4. Compaction shall be accomplished by mechanical equipment such as tamping rollers, sheepsfoot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical equipment suitable for the work.
5. Light hand-operated tampers shall be used within 1 foot of structures to minimize the possibility of overstressing structure walls.
6. Compacting by flooding or jetting will not be allowed.

**3.07 EARTHWORK FOR EMBANKMENTS**

**A. FOUNDATION PREPARATION:**

1. The foundation soils shall not exceed the optimum moisture content for a minimum of 3 foot depth below the bottom of excavation. The surface of the foundation shall

be free of loose material, foreign objects and rocks greater than 6 inches in maximum dimension.

2. Immediately prior to placement of embankment fill material, the foundation surface shall be moistened, scarified to a depth of 8 inches, moisture conditioned to optimum moisture content, and recompact to the relative compaction as shown.
3. After the preparation has been completed, the Contractor shall immediately place and compact the first lift of embankment on the foundation to prevent damage to the surface. If the foundation surface is damaged, the Contractor shall repair the surface to the specified condition.

**B. EMBANKMENT FILL:**

1. The temporary differential elevation between any two adjoining zones of the embankment due to construction operations shall not exceed 24 inches.
2. Fill slopes shall be overfilled and trimmed back to the lines and grades shown on the drawings to expose a firm surface free of loose material.
3. If the compacted surface of any layer of material is too smooth to bond properly with the succeeding layer, the surface shall be scarified. The surface shall be moisture conditioned before the succeeding lift is placed. Any surface crust formed on a layer of fill material that has been dumped and spread shall be broken up and the full depth of the affected layer shall be moisture conditioned to the optimum moisture content immediately prior to rolling.
4. The surface of the embankment shall be maintained to permit travel of construction equipment. In any areas where materials become soft or yielding, such materials shall be removed, disposed of, and replaced with specified material. Ruts in the surface of any layer shall be filled and leveled before compacting.
5. Embankment material moisture shall be within optimum minus one percent (-1.0%) to optimum plus two percent (+2.0%) as determined by ASTM D1557.
6. When the moisture content and conditions of the embankment material are satisfactory, fill material shall be placed and compacted by a minimum of eight passes of a sheepsfoot tamper roller or approved equivalent. Roller drums shall be no less than 60 inches in diameter and not less than 60 inches in length. The weight of the roller shall not be less than 4000 pounds per linear foot of drum length. If, with the required water content, it is found necessary to roll each 8-inch layer more than eight times to obtain the required compaction, the number of passes shall be changed accordingly as directed by the District Representative. However, the embankment fill shall be compacted to an average density of at least 97 percent with no test less than 95 percent, as determined by ASTM D1557. Compaction by flooding or jetting will not be permitted.

C. EMBANKMENT TOLERANCES:

1. GENERAL:

- a. Embankment slopes shall vary less than 0.5 foot from the designated slope. Measurements for variance shall be made perpendicular to the slope. Slopes which are 6:1 or flatter shall vary less than 0.2 foot from the designated slope.

2. ROADWAY EMBANKMENT TOLERANCES:

- a. The excavated surface shall be less than 0.08 foot above or below the grades specified after deducting for the roadway pavement thickness.
- b. Vertical alignment tolerances permitted on the roadway surface shall not exceed plus or minus 0.30 feet from the vertical alignment specified, with the provision that within the tolerance range local surface irregularities shall not exceed 0.15 foot as measured by the gap between the roadway surface and a 10-foot straightedge placed on any flat graded surface. On vertical curves, the same standards will apply except that an additional gap allowance will be made for the road surface curvature over the 10-foot length of the straightedge.
- c. Horizontal alignment tolerances permitted shall not exceed plus or minus 1 foot providing the departure is relatively uniform over any specific length of the roadway.
- d. Roadway median strips shall be graded to drain and shall not vary more than 0.1 foot from the specified grade.

**3.08 EARTHWORK FOR PAVEMENT**

- A. The prepared subgrade shall be scarified a minimum of 12 inches below finish subgrade and recompact to at least 95 percent of the maximum density.
- B. Pavement aggregate base material shall be installed in accordance with Caltrans Standard Specifications Section 26 and the ASPHALT PAVING Section (32 12 16). Material shall be compacted per California Test 231.

**3.09 SITE FILL**

- A. If the existing slope in an area to be filled is greater than 5:1, the Contractor shall bench the area prior to filling.

**3.10 DUST CONTROL**

- A. Contractor shall provide dust control as specified in the SITE CLEARING Section (31 10 00).

### 3.11 SHORING AND SHEETING

- A. The Contractor shall construct and maintain all shoring, sheeting, and slope layback necessary to protect the excavation, as needed for the safety of the employees and as required by applicable state and federal laws and as specified in the SHORING Section (31 40 00).

### 3.12 TESTING

#### A. QUALITY CONTROL:

1. The Contractor shall be completely responsible for conducting all compaction testing and quality control of compacted fill to determine that the compaction requirements are being met.
2. The Contractor shall have the equipment and capability to perform in-place and maximum density tests, as specified, in the field at the construction site. All testing shall be conducted under the authority and responsible charge of a professional civil or geotechnical engineer or a certified engineering geologist.
3. Field density tests during fill compaction shall be performed at least once for every 100 cubic yards of fill and at least once for every 1 foot of vertical fill height. Tests will be made in accordance with the following criteria:

<u>Standard Procedure Test</u>	<u>Reference</u>
Moisture Content	ASTM D2216 and D6938-10
Gradation	ASTM C136
Moisture-Density Relationship	ASTM D1557
Sand Equivalent	ASTM D2419
Maximum Density	ASTM D1557
Pavement Base Compaction	CTM 231

4. All daily field and laboratory testing reports shall be provided within 24 hours of completion to the District Representative during mass grading and during backfill of utilities and structures.
5. All areas not meeting the specified compaction requirements shall be reworked and retested within 24 hours.
6. At the conclusion of all backfill and grading work, a compaction report shall be submitted to the District Representative documenting all field and laboratory test results. Any field density test that does not meet the specified compaction requirement shall be shown as a failed test, and a successful retest shall be indicated in the report.

## B. QUALITY ASSURANCE:

1. The District will take samples and perform tests during placement of fill and backfill materials to check compliance with these specifications. This quality assurance will serve to validate the quality control testing provided by the Contractor.
2. The Contractor shall remove surface material at locations designated by the District Representative and provide such assistance as necessary for sampling and testing. The District Representative may direct the Contractor to construct inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these specifications. Payment for inspection trenches shall be as specified in the GENERAL CONDITIONS Section (00 72 00).

### 3.13 TRAINING – NOT USED

**\*\*END OF SECTION\*\***

#### Notes to Specifier:

1. Drawings need to show acceptable stockpile locations. The areas should be identified as “Excess Fill Disposal Area”. Coordinate with Plant staff and other projects.
2. Buried structures that can be abandoned in place should be identified on the drawings along with a note to fill with Type J material.
3. The Designer is responsible to determine whether there is sufficient native backfill material for the project. This is to be accomplished by soils investigation and mass balance calculations. If it is determined that import backfill material will be (or has the potential to be) necessary, then an “Import Type \_\_ Fill Material” item should be included on the bid schedule. The bid item should include an estimated quantity to be used in calculating the bid.
4. Include the project soils report in the Appendix to the project specifications.



## SECTION 31 41 00

### SHORING

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies requirements for sheeting, shoring, and bracing of trenches and structural excavations greater than 5 feet in depth. The Contractor shall design sheeting, shoring, and bracing in accordance with Title 8, Division 1, Chapter 4, Sub-Chapter 4, Article 6 of Cal/OSHA.

##### 1.02 REFERENCES

- A. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
Title 8 Article 6	California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Article 6 – Excavations
Section 6705	California Labor Code

##### 1.03 SUBMITTALS

- A. The following information shall be submitted for review for trenches and excavations deeper than five feet or those requiring support in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
  1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. Contractor designed shoring system signed and stamped by a registered California Engineer. Calculations and design drawings shall be submitted for shoring systems for:
    - a. Trench excavation

- b. Structure excavation
- 3. MANUFACTURER'S DATA:
  - a. Wood sheeting, plywood, dimensional lumber.
  - b. Hydraulic shoring, screwjacks.
- 4. Qualified personnel resumes.

#### **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

### **PART 2 -- PRODUCTS**

#### **2.01 CONTRACTOR'S DESIGN**

- A. Contractor's design shall include access, barricades, shoring, bracing, sloping, benching, bulkheads, cofferdams, dewatering, and other items required to conform to CAL/OSHA Article 6. The design shall be prepared and signed by a registered civil engineer registered in the state of California for depths to 20 feet or a California registered structural engineer for depths greater than 20 feet.
- B. The Contractor's attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. The Contractor, prior to beginning any trench or structure excavation 5 feet deep or over shall submit to the District Representative and shall be in receipt of the District Representative's written acceptance of the Contractor's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, monument monitoring, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative systems plans shall be prepared and sealed by a civil or structural engineer licensed in the State of California.
- C. The Contractor's attention is also directed to the California Code of Regulations, Title 8, Section 1541.1. The code requires when excavation is adjacent to an existing structure, a registered professional engineer must approve the determination that such excavation work will not pose a hazard to employees. It is the Contractor's responsibility to hire a California Registered Civil Engineer to prepare analysis on trench safety, and to install all safety measures recommended by the Registered Engineer.
- D. Excavation support systems shall be designed by the Contractor to support earth pressure, unrelieved hydrostatic pressure, utility loads, equipment, applicable traffic loads, and other surcharge loads in such manner as will allow safe construction and will prevent damage to adjacent structures (including existing pipelines and utilities) and injury to workers and the public. In addition, a shoring deflection analysis shall be

performed. The installation of excavation support system shall not cause a disruption to SRWTP operations or maintenance access. Design shall be prepared and sealed by a California registered Civil or Structural Engineer.

- E. If utilized, all soldier piles shall be placed in pre-drilled holes and grouted in-place to a depth in accordance with the Contractor's Plan.
- F. The owner's approval of the Contractor's plans and methods of construction does not relieve the Contractor of the responsibility for adequacy of the design, installation or resulting trench support.

## **2.02 MATERIALS**

- A. Materials shall conform to the requirements of CAL/OSHA Article 6.

## **PART 3 -- EXECUTION**

### **3.01 GENERAL**

- A. The construction of sheeting, shoring, and bracing shall not disturb the state of soil adjacent to or below the excavation bottom. This work shall be coordinated with the EARTH MOVING Section (31 20 00).
- B. Horizontal strutting below the barrel of a pipe being installed is not acceptable. The pipe being installed shall not be used for support of the excavation.

### **3.02 INSTALLATION (NOT USED)**

### **3.03 TESTING (NOT USED)**

### **3.04 TRAINING (NOT USED)**

### **3.05 SEQUENCE**

- A. Excavation of 5 feet or more shall not be started until the design of the sheeting, shoring and bracing system has been submitted in accordance with the SUBMITTAL PROCEDURES Section (01 33 00).
- B. Excavations of less than 5 feet can be started only after the qualified supervisor (competent person as defined by OSHA) has inspected the ground and determined there is no potential cave-in hazard.

### **3.06 SUPERVISION**

- A. Work in an excavation of 5 feet or more shall at all times be under the immediate supervision of a qualified person who is authorized to modify the shoring or sloping in accordance with CAL/OSHA Article 6.

- B. A qualified supervisor shall inspect the excavation, air quality, adjacent areas and protective equipment. Inspections shall be made daily, at shift start, and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard intensity occurrence.

### **3.07 ACCESS**

- A. A convenient and safe means of access shall be provided to enter and leave an excavated area. This shall consist of a stairway, ladder or ramp securely fastened in-place. For trenches 4 feet or more in depth, a safe means of access shall be provided and located so as to require no more than 25 feet of lateral travel.

### **3.08 CROSSINGS**

- A. When walkways or bridges are provided across excavated areas, they shall be provided with standard guardrail and toeboards when the depth of excavation exceeds 6 feet in depth and is more than 30 inches wide.

### **3.09 AIR QUALITY TESTING**

- A. The qualified supervisor shall test the atmosphere for oxygen deficiency and flammable gas concentrations before any person enters excavations greater than 4 feet in depth.

**\*\*END OF SECTION\*\***

## SECTION 31 71 26.13

### UTILITY PIPE JACKING

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies jacked casing and carrier pipe crossing beneath the Union Pacific Railroad tracks and right-of-way as shown and specified.

###### B. DESIGN REQUIREMENTS:

1. Contractor shall install carrier pipe and casing pipe in accordance with Union Pacific Railroad Company Common Standard Specification C.S. 1029, as revised July 1990.
2. Casing pipe shall be designed for the following conditions:
  - a. Dead load - minimum soil cover of twelve (12) feet
  - b. Live load - Coopers E72
  - c. Minimum wall thickness shall be 0.625 inch.
3. Carrier pipe shall be ASTM 361 rated for 15 feet of cover and 20 feet of internal hydraulic head. Carrier pipe shall be steel pipe conforming to the STEEL PROCESS PIPE Section (40 05 24).

##### 1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of the referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C206	Field Welding of Steel Water Pipe
ASTM A36/A36M	Structural Steel

<u>Reference</u>	<u>Title</u>
Union Pacific Railroad Company Standard Number 1029	Specifications for Pipelines with Maximum Casing Diameter of 48 Inches Common and Encased Gas Transmission Lines Crossing Under Railroad Tracks (Part B. For Nonflammable Substances)

### **1.03 SUBMITTALS**

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviation.
  2. Description of equipment to be used and timetable for disposing of excavated soil from boring.
  3. Material certification for steel casing pipe.
  4. Joint detail and wall thickness for steel carrier pipe.
  5. Description of plan for grouting annular space between casing pipe and carrier pipe.

### **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS – NOT USED**

### **1.05 UNIT RESPONSIBILITY**

- A. The Contractor shall assign unit responsibility to the jacking subcontractor, if the work specified in this section is subcontracted. The unit responsibility shall include providing and installing both the casing and carrier pipe, materials for filling the annular space between pipes, and temporary facilities required for jacking and boring.

## **PART 2 -- PRODUCTS**

### **2.01 CASING PIPE**

- A. Pipe for casings shall be steel, 18-inch minimum diameter and 0.625 inches minimum thickness. The Contractor is responsible for fully acquainting himself with the conditions of the work to determine the diameter and thickness of the casing pipe required to do the work. The pipe shall be unlined and uncoated, meeting the requirements of AWWA C200. Joints as required by the Contractor's operation shall be continuous butt-welded joints capable of developing the strength of the pipe and in full conformance with the requirements of AWWA C206. Joints shall be flush with the

outside diameter of the pipe. Joints shall be designed for jacking pressures based on Contractors design for installation. Pipe shall be Grade A-36 steel minimum.

## **2.02 CARRIER PIPE**

- A. Carrier pipe shall be steel pipe conforming to the STEEL PROCESS PIPE Section (40 05 24). Joints shall be welded. Contractor shall install carrier pipe that does not exceed a maximum outside diameter of 10 inches.

## **2.03 ANNULAR SPACE**

- A. Contractor shall provide concentric annular space, minimum 3 inches, between the casing pipe and the carrier pipe. Contractor shall fill and seal the annular space with cementitious grout as shown and specified. Contractor shall prepare a test plan to verify that annular space is filled completely.

## **2.04 CORROSION TEST STATION**

- A. Corrosion test station components shall be as specified in the CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).

# **PART 3 -- EXECUTION**

## **3.01 INSTALLATION OF JACKED STEEL CASING PIPE**

- A. Casing pipe shall be installed by jacking as indicated on the drawings. The Contractor shall remove or penetrate all obstructions encountered. If groundwater is found during construction, the Contractor shall control the flow sufficiently to protect the excavation, pipe, and equipment. Groundwater shall be controlled as specified in the EARTH MOVING Section (31 20 00). Any pipe damaged during the jacking operation shall be repaired by the Contractor at no expense to the District in a manner acceptable to the District Representative.
- B. A bentonite slurry may be used for lubricating the pipe but shall not be projected ahead of the pipe.
- C. Sluicing or jetting will not be permitted.
- D. In the event that the pipe is damaged during jacking operations and the defects cannot be corrected to the satisfaction of the District Representative, the Contractor shall fill the pipe with sand and seal it in a manner to prevent future settlement and begin jacking in an alternative location as designated by Union Pacific Railroad.
- E. Deviations in line and grade of the casing pipe will only be allowed to the extent that the carrier pipe can be shifted within the casing to compensate for the deviation. The Contractor shall remove all augers and check the alignment and grade of the leading end of the casing often enough to be able to correct any line or grade deviations while

the boring is in progress. In no event shall the line and grade checks be at intervals exceeding 40 feet. The Contractor shall correct any deviation from grade or alignment resulting from the bore at no cost to the District.

- F. Special care shall be taken during the installation of the jacked pipe to ensure that no settlement or caving be caused to the above surface. Any caving caused by the placement of the pipe shall be the Contractor's responsibility and he shall repair any area so affected as directed by the District Representative. Refer to permit for requirements of grade checking.
- G. During jacking operations, particular care shall be exercised to prevent caving ahead of the pipe which will cause voids outside of the pipe. If caving occurs, the Contractor shall install three 1-1/2-inch grout ports, 120 degrees apart every 8 feet along the casing. The District Representative will inspect each port after opening to confirm the requirement for grouting. Cement grout shall then be pumped into each port under low pressure. Grout shall be placed by positive displacement pumps capable of placing grout at pressures up to 50 psi unless otherwise allowed by the District Representative. Grout shall be placed at pressures which are requisite for the conditions encountered and will normally be less than 10 psi except in cases where large cave-ins or other adverse conditions may require higher pressures. Gages shall be provided to indicate grout pressure obtained. All voids shall be filled to the satisfaction of the District Representative.
- H. The carrier pipe shall be installed in the casing using creosote-treated Douglas fir skids or alternate acceptable to the District Representative. The first pipe joint outside all casings shall be within 12 inches of the end of the casing. The casing pipe shall then have cement grout placed in it to the top of the casing pipe. After the lines have been pressure tested, cement grout plugs shall be placed at each end of the casing pipe.
- I. The pipe shall be jacked ahead when stopping work each night to create a plug of sufficient thickness to assure material stability.
- J. A corrosion test station shall be installed on each side of the casing as specified in the CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).
- K. Electrical isolation testing between the casing and carrier pipe shall be conducted as specified in the CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).

**\*\*\*END OF SECTION\*\*\***



Notes to Specifiers:

1. Annular space may not be required to be filled, depending on crossing specifics. A previous District UPRR cross was required to leave the annular space unfilled for a reclaimed water pipeline crossing north of Sims Road. Specifier shall research permitting agency requirements prior to editing specification.

## SECTION 32 12 16

### ASPHALT PAVING

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies paving consisting of scarifying, grading, compacting, sealing, asphaltic concrete, and associated materials.

##### 1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern, except where a specific date or edition is given below. In case of conflict between the requirements of this section and those of the listed references, the requirements of this section shall govern.

<u>Reference</u>	<u>Title</u>
County of Sacramento Standard Construction Specification (SACSPEC)	
SS-23	Asphalt Concrete
Section 48	Traffic Stripes and Pavement Markings
State of California Department of Transportation (Caltrans)	
	Standard Plans and Specifications
CTM 205	Method of Test for Percentage of Crushed Particles
CTM 216	Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregate
CTM 231	Method of Testing for Relative Compaction of Untreated and Treated Soils and Aggregates by the Area Concept Utilizing Nuclear Gauges

###### B. DEFINITIONS: (Not Used)

### **1.03 SUBMITTALS**

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
  - 1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  - 2. Manufacturer's data and mix design.
  - 3. A certificate of compliance signed by the manufacturer shall be furnished prior to the use of all bituminous materials. The certificate shall state that the material complies with the requirements of these specifications. A certificate shall be furnished with each lot of material delivered to the site and the lot so certified shall be clearly identified in the certificate.

### **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

## **PART 2 -- PRODUCTS**

### **2.01 LIQUID ASPHALT**

- A. Liquid asphalt base shall be Grade MC 250 conforming to Caltrans Section 93.

### **2.02 SEAL COAT**

- A. The bituminous binder shall meet all requirements of Caltrans Section 94-1.02 including Table 1 for Type SS-1 slow setting anionic asphaltic emulsion.

### **2.03 TACK COAT**

- A. Material for tack coat shall be SS-1 grade emulsified asphalt conforming to Caltrans Section 94.

### **2.04 PAVEMENT REINFORCING FABRIC**

- A. Pavement reinforcing fabric, where required on the drawings, shall conform to the provisions of Section 39-4.03 and Section 88-1.02 of the State Standard Specifications, "Pavement Reinforcing Fabric". Paving fabric shall have minimum asphalt retention of 0.2 gallon per square yard per Task Force 25 Method #8, certified by the manufacturer, shall be of stable fiber construction in order to resist delamination and shall be heat bonded on one side in order to facilitate handling and trafficking

### **2.05 ASPHALT CONCRETE**

- A. Aggregate shall be Type A, 3/4-inch maximum medium grading, conforming to Caltrans Section 39. Asphalt binder shall be paving asphalt, Grade PG-64-10, and

shall comply with Caltrans Section 92. Asphalt concrete mixing and proportioning shall comply with Caltrans Section 39.

## **2.06 TRAFFIC LINE PAINT**

- A. Traffic line paint and pavement markings shall conform to Section 48 of the Sacramento County Standard Specifications and Section 84 of the Standard State Specifications.

## **2.07 CHIP SEAL**

- A. This work shall consist of preparing and applying two coats of asphalt emulsion and screenings to the compacted aggregate base roadway. This double chip seal shall consist of an application of asphalt emulsion followed with an application of screenings, and another application of asphalt emulsion followed with another application of screenings.
- B. Asphalt emulsions shall be composed of a bituminous material uniformly emulsified with water and an emulsifying or stabilizing agent and conform to the requirements prescribed in Caltrans Section 94-1.02 "Requirements". Emulsified asphalt shall be Type CRS-2, or equal.
- C. Screenings shall consist of broken stone, crushed gravel, or both. At least 90 percent by weight of the screenings shall consist of crushed particles as determined by Caltrans CTM 205. Screenings shall be clean and free from dirt and other deleterious substances. Screenings shall be sized at 3/8-inch by No. 6 or 5/16-inch by No. 8, as specified as a "medium or medium fine" seal coat type in Caltrans standard specifications Section 37-1.02 "Materials".

## **2.08 GEOTEXTILE FABRIC**

- A. Geotextile fabric, where required on the drawings, shall be Mirafi 140.

## **PART 3 -- EXECUTION**

### **3.01 GENERAL**

- A. Construction shall conform to the details, dimensions and grades specified and shown on the drawings. Maximum variations in finished grade of paving shall be plus or minus 0.05 feet. Survey monuments have been or will be set by the District in the locations indicated on the drawings as reference for vertical and horizontal control. The Contractor shall be responsible for setting all additional stakes or marks required for the completion of the work. New paving shall be installed after all trenching and backfilling is completed beneath it in accordance with the EARTH MOVING Section (31 20 00) and all associated piping has been tested and accepted. Installation shall comply with "Standard Construction Specifications" of the County of Sacramento

referred to herein as CSCS and with "Standard Plans and Specifications" of the State of California, Department of Transportation referred to herein as Caltrans.

### **3.02 INSTALLATION**

#### **A. PLACEMENT OF AGGREGATE BASE AND SUBGRADE FOR ROADWAYS:**

1. Refer to the EARTH MOVING Section (31 20 00) for aggregate base and subgrade materials.
2. SUBGRADE PREPARATION:
  - a. The subgrade shall be compacted as specified in accordance with the EARTH MOVING Section (31 20 00).
3. AGGREGATE BASE TOLERANCE:
  - a. The aggregate base shall not be placed before the subgrade is approved by the District Representative. The finished aggregate base shall not vary more than 0.05 foot above, nor 0.10 foot below, the planned grade.
4. AGGREGATE BASE PLACING:
  - a. The aggregate base material shall be spread on the prepared subgrade by means of approved spreading devices subject to approval by the District Representative; the aggregate base material may be dumped in piles upon the subgrade and spread by bulldozing ahead from the dumped material. Each layer shall not exceed 0.50 feet. Segregation of large or fine particles of aggregate shall be avoided, and the material as spread shall be free from pockets of large and fine material.
  - b. The relative compaction of each layer of compacted aggregate base and subgrade material shall in accordance with the EARTH MOVING Section (31 20 00). Compaction shall not be less than 95 percent of Caltrans CTM 216 as determined by Caltrans CTM 231). Compaction shall be in accordance with Caltrans Section 26-1.05. Aggregate base, after compaction, shall be watered as provided in Caltrans Section 17.

#### **B. TACK COAT APPLICATION:**

1. TACK COAT:
  - a. In advance of spreading bituminous material upon an existing bituminous or Portland cement concrete surface, a tack coat shall be applied to all areas to be surfaced and to all vertical surfaces of existing pavement, curb, gutters and construction joints in the surfacing against which additional material is to be placed. When two or more lifts of asphaltic concrete are required, a tack coat

shall be applied between each lift unless successive lifts are placed within eight hours.

2. PREPARATION:

- a. Immediately before applying a tack coat, the area to be surfaced shall be cleaned of all loose material by power broom or equivalent method acceptable to the District Representative.

3. APPLICATION:

- a. The tack coat shall be applied by means of pressure distributors by pressure hand-spray equipment. The rate of application shall be 1/20 of a gallon per square yard. Emulsified asphalt shall not be applied when the atmospheric temperature is below 50 degrees F. If emulsified asphalt Type SS-1 is used, it may be diluted with an equal part of water. The rate of application of the dilution shall be such that the rate of application of undiluted emulsion shall be within the tolerances specified.

C. PLACEMENT OF PAVEMENT REINFORCING FABRIC:

1. REINFORCING FABRIC:

- a. Mechanical laydown equipment used must be capable of handling full rolls of fabric, and be capable of laying the fabric smoothly, without excessive wrinkles and/or folds. The laydown equipment shall maintain a 50- to 100-foot separation from the asphalt binder distributor truck to allow the proper inspection of the binder application. The minimum asphalt binder temperature shall be 290 degree F with a distributor tank temperature not to exceed 325 degrees F. While the separate tractor is desired, a single laydown unit may be used, subject to the approval of the District Representative, if inspection of the oil distribution system can be verified as operating properly and accurately. Such a procedure must be presented in writing prior to the start of the job and approved in advance by the District Representative.
- b. Asphalt binder shall be spread at a minimum rate of 0.2 gallon per square yard regardless of ambient or pavement temperature, and up to 0.25 gallon per square yard at the discretion of the District Representative. Actual spread rate will be determined by the District Representative, and gallonage corrected for temperature will be verified from weigh-backs for each load of asphalt binder spread.
- c. The Contractor shall calibrate, prior to starting asphalt binder application, the bituminous distributor.

#### D. PLACEMENT OF ASPHALT CONCRETE:

##### 1. DELIVERY AND SPREADING:

- a. Bituminous mixtures shall be delivered to the roadbed at temperatures specified in Caltrans Section 39. Spreading of the mixture shall be in accordance with Caltrans Section 39. All loads shall be covered with tarpaulin or other material during transportation. The top layer of asphalt concrete shall not exceed 0.20 foot in compacted thickness. The next lower layer shall not exceed 0.25 foot in compacted thickness, and any lower layers shall not exceed 0.50 foot in compacted thickness.

##### 2. COMPACTION:

- a. Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be compacted in accordance with Caltrans Section 39. Compaction by vehicular traffic shall not be permitted. The District reserves the right to require an adjustment of the temperature of the asphalt concrete at the time of placement at the direction of the District Representative.

##### 3. PAVEMENT THICKNESS:

##### 4. Pavement shall match the existing adjoining pavement in thickness, as indicated on the Drawings, Joining Pavement:

- a. The joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to ensure a continuous bond between old and new sections of the course. Edges of existing pavement shall be exposed and cleaned and edges cut to straight, vertical surfaces. All joints shall be painted with a uniform tack coat before the fresh mixture is applied.

##### 5. PROTECTION OF PAVEMENT:

- a. After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened and in no case less than 6 hours.

#### E. APPLICATION OF FOG SEAL:

1. A fog seal shall be applied to the upper surfaces of all installed asphalt concrete as indicated on the drawings. It shall be applied in accordance with the applicable requirements of Caltrans Section 37.
2. A final fog seal shall be applied to asphalt concrete after all other construction is complete.

F. CHIP SEAL:

1. Asphalt emulsions shall be applied to the width of the section to be primed by means of a pressure distributor is a uniform, continuous spread at a rate of between 0.25 to 0.35 gallons per square yard. Asphalt emulsions shall be applied as specified in Caltrans Section 94-2.06 "Applying." Asphalt emulsion shall not be applied on a wet surface, or when weather conditions would prevent the proper application and curing of the coat. When traffic is maintained, not more than one-half of the width of the section shall be treated in one application. Traffic shall not be permitted on the roadway until the asphalt emulsion and screenings have been placed and completely cured. Care shall be taken that the application of asphalt emulsion at junctions is not in excess of the specified amount. Excess material shall be squeegeed from the surface.
2. Screenings shall be applied at a rate of 20 to 30 pounds per square yard and conform to Caltrans Section 37-1.06 "Spreading Screenings" and Section 37-1.07 "Finishing."

G. PAINTING:

1. Line paint shall be applied in accordance with the paint manufacturer's instructions and Caltrans Section 84.

**3.03 TESTING**

A. QUALITY CONTROL:

1. The Contractor shall be completely responsible for conducting all testing and quality control of asphalt pavement to ensure that all requirements of Caltrans Section 26 and 39 are met.
2. The Contractor shall be completely responsible for conducting all compaction testing and quality control of compacted fill to determine that the compaction requirements are being met in accordance with the EARTH MOVING Section (31 20 00).
3. The Contractor shall have the equipment and capability to perform all tests, as specified, in the field at the construction site. All testing shall be conducted under the authority and responsible charge of a professional civil or geotechnical engineer or a certified engineering geologist.
4. All daily field and laboratory testing reports shall be provided within 24 hours of completion to the District Representative during mass grading and during backfill of utilities and structures.



5. All areas not meeting the specified compaction requirements shall be reworked and retested within 24 hours.

**B. QUALITY ASSURANCE:**

1. The District will take samples and perform tests during placement of materials to check compliance with these specifications. This quality assurance will serve to validate the quality control testing provided by the Contractor.
2. The Contractor shall remove surface material at locations designated by the District Representative and provide such assistance as necessary for sampling and testing.

**3.04 TRAINING – NOT USED**

**3.05 REGULATORY REQUIREMENTS**

- A. The Contractor shall comply with the requirements of the Sacramento Metropolitan Air Quality Management District with regard to all asphalt paving materials and application.

**\*\*END OF SECTION\*\***

## SECTION 32 12 53

### DECOMPOSED GRANITE AND GRAVEL PAVING

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies decomposed granite and gravel paving. Paving type shall be installed in locations as indicated on the plans.

##### 1.02 REFERENCES

- A. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
CalTrans	Standard Specifications
ASTM C150	Standard Specification for Portland Cement

##### 1.03 SUBMITTALS

- A. The following information shall be submitted for review in accordance with SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. One (1) pound sample of decomposed material.
  3. One (1) pound sample of gravel granite material.
  4. Gravel paving gradation.
  5. Manufacturer information on geotextile fabric, including installation instructions.

#### **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

#### **1.05 QUALITY ASSURANCE**

- A. Comply with State of California Business and Transportation Agency, Department of Transportation (CalTrans) Standard Specifications, 2010 Edition.

#### **1.06 JOB CONDITIONS**

##### **A. SEQUENCING:**

- 1. Coordinate decomposed granite paving with other trades.

##### **B. PROTECTION:**

- 1. Protect surrounding work as required against damage from paving installation. Clean satisfactorily or otherwise correct damage to surrounding work resulting from paving installation.

##### **C. CEMENTITIOUS MATERIAL:**

- 1. Protect against exposure to moisture. Use of cementitious or other materials that have become caked and hardened from absorption of moisture will not be permitted.

### **PART 2 -- PRODUCTS**

#### **2.01 GENERAL (NOT USED)**

#### **2.02 DECOMPOSED GRANITE**

- A. "Dust" as available from Gallagher and Burk, Inc., 344 High Street, Oakland, CA. Graded to 1/4-inch maximum size, with sufficient fines to produce paving which is smooth and even without being slick. Buff color range as approved by the District Representative.

#### **2.03 PORTLAND CEMENT**

- A. ASTM C150, Type II.

#### **2.04 WATER**

- A. Potable, free from contaminants detrimental to paving mix.

#### **2.05 PRE-EMERGENT HERBICIDE**

- A. Surflan manufactured by DowElanco or Devrinol manufactured by United Phosphorus Limited.

## 2.06 GEOTEXTILE FABRIC

### A. ACCEPTABLE PRODUCTS:

1. "Mirafi 140 N" as manufactured by Tencate Mirafi Inc., Pendergrass, Georgia 30567, telephone: 706-693-2226.
2. "Tensar TriAx 130S" as manufactured by Tensar International Corporation, Alpharetta, Georgia, 30009, telephone: 800-TENSAR-1.
3. Or equal.

## 2.07 GRAVEL PAVING

- A. Crushed Rock of ¾ inch or equivalent conforming to the following gradation table and as approved by the District Representative.

SIEVE SIZE	PERCENTAGE PASSING, ¾ inch MAXIMUM
2 inches	--
1½ inches	--
1 inch	100
¾ inch	90-100
½ inch	30-60
3/8 inch	0-20
No. 4	0-5
No. 8	0-2

1. Minimum Cleanliness Value of 60 as determined by State of California Test Method 227.
2. The portion of material which is retained on the 3/8-inch sieve shall contain at least 50 percent of particles having three (3) or more fracture faces.

## PART 3 -- EXECUTION

### 3.01 GENERAL

- A. Install decomposed granite paving and gravel paving in locations noted on the plans. Installation shall comply with the requirements herein.

### **3.02 INSTALLATION OF DECOMPOSED GRANITE PAVING**

#### **A. MIX:**

1. Decomposed granite material with cement at ratio of 3% by volume (5 percent maximum by volume). Moisten slightly when mixing. Add water as required for mix to reach optimum moisture content for compaction.

#### **B. MIXING:**

1. Mix batches using equipment with revolving blades or rotary drum or similar continuous mixing process.
2. Add cement to decomposed granite in manner to attain uniform distribution during mixing. Moisten slightly while mixing.
3. Adjust quantity of water to maximize compaction during placement. Avoid making mixture plastic and sloppy.

#### **C. PLACEMENT OF DECOMPOSED GRANITE PAVING:**

1. Treat all areas to receive decomposed granite paving with pre-emergent herbicide.
2. Install geotextile fabric in locations as detailed on the plans. Follow manufacturer installation instructions.
3. Install Turf Block in decomposed granite paving, allowing 1-inch clear above top of Turf Block to surface of compacted decomposed granite.
4. Uniformly spread and compact mixture to 4-inch depth.
5. Do not vary finish surface more than 0.02 foot in 10 feet. Roll to 90 percent compaction.
6. Where necessary for bringing compacted surface up to grade, rake area to provide bond for additional material.

#### **D. COMPACTION:**

1. Use vibrator-type compaction equipment to achieve desired compaction.

#### **E. FINISH SURFACE:**

1. Uniform texture and color; without cement mortar film.

#### **F. CURING:**

1. After finishing, keep moist for not less than 7 days.

2. Apply water in fine mist or spray so as not to damage finished surface.

### **3.03 INSTALLATION OF GRAVEL PAVING**

1. Install as detailed on the plans.
2. Install geotextile fabric in locations as required on the plans. Follow manufacturer installation instructions.

### **3.04 TESTING (NOT USED)**

### **3.05 TRAINING (NOT USED)**

**\*\*END OF SECTION\*\***

## SECTION 32 31 13

### CHAIN LINK FENCES AND GATES

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies galvanized chain link fence comprising fence fabric, posts, excavation, concrete bases, gates, and appurtenances.

##### 1.02 REFERENCES

- A. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of the referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed reference, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM A53	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless
ASTM A90	Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A121	Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A239	Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
ASTM A392	Zinc-Coated Steel Chain-Link Fence Fabric

##### 1.03 SUBMITTALS

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

2. List of ten chain link fence installations in northern California. Include job location, name and phone number of Owner's project administrator.
3. MANUFACTURER'S DATA:
  - a. Chain-link fabric
  - b. Framework (post, rail, and gate) and accessories
  - c. Barbed wire and support arms
  - d. Gate hardware
4. The layout of the chain link fence illustrating fence height, post sizes, gates, bracing configurations, and accessories.

## **PART 2 -- PRODUCTS**

### **2.01 CHAIN LINK FABRIC**

- A. Chain link fabric shall be zinc coated steel, 2-inch diamond mesh, interwoven 9-gage wire, top selvage twisted tight, bottom selvage knuckle end closed, hot-dip galvanized after weaving. Fabric shall conform to the requirements of ASTM A392 and shall have a Class 2 zinc coating. Unless otherwise specified or shown on the plans, height of fabric shall be 6 feet 0 inch.

### **2.02 BARBED WIRE**

- A. Barbed wire shall be double strand 12-1/2 gage galvanized steel with 14-gage barbs in 4-point pattern on 5-inch centers and shall have a Class 3 galvanized coating per ASTM A121, chain-link fence grade.

### **2.03 POSTS, RAIL BRACES AND GATE FRAME WORK**

- A. Pipe used shall be ASTM A53, Schedule 40 steel pipe. Posts, rails, braces and frames shall be hot-dip galvanized per ASTM A123 or A153, whichever is applicable. Galvanizing shall apply at least 2.0 ounces of zinc per square foot of surface, as determined by ASTM A90.
  1. Nominal pipe size diameter shall be 2 inches for line posts; 2-1/2 inches for corner, pull and end posts; 1-1/4 inches for braces and rails; 1-1/2 inches for gate frames; 6 inches for drive gate posts; and 3-1/2 inches for personnel gate posts.

### **2.04 TRUSS RODS AND MISCELLANEOUS FITTINGS**

- A. Truss rods shall be fabricated of 3/8-inch-diameter steel rods and shall have turnbuckles.



- B. Extension arms for barbed wire shall be steel or malleable iron set screw retained.
- C. Hinges, drop rods, catches and all other gate hardware shall be heavy-duty style. Hinges shall be of the "bulldog" type.
- D. Sleeves, bands, clips, rail ends, tension bars, fasteners, fittings, caps, and miscellaneous bolts, and other appurtenances shall be consistent in quality and strength to the rest of the fence.
- E. Fittings used shall be hot-dip galvanized iron or steel with a minimum coating of at least 2.0 ounces of zinc per square foot of surface, as determined by ASTM A90, in accordance with ASTM A123 or A153, whichever is applicable.

## **2.05 WIRE**

- A. Reinforcing wire shall have a minimum tensile strength of 75,000 psi, zinc-coated for use with zinc-coated fabric. Tie wire shall be aluminum alloy of 0.144-inch diameter for attaching fabric to top rail and to intermediate posts. Preformed clips of 6-gage, zinc-coated, steel wire may be used for attaching fabric to intermediate posts. Hog rings shall be aluminum wire of 0.110-inch diameter for attaching fabric to reinforcing wires. Bottom tension wires shall be at least 7-gage galvanized coil spring steel.

## **2.06 CONCRETE:**

- A. Concrete for post foundations shall be Class 4 as specified in the CAST-IN-PLACE Section (03 30 00).

## **PART 3 -- EXECUTION**

### **3.01 GENERAL (NOT USED)**

### **3.02 INSTALLATION**

#### **A. FENCE:**

1. Unless otherwise shown on the drawings, all fence shall be constructed with a top rail and a bottom tension wire. Stretcher bar and truss bands shall be spread and slipped on end, corner, pull, brace, and gate posts before installation of top rails. Extension joints shall be provided from rails at intervals of 100 feet. Pass top rail through line post tops to form continuous bracing. At top rail splices, install 6-inch-long couplings midspan of line posts.
2. Line posts shall be equally spaced between corners, end posts, and gate posts at a spacing not exceeding 10 feet. Posts shall be set vertical, shall be accurately aligned, and shall have their tops level or at a constant slope between changes in grade. Tubular posts shall be fitted with rainproof caps.

3. Corner, end, and gate posts shall be braced to the nearest line post. Corner and end posts shall be diagonally braced. Bracing for gate posts shall be horizontal braces with truss rods. Line posts shall be braced horizontally and trussed in both directions with truss rods at 500-foot maximum intervals.
4. Chain link fabric shall be taut and shall be attached to posts, top rail and bottom wire with galvanized fabric bands or tie wires at a maximum spacing of 12 inches on posts and 18 inches on the rail and tension wires. Stretcher bars shall be provided at ends of fabric. The fabric shall be securely tied to posts and rails in a manner so that the fabric will remain tight and immovable. The bottom tension wire shall be stretched tight and shall be located 2 inches maximum above finished grade and on a straight grade between posts by excavating the high points of ground, and in no case shall depressions be filled.
5. Three strands of barbed wire attached to extension arms shall be provided along the fence top. Extension arms shall overhang the outside of the fence at a 45-degree angle. The topmost strand of barbed wire shall be 12 inches above the top of the fabric.

#### B. GATES:

1. Install three hinges per leaf, latch, catches, foot bolts and sockets, retainer and locking clamp. Gate frames shall be fabricated with welded joints. The fabric shall be the same as that used for the fence and shall be rigidly attached to the frames. Frames less than 6 feet wide shall have top, center and bottom rails. Drive gate frames shall be constructed with vertical rails at 6-foot maximum spacing and "X" truss rods in each bay. Gates shall be equipped with suitable offset hinges to permit a 180-degree swing and a drop bar locking device with provision for padlocking. A stop to hold the gate open and a concrete center rest with catch shall be provided. Gate frames shall extend 18 inches above the top rail for attachment of three strands of barbed wire.

#### C. CONCRETE BASE:

1. Terminal posts and gate posts shall be set 42 inches in concrete bases. Line posts shall be set 36 inches in concrete bases. Base diameter shall be at least 3 times that of the post, with an 8-inch minimum. Set the post 3 inches from the bottom of the concrete base. The top of concrete post bases shall be 1 inch above grade and sloped for drainage. Concrete bases for corner, end, and gate posts shall cure for not less than 5 days before wire fabric is placed. Concrete bases for line posts shall cure for not less than 3 days before wire fabric is placed.

#### D. ELECTRICAL GROUNDING:

1. Grounding shall be in accordance with the **GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS** Section (26 05 26).

**3.03 TESTING (NOT USED)**

**3.04 TRAINING (NOT USED)**

**\*\*END OF SECTION\*\***

Notes to Designers:

1. For additional information refer to CalTrans Standard Specification Section 80-4 and County of Sacramento Construction Specifications Section 102.
2. This section can be modified for use with or without CAST-IN-PLACE CONCRETE Specification Section. Paragraphs that need to be coordinated are 1.01B.1, 1.02.A, 1.03A.2e, and 2.06

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE:			SYMBOL: <b>XXX</b>	
FLUID:				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX:	TEST:	TEST TYPE:	NORMAL:	MAX:
TEST MEDIUM:		TEST DURATION:	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Boiler Feedwater			SYMBOL: <b>BF</b>	
FLUID: Water				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 225	TEST: 300	TEST TYPE:	NORMAL: 210	MAX: 375
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
≤ 2"	Interior	Steel, ASTM A53 Grade B, Sch 80, Type S, black	Forged steel, socket weld, 2000 #, ASTM A234. Use threaded adapters for valves.	
> 2"	Interior	Steel, ASTM A53 Grade B, Sch 80, Type S, black	Forged steel, socket weld, 2000 #, ASTM A234. Use flanged adapters for valves.	
All	All	Flange Gaskets: Filled PTFE		
		Push-on/Mech. Couplings: N/A		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
≤ 2"	Interior	Isolation	Ball valve, Type SS-3P	MLQ
> 2"	Interior	Isolation	Ball valve, Type SS-3P	MGQ
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Biosolids Recycling Facility			SYMBOL: <b>BRF</b>	
FLUID: Wastewater/Treated Wastewater				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 35	TEST: 40	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, galvanized or stainless steel, ASTM A312, Sch. 40S, type 316L	Malleable iron, ASTM A197, ANSI B16.3, class 150, galvanized threaded or stainless steel, type 316L.	
	Buried	PVC, ASTM D1785, Sch 80	PVC, ASTM D1784, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adaptors for valves.	
4-12"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, black with epoxy or mortar lining.	Butt weld, grooved end couplings, or flanged connections. Epoxy or mortar lined fittings, ASTM A47 malleable iron, ASTM A234 steel.	
	Buried	Same as <4" Buried	Same as <4" Buried. Or, push-on couplings and fittings, ASTM A536 ductile iron, ASTM D1784 PVC.	
12"-<16"	Interior or Exterior	Steel, AWWA C200, with mortar lining	AWWA C208	
	Buried	HDPE, ASTM D3035 or F714, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
≥ 16"	Interior or Exterior	Steel, AWWA C200, with mortar lining	AWWA C208	
	Buried	HDPE, ASTM D3035 or F714, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: Neoprene CI		
		Push-on/Mech. Couplings: Nitrile or Neoprene		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<4"	All	Isolation	Ball Valve, Type BR-2P, per BALL VALVES Section (40 05 63).	MLQ
≥ 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP125	
	Buried	Isolation	Eccentric plug valve, Type EP125	MLQ
All	All	Check	Resilient flapper check valve, Type FDC	MLQ with 2" AWWA nut
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

PIPING SYSTEM SPECIFICATION				
SERVICE: Channel Aeration Air			SYMBOL: <b>CAA</b>	
FLUID: Air				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 8	TEST: 15	TEST TYPE:	NORMAL:	MAX:
TEST MEDIUM: Air		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Chemical Drain, Waste and Vent			SYMBOL: <b>CD</b>	
FLUID: Chemical Waste				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX:	TEST: UPC	TEST TYPE: 3	NORMAL: 70	MAX: 140
TEST MEDIUM: Water		TEST DURATION: UPC	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				



PIPING SYSTEM SPECIFICATION				
SERVICE: Chlorinated Final Effluent			SYMBOL: <b>CFE</b>	
FLUID: Treated Wastewater, Chlorinated to 15 ppm				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 35	TEST: 40	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, galvanized.	Malleable iron, ASTM A197, ANSI B16.3, class 150, galvanized threaded.	
	Buried	PVC, ASTM D1785, Sch 80	PVC, ASTM D1784, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adaptors for valves	
4-12"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, black with epoxy or mortar lining.	Butt weld, grooved end couplings, or flanged connections. Epoxy or mortar lined fittings, ASTM A47 malleable iron, ASTM A234 steel.	
	Buried	Same as <4" Buried	Same as <4" Buried. Or, push-on couplings and fittings, ASTM A536 ductile iron, ASTM D1784 PVC.	
>12"	Interior or Exterior	Steel, AWWA C200, with mortar lining	AWWA C208	
	Buried	Reinforced concrete low head pressure pipe, ASTM C361 Class C100.	Bell and Spigot (no restraint on straight runs that terminate at manholes and structures)	
All	All	Flange Gaskets: PTFE Bonded		
		Push-on/Mech. Couplings: N/A		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<4"	Interior or Exterior	Isolation	Ball Valve, Type SS-3P	MLQ
	Buried	Isolation	Eccentric plug valve, Type EP	MLQ
4-12"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP	MGQ
	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
>12"	Interior or Exterior	Isolation	Butterfly valve, Type AW75	MGQ and EMQTLD
	Buried	Isolation	Butterfly valve, Type AW75	MGQ with 2" AWWA nut and EMQTLD
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

PIPING SYSTEM SPECIFICATION				
SERVICE: Chlorine Gas			SYMBOL: <b>CLG</b>	
FLUID: Chlorine Gas				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 225	TEST: 340	TEST TYPE: 1	NORMAL: 70	MAX: 110
TEST MEDIUM: Nitrogen		TEST DURATION: 120 minutes	CLEANING TYPE: 5	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Chlorine Liquid			SYMBOL: <b>CLL</b>	
FLUID: Water-free Liquid Chlorine				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 225	TEST: 300	TEST TYPE: 1	NORMAL: 70	MAX: 110
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 5	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Chlorine Solution			SYMBOL: <b>CLS</b>	
FLUID: Chlorine and Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 125	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 5	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Chlorine Vacuum			SYMBOL: <b>CLV</b>	
FLUID:				
<b>PRESSURE / VACUUM – PSIG / INCHES HG</b>			<b>TEMPERATURE - °F</b>	
MAX:	TEST: 50 / 28	TEST TYPE: 2	NORMAL:	MAX:
TEST MEDIUM: Water / Vacuum	TEST DURATION: 2 hrs / 24 hrs	CLEANING TYPE: 5		
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Chemical Pad Air			SYMBOL: <b>CPA</b>	
FLUID: Dry Air or Nitrogen				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 125	TEST: 340	TEST TYPE: 1	NORMAL:	MAX:
TEST MEDIUM: Nitrogen		TEST DURATION: 120 minutes	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Circulating Sludge			SYMBOL: <b>CS</b>	
FLUID: Sludge, 3% to 10% solids				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 75	TEST: 150	TEST TYPE: 1	NORMAL: 95	MAX: 115
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Caustic Soda			SYMBOL: <b>CSO</b>	
FLUID: Sodium Hydroxide				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 100	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				



PIPING SYSTEM SPECIFICATION				
SERVICE: Chilled Water Return			SYMBOL: <b>CWR</b>	
FLUID: Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 75	TEST: 125	TEST TYPE: 1	NORMAL: 45	MAX: 80
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Chilled Water Supply			SYMBOL: <b>CWS</b>	
FLUID: Water				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 75	TEST: 125	TEST TYPE: 1	NORMAL: 45	MAX: 80
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Dechlorinated Final Effluent			SYMBOL: <b>DFE</b>	
FLUID: Treated Wastewater				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 25	TEST: 40	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, galvanized.	Malleable iron, ASTM A197, ANSI B16.3, class 150, galvanized threaded.	
	Buried	PVC, ASTM D1785, Sch 80	PVC, ASTM D1784, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adaptors for valves	
4-12"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, black with epoxy or mortar lining.	Butt weld, grooved end couplings, or flanged connections. Epoxy or mortar lined fittings, ASTM A47 malleable iron, ASTM A234 steel.	
	Buried	Same as <4" Buried	Same as <4" Buried. Or, push-on couplings and fittings, ASTM A536 ductile iron, ASTM D1784 PVC.	
>12"	Interior or Exterior	Steel, AWWA C200, with mortar lining	AWWA C208	
	Buried	Reinforced concrete low head pressure pipe, ASTM C361 Class C100.	Bell and Spigot (no restraint on straight runs that terminate at manholes and structures)	
All	All	Flange Gaskets: Neoprene CI		
		Push-on/Mech. Couplings: Nitrile or Neoprene		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<4"	Interior or Exterior	Isolation	Ball Valve, Type SS-3P	MLQ
	Buried	Isolation	Eccentric plug valve, Type EP	MLQ
4-12"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP	MGQ
	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
>12"	Interior or Exterior	Isolation	Butterfly valve, Type AW75	MGQ and EMQTLD
	Buried	Isolation	Butterfly valve, Type AW75	MGQ with 2" AWWA nut and EMQTLD
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

XX/XX/XX (Last Modified by Project)

Project Name

40 05 03 - A16

PIPING SYSTEM SPECIFICATION				
SERVICE: Digested Sludge			SYMBOL: DS	
FLUID: Sludge, 3% to 10% solids				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 100	TEST: 150	TEST TYPE: 1	NORMAL: 90	MAX: 100
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type S, hot dip galvanized.	Class 150, galvanized ASTM A197 or A47 malleable iron, ASTM A536 ductile iron, or ASTM A234 steel. Joints: Threaded, flanged, or grooved end coupling.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket fusion welding. Electrofusion joints are not acceptable.	
4" – 12"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type E, black with double thickness mortar lining.	Grooved end fittings with double thickness mortar lining, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel. Joints: Grooved end couplings, with flanged adapters for valves.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket fusion welded connections. Electrofusion joints are not acceptable.	
14" – 16"	Interior or Exterior	Steel, ASTM A53 Grade B, standard weight, Type E, black with double thickness mortar lining.	Grooved end fittings with double thickness mortar lining, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel. Joints: Grooved end couplings, with flanged adapters for valves.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: Neoprene or Nitrile		
		Push-on/Mech. Couplings: Neoprene or Nitrile		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
≤ 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MLQ
> 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MGQ
All	Buried	Isolation	Eccentric plug valve, Type EP150	MGQ with 2" AWWA nut
All	All	Check	Resilient flapper check valve, Type FDC	
All	All	Drain & vent	Ball valve, Type SS-2P	MLQ
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained. .				

XX/XX/XX (Last Modified by Project)

Project Name

40 05 03 - A17

PIPING SYSTEM SPECIFICATION					
SERVICE: Drain, Waste and Vent				SYMBOL: DWV	
FLUID: Wastewater					
PRESSURE – PSIG			TEMPERATURE - °F		
MAX: Atmospheric	TEST: In accordance with UPC Section 318	TEST TYPE: 3	NORMAL: 70	MAX: 120	
TEST MEDIUM: Water		TEST DURATION: 2 hrs	CLEANING TYPE: 2		
PIPE AND FITTING SPECIFICATION					
SIZE	EXPOSURE	PIPE		FITTINGS AND JOINTS	
1.25 – 12"	Interior or Exterior	PVC, ASTM D1785 Sch 40 DWV		PVC, ASTM D2665, Sch. 40 DWV couplings and drainage fittings. Solvent weld sockets.	
All	All	Flange Gaskets: N/A			
		Push-on/Mech. Couplings: N/A			
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE					
SIZE	EXPOSURE	DUTY	SPECIFICATION		OPERATOR
N/A					
<b>REMARKS:</b>					

PIPING SYSTEM SPECIFICATION				
SERVICE: Equipment Drain			SYMBOL: ED	
FLUID: Non-Potable Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 50	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 125
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Schedule 40, Type E, galvanized or stainless steel, Sch. 40S; type 316L	Malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized. Threaded, flanged or grooved end coupling or stainless steel.	
	Buried	PVC, ASTM D1785, Schedule 80.	PVC, ASTM D1784, Schedule 80 couplings and fittings. Solvent weld sockets with threaded or flanged adapters for valves.	
4" – 12"	Interior or Exterior	Steel, ASTM A53 Grade A, Schedule 40, Type E, black with epoxy lining.	Grooved end couplings, with flanged adapters for valves. Grooved end fittings, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel.	
	Buried	Same as <4" Buried	Same as <4" Buried. Or, push-on couplings and fittings, ASTM A536 ductile iron, ASTM A234 steel.	
>12"	Interior or Exterior	Steel, AWWA C200, 3/16" wall, black with epoxy pipe lining.	Butt weld, or flanged connections. Epoxy lined fittings	
	Buried	Concrete cylinder pipe	Push-on couplings and fittings, ASTM A234 AWWA C208 steel, epoxy lined.	
All	All	Flange Gaskets: Neoprene CI		
		Push-on/Mech. Couplings: Neoprene or Nitrile.		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
< 2.5"	Interior or Exterior	Isolation	Ball valve, Type BR-2P	MLQ
2.5" – 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MLQ
> 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MGQ
All	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
All	All	Check	Resilient flapper check valve, Type FDC	
All	All	Drain & vent	Ball valve, Type BR-2P	MLQ
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

XX/XX/XX (Last Modified by Project)

Project Name

40 05 03 - A19

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Foul Air Exhaust			SYMBOL: <b>FAE</b>	
FLUID: Foul Air				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 0.5	TEST: 1	TEST TYPE: 1	NORMAL: 60	MAX: 100
TEST MEDIUM: Air		TEST DURATION: 120 minutes	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Ferric Chloride			SYMBOL: <b>FC</b>	
FLUID: Ferric Chloride solution				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 150	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				



PIPING SYSTEM SPECIFICATION				
SERVICE: Final Effluent			SYMBOL: FE	
FLUID: Treated Wastewater				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 35	TEST: 40	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, galvanized or stainless steel, ASTM A312, Sch. 40S, type 316L	Malleable iron, ASTM A197, ANSI B16.3, class 150, galvanized threaded or stainless steel, type 316L.	
	Buried	PVC, ASTM D1785, Sch 80	PVC, ASTM D1784, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adaptors for valves.	
4-12"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, black with epoxy or mortar lining.	Butt weld, grooved end couplings, or flanged connections. Epoxy or mortar lined fittings, ASTM A47 malleable iron, ASTM A234 steel.	
	Buried	Same as <4" Buried	Same as <4" Buried. Or, push-on couplings and fittings, ASTM A536 ductile iron, ASTM D1784 PVC.	
>12"	Interior or Exterior	Steel, AWWA C200, with mortar lining	AWWA C208	
	Buried	Reinforced concrete low head pressure pipe, ASTM C361 Class C100.	Bell and Spigot (no restraint on straight runs that terminate at manholes and structures)	
All	All	Flange Gaskets: Neoprene CI		
		Push-on/Mech. Couplings: Nitrile or Neoprene		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<4"	Interior or Exterior	Isolation	Ball Valve, Type SS-3P	MLQ
	Buried	Isolation	Eccentric plug valve, Type EP	MLQ
4-12"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP	MGQ
	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
>12"	All	Isolation	Butterfly valve, Type AW75	MGQ and EMQTLD
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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Project Name

40 05 03 - A22

PIPING SYSTEM SPECIFICATION				
SERVICE: Grit			SYMBOL: <b>GR</b>	
FLUID: Grit 5% to 50% solids				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 35	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Grit Overflow			SYMBOL: <b>GRO</b>	
FLUID: Sludge, 1% to 15% solids				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 35	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Hydrochloric Acid (Muriatic Acid)			SYMBOL: <b>HCL</b>	
FLUID: Water and 37% Hydrochloric Acid				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX:	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 120
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
1/4" to 3/8" O.D.	All	Low density polyethylene (PE) tubing, black, 1/16" wall thickness.	Black polypropylene compression fittings with polypropylene tube inserts and stainless steel or plastic gripping ring.	
All	All	Flange Gaskets: PTFE Bonded.		
		Push-on/Mech. Couplings: N/A		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
1/4" to 3/8" O.D.	All	Isolation	Drilled PVC ball valve, Teflon, with compression fitting ends.	Tee handle
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Hydraulic Oil			SYMBOL: <b>HO</b>	
FLUID: Hydraulic Oil				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 3000	TEST: 4500	TEST TYPE: 1	NORMAL: 70	MAX: 150
TEST MEDIUM: Hydraulic Oil		TEST DURATION: 120 minutes	CLEANING TYPE:	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Heat Reservoir Return			SYMBOL: <b>HRR</b>	
FLUID: Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 50	TEST: 150	TEST TYPE: 1	NORMAL: 180	MAX: 200
TEST MEDIUM: Water		TEST DURATION: 120 Minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< = 2"	Interior or Exterior	Copper tube, ASTM B88, Type L hard copper.	Wrought copper fittings.	
	Buried	Copper tube, ASTM B88, Type K hard copper, pre-insulated pipe assembly.	Wrought copper fittings.	
2.5" – 6"	Interior or Exterior	Steel, ASTM A53 Grade B, Sch. 40, Type E, black.	Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A234. Grooved couplings or flanges.	
	Buried	Copper tube, ASTM B88, Type K hard copper, pre-insulated pipe assembly.	Wrought copper fittings.	
8" – 12"	Interior or Exterior	Steel, ASTM A53 Grade B, Sch. 40, Type E, black.	Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A234. Grooved couplings or flanges.	
All	All	Flange Gaskets: EPDM		
		Push-on/Mech. Couplings: EPDM		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
< = 2"	Interior or Exterior	Isolation	Ball valve, Type SS-3P	MLQ.
2.5" – 4"	Interior or Exterior	Isolation	Butterfly valve, Type GP150	MLQ.
5" – 12"	Interior or Exterior	Isolation	Butterfly valve, Type GP150	MGQ.
All	Interior or Exterior	Check	Silent check valve, Type CGSC	
<b>REMARKS:</b> Add inhibitor, 1000 ppm sodium nitrate. Insulate per PROCESS PIPING AND EQUIPMENT INSULATION Section (40 42 00).				

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Project Name

40 05 03 - A27

PIPING SYSTEM SPECIFICATION				
SERVICE: Heat Reservoir Supply			SYMBOL: <b>HRS</b>	
FLUID: Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 50	TEST: 150	TEST TYPE: 1	NORMAL: 180	MAX: 200
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< = 2"	Interior or Exterior	Copper tube, ASTM B88, Type L hard copper.	Wrought copper fittings.	
	Buried	Copper tube, ASTM B88, Type K hard copper, pre-insulated pipe assembly.	Wrought copper fittings.	
2.5" – 6"	Interior or Exterior	Steel, ASTM A53 Grade B, Sch. 40, Type E, black.	Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A234. Grooved couplings or flanges.	
	Buried	Copper tube, ASTM B88, Type K hard copper, pre-insulated pipe assembly.	Wrought copper fittings.	
8" – 12"	Interior or Exterior	Steel, ASTM A53 Grade B, Sch. 40, Type E, black.	Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A234. Grooved couplings or flanges.	
All	All	Flange Gaskets: EPDM		
		Push-on/Mech. Couplings: EPDM		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
< = 2"	Interior or Exterior	Isolation	Ball valve, Type SS-3P	MLQ.
2.5" – 4"	Interior or Exterior	Isolation	Butterfly valve, Type GP150	MLQ.
5" – 12"	Interior or Exterior	Isolation	Butterfly valve, Type GP150	MGQ.
All	Interior or Exterior	Check	Silent check valve, Type CGSC	
<b>REMARKS:</b> Add inhibitor, 1000 ppm sodium nitrate. Insulate per PROCESS PIPING AND EQUIPMENT INSULATION Section (40 42 00).				

XX/XX/XX (Last Modified by Project)

Project Name

40 05 03 - A28

PIPING SYSTEM SPECIFICATION				
SERVICE: Harvested Sludge			SYMBOL: <b>HS</b>	
FLUID: Sludge, 3% to 15% solids				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 125	TEST: 150	TEST TYPE: 1	NORMAL: 50	MAX: 100
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type S, hot dip galvanized.	Class 150, galvanized, ASTM A197 or A47 malleable iron, ASTM A536 ductile iron, or ASTM A234 steel. Joints: Threaded, flanged, or grooved end coupling.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
4" – 12"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type E, black with double thickness mortar lining.	Grooved end fittings with double thickness mortar lining, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel. Joints: Grooved end couplings, with flanged adapters for valves.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
14" – 16"	Interior or Exterior	Steel, ASTM A53 Grade B, Standard weight, Type E, black with double thickness mortar lining.	Grooved end fittings with double thickness mortar lining, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel. Joints: Grooved end couplings, with flanged adapters for valves.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: Neoprene or Nitrile		
		Push-on/Mech. Couplings: Neoprene or Nitrile		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
< = 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MLQ
> 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MGQ
All	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
All	All	Check	Resilient flapper check valve, Type FDC	
All	All	Drain & vent	Ball valve, Type SS-2P	MLQ
<b>REMARKS:</b>				
1. Buried cleanout assemblies may be flanged ductile iron fittings.				
2. All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

XX/XX/XX (Last Modified by Project)

Project Name

40 05 03 - A29



PIPING SYSTEM SPECIFICATION				
SERVICE: Domestic Hot Water Return			SYMBOL: <b>HWR</b>	
FLUID: Potable Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 50	TEST: 100	TEST TYPE: 1	NORMAL: 120	MAX: 140
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 1	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	Interior or Exterior	Copper tube, ASTM B88, Type L hard copper.	Wrought copper fittings with silver bearing solder.	
All	All	Flange Gaskets: EPDM.		
		Push-on/Mech. Couplings: EPDM.		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
< = 2"	Interior or Exterior	Isolation	Ball valve, Type SS-3P	MLQ.
2.5" – 4"	Interior or Exterior	Isolation	Butterfly valve, Type GP150	MLQ.
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Domestic Hot Water Supply			SYMBOL: <b>HWS</b>	
FLUID: Potable Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 50	TEST: 100	TEST TYPE: 1	NORMAL: 120	MAX: 140
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 1	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	Interior or Exterior	Copper tube, ASTM B88, Type L hard copper.	Wrought copper fittings with silver bearing solder.	
All	All	Flange Gaskets: EPDM		
		Push-on/Mech. Couplings: EPDM		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
< = 2"	Interior or Exterior	Isolation	Ball valve, Type SS-3P	MLQ.
2.5" – 4"	Interior or Exterior	Isolation	Butterfly valve, Type GP150.	MLQ.
<b>REMARKS:</b> Insulate per PROCESS PIPING AND EQUIPMENT INSULATION Section (40 42 00).				

XX/XX/XX (Last Modified by Project)

Project Name

40 05 03 - A31

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Low Pressure Sludge Gas			SYMBOL: <b>LSG</b>	
FLUID: 70% Methane Gas				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 15	TEST: 50	TEST TYPE: 1	NORMAL: 95	MAX: 180
TEST MEDIUM: Nitrogen Gas		TEST DURATION: 120 minutes	CLEANING TYPE: 3	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Mixed Sludge			SYMBOL: MS	
FLUID: Sludge, 2% to 10% solids				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 50	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Medium Pressure Sludge Gas			SYMBOL: <b>MSG</b>	
FLUID: 70% Methane Gas				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
WORK: 15	MAX: 50	TEST: 1	NORMAL: 70	MAX: 200
TEST MEDIUM: Nitrogen Gas		TEST DURATION: 120 minutes	CLEANING TYPE: 3	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Sodium Hypochlorite			SYMBOL: <b>SCLS</b>	
FLUID: Water and __% Sodium Hypochlorite				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX:	TEST: 50	TEST TYPE: 1	NORMAL: 50	MAX: 125
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	PVC, ASTM D1785, Sch 80.	PVC, ASTM D2467, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adapters for valves.	
All	All	Flange Gaskets: PTFE Bonded.		
		Push-on/Mech. Couplings: N/A		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
≤ 1½"	Interior or Exterior	Isolation	Ball valve with ball drilled on upstream side, Type PVC.	Tee handle.
2-4"	Interior or Exterior	Isolation	Butterfly valve, Type TF	Type MLQ.
<b>REMARKS:</b>				

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40 05 03 - A35

PIPING SYSTEM SPECIFICATION				
SERVICE: Sodium Hydroxide			SYMBOL: <b>NAOH</b>	
FLUID: Water and 25% Sodium Hydroxide				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX:	TEST:	TEST TYPE: 1	NORMAL: 50	MAX: 125
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	PVC, ASTM D1785, Sch 80.	PVC, ASTM D2467, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adapters for valves.	
All	All	Flange Gaskets: PTFE Bonded		
		Push-on/Mech. Couplings: N/A		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
≤ 1½"	Interior or Exterior	Isolation	Ball valve, Type PVC	Tee handle.
2-4"	Interior or Exterior	Isolation	Butterfly valve, Type TF	Type MLQ.
<b>REMARKS:</b>				

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40 05 03 - A36

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Natural Gas			SYMBOL: <b>NG</b>	
FLUID: Natural Gas				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 15	TEST: 60	TEST TYPE: 3	NORMAL:	MAX:
TEST MEDIUM: Nitrogen Gas	TEST DURATION: 120 minutes	CLEANING TYPE: 3		
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				



PIPING SYSTEM SPECIFICATION				
SERVICE: Oxygen Dry Gas			SYMBOL: <b>ODG</b>	
FLUID: 99% Oxygen Gas				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 15	TEST: 30	TEST TYPE: 1	NORMAL: 80	MAX:
TEST MEDIUM: Air		TEST DURATION: 120 minutes	CLEANING TYPE: 4	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Overflow			SYMBOL: <b>OF</b>	
FLUID: Wastewater				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 10	TEST: 15	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Process Condensate Return			SYMBOL: PCR	
FLUID: Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 25	TEST: 125	TEST TYPE: 1	NORMAL: 210	MAX: 250
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Pumped Discharge			SYMBOL: PD	
FLUID: Wastewater				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 50	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 125
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Schedule 40, Type E, galvanized or stainless steel, Sch. 40S; type 316L	Malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized. Threaded, flanged or grooved end coupling or stainless steel.	
	Buried	HDPE, ASTM D3035 or F714, AWWA, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
4" – 12"	Interior or Exterior	Steel, ASTM A53 Grade A, Schedule 40, Type E, black with epoxy lining.	Grooved end couplings, with flanged adapters for valves. Grooved end fittings, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel.	
	Buried	Same as <4" Buried, 4"-6" coiled stock, 8"-12" straight joints.	Same as <4" Buried.	
12"-18"	Interior or Exterior	Steel, AWWA C200, 3/16" wall, black with epoxy pipe lining.	Butt weld, or flanged connections. Epoxy lined fittings	
	Buried	HDPE, ASTM D3035 or F714, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: Neoprene		
		Push-on/Mech. Couplings: Neoprene or Nitrile.		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
< 2.5"	Interior or Exterior	Isolation	Ball valve, Type BR-2P	MLQ
2.5" – 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MLQ
> 4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MGQ
All	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
All	Interior or Exterior	Check	Resilient flapper check valve, Type FDC	
All	All	Drain & vent	Ball valve, Type BR-2P	MLQ
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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Project Name

40 05 03 - A41

PIPING SYSTEM SPECIFICATION				
SERVICE: Primary Effluent			SYMBOL: PE	
FLUID: Wastewater				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX:	TEST:	TEST TYPE:	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
4-12"	All	Ductile iron, AWWA C151 and AWWA C111, with mortar lining.	Restrained mechanical joint couplings and fittings.	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
4-12"	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut.
4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MLQ
6-12"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MGQ
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Primary Sludge			SYMBOL: <b>PS</b>	
FLUID: Sludge, 2% to 10% solids				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX:	TEST: 150	TEST TYPE: 1	NORMAL:	MAX:
TEST MEDIUM: Water	TEST DURATION: 120 minutes		CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Primary Scum			SYMBOL: <b>PSC</b>	
FLUID: Sludge, 2% to 10% solids				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX:	TEST:	TEST TYPE: 1	NORMAL:	MAX:
TEST MEDIUM: Water	TEST DURATION: 120 minutes	CLEANING TYPE: 2		
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Process Steam Supply			SYMBOL: <b>PSS</b>	
FLUID: Steam				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 175	TEST:	TEST TYPE: 1	NORMAL: 350	MAX: 400
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				



PIPING SYSTEM SPECIFICATION				
SERVICE: Return Activated Sludge			SYMBOL: <b>RAS</b>	
FLUID: Sludge, 0.5% to 3% solids				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 30	TEST: 50	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Raw Sewage			SYMBOL: <b>RS</b>	
FLUID: Wastewater				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 20	TEST: 50	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
4-12"	All	Ductile iron, AWWA C151 and AWWA C111, with mortar lining.	Restrained mechanical joint couplings and fittings.	
All	All	Flange Gaskets: Nitrile		
		Push-on/Mech. Couplings: Nitrile		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
4-12"	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut.
4"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MLQ
6-12"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP150	MGQ
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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Project Name

40 05 03 - A47

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Low Pressure Steam Supply			SYMBOL: <b>S</b>	
FLUID: Steam				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 25	TEST:	TEST TYPE: 1	NORMAL:	MAX:
TEST MEDIUM: Water	TEST DURATION: 120 minutes	CLEANING TYPE: 2		
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Service Air			SYMBOL: SA	
FLUID: Air				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 138	TEST: 150	TEST TYPE: 1	NORMAL: 100	MAX: 140
TEST MEDIUM: Air		TEST DURATION: 120 minutes	CLEANING TYPE: 3	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< ½" O.D.	Interior or Exterior	Copper tube, ASTM B88, Type L hard or Type L soft copper.	Wrought copper fittings, ANSI B16.22, with silver bearing solder. Or, brass compression fittings, ANSI B16.26.	
	Buried	N/A		
½" – 2"	Interior or Exterior	Copper tube, ASTM B88, Type L hard copper. However, risers for utility stations shall be steel, ASTM A53 Grade A, Sch 40 Type E, galvanized.	Wrought copper fittings, ANSI B16.22, with silver bearing solder. Or malleable iron, ANSI B16.3, Class 150, threaded, galvanized.	
	Buried	Copper tube, ASTM B88, Type K hard copper. Or, HDPE 8CCR462.	Wrought copper fittings, ANSI B16.22, with silver bearing solder. Or, matching fusion welded fittings. Electrofusion joints are not acceptable.	
2½" – 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Schedule 40, Type E, galvanized. Or, copper tube, ASTM B88, type L hard copper.	Galvanized grooved end couplings. Galvanized grooved end fittings, ASTM A47 malleable iron, ASTM A536, ductile iron, or ASTM A234 steel. Or, wrought copper fittings ANSI B16.22, with silver brazing.	
	Buried	HDPE 8CCR462.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: EPDM		
		Push-on/Mech. Couplings: EPDM		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
< = 2"	Interior or Exterior	Isolation	Ball valve, Type SS-3P	MLQ
	Buried	Isolation	Ball valve, Type SS-3P	MLQ
2.5" – 4"	All	Isolation	Butterfly valve, Type GP2000	MLQ
All	All	Check	Center guided check valve, Type CGSC	
<b>REMARKS:</b> Per California Code of Regulations, Title 8, Section 462, all piping between an air receiver and the first isolation valve shall be Schedule 80 steel.				

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Project Name

40 05 03 - A49

PIPING SYSTEM SPECIFICATION				
SERVICE: Sodium Bisulfite			SYMBOL: <b>SBIS</b>	
FLUID: Water and ___% Sodium Bisulfite				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 100	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 120
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
1/4" to 3/8" O.D.	All	Low density polyethylene (PE) tubing, black, 1/16" wall thickness.	Black polypropylene compression fittings with polypropylene tube inserts and stainless steel or plastic gripping ring.	
All	All	PVC, ASTM D1785, Sch 80.	PVC, ASTM D2467, Sch 80 couplings and fittings. Solvent weld sockets, with flanged adapters for valves.	
All	All	Flange Gaskets: PTFE Bonded. Push-on/Mech. Couplings: N/A		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
1/4" to 3/8" O.D.	All	Isolation	Ball valve with ball drilled on upstream side, Type PVC, with compression fitting ends	Tee handle.
1/2" to 1 1/2"	All	Isolation	Ball valve, Type SS-F	MLQ
2-4"	All	Isolation	Butterfly valve, Type TF	MLQ.
<b>REMARKS:</b>				
1. Provide crystallization and precipitation protection heat tracing per PROCESS PIPING HEAT TRACING Section (40 41 13).				
2. Provide pipe insulation per PROCESS PIPING AND EQUIPMENT INSULATION Section (40 42 00).				

PIPING SYSTEM SPECIFICATION				
SERVICE: Scum Overflow			SYMBOL: <b>SCO</b>	
FLUID: Scum				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX:	TEST:	TEST TYPE:	NORMAL:	MAX:
TEST MEDIUM:		TEST DURATION:	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION					
SERVICE: Sanitary Drain (Sewer)				SYMBOL: SD	
FLUID: Sewage					
PRESSURE – PSIG			TEMPERATURE - °F		
MAX: Atmospheric	TEST: In accordance with UPC Section 318	TEST TYPE: 3	NORMAL: 70	MAX: 100	
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2		
PIPE AND FITTING SPECIFICATION					
SIZE	EXPOSURE	PIPE		FITTINGS AND JOINTS	
≤12"	Interior or Exterior	PVC, ASTM D1785 Sch 40 DWV		PVC, ASTM D2665, Sch. 40 DWV couplings and drainage fittings. Solvent weld sockets.	
	Buried	PVC, ASTM D3034, SDR 35 Sewer pipe		Bell and spigot, ASTM D3212, synthetic rubber.	
>12"	Interior or Exterior	PVC, ASTM D1785 Sch 40 DWV		PVC, ASTM D2665, Sch. 40 DWV couplings and drainage fittings. Solvent weld sockets.	
	Buried	Reinforced concrete pipe ASTM C76, class III minimum, with PVC lining		Rubber gasket joints.	
All	All	Flange Gaskets: Neoprene			
		Push-on/Mech. Couplings: Nitrile or Neoprene			
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE					
SIZE	EXPOSURE	DUTY	SPECIFICATION		OPERATOR
N/A					
<b>REMARKS:</b>					

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Project Name

40 05 03 - A52

PIPING SYSTEM SPECIFICATION					
SERVICE: Secondary Effluent (Pumped)				SYMBOL: SE	
FLUID: Treated Wastewater					
PRESSURE – PSIG			TEMPERATURE - °F		
MAX: 80	TEST: 120	TEST TYPE: 1	NORMAL: 70	MAX: 85	
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2		
PIPE AND FITTING SPECIFICATION					
SIZE	EXPOSURE	PIPE		FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, galvanized or stainless steel, ASTM A312, Sch. 40S, type 316L		Malleable iron, ASTM A197, ANSI B16.3, class 150, galvanized threaded or stainless steel, type 316L.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.		HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
4-12"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, black with epoxy or mortar lining.		Butt weld, grooved end couplings, or flanged connections. Epoxy or mortar lined fittings, ASTM A47 malleable iron, ASTM A234 steel.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.		HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
>12"	Interior or Exterior	Steel, AWWA C200, with mortar lining		AWWA C208	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.		HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: Neoprene CI			
		Push-on/Mech. Couplings: Nitrile or Neoprene			
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE					
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR	
<4"	All	Isolation	Ball Valve, Type SS-3P	MLQ	
4-10"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP	MGQ	
	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut	
≥12"	Interior or Exterior	Isolation	Butterfly valve, Type AW75	MGQ and EMQTLD	
	Buried	Isolation	Butterfly valve, Type AW75	MGQ with 2" AWWA nut and EMQTLD	
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.					

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Project Name

40 05 03 - A53



PIPING SYSTEM SPECIFICATION					
SERVICE: Sample				SYMBOL: <b>SMP</b>	
FLUID: Treated Wastewater					
PRESSURE – PSIG			TEMPERATURE - °F		
MAX: 60	TEST: 125	TEST TYPE: 1	NORMAL: 70	MAX: 120	
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:		
PIPE AND FITTING SPECIFICATION					
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS		
< 2"	Interior or Exterior	PVC, ASTM D1785, Sch 80	PVC, ASTM D1784, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adaptors for valves.		
	Buried	PVC, ASTM D1785, Sch 80	PVC, ASTM D1784, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adaptors for valves.		
2.5-4"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, galvanized	Galvanized grooved end couplings. Galvanized grooved end fittings, ASTM A47 malleable iron, ASTM A234 steel.		
	Buried	Same as <2" Buried.	Same as <2" Buried		
>4"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch 40 Type E, black with epoxy lining.	Galvanized grooved end couplings. Galvanized grooved end fittings, ASTM A47 malleable iron, ASTM A234 steel.		
	Buried	Same as <2" Buried.	Same as <2" Buried.		
All	All	Flange Gaskets: Neoprene CI			
		Push-on/Mech. Couplings: Nitrile or Neoprene			
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE					
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR	
<2"	Interior or Exterior	Isolation	Ball Valve, Type PVC	MLQ	
	Buried	Isolation	Ball Valve Type SS-3P	MLQ	
>2"	Interior or Exterior	Isolation	Butterfly Valve, Type GP150	MLQ or MGQ	
	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut	
All	All	check	Center Guided Silent Check Valve, Type CGSC		
<b>REMARKS:</b>					

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Project Name

40 05 03 - A54

PIPING SYSTEM SPECIFICATION				
SERVICE: Supernatant			SYMBOL: <b>SN</b>	
FLUID: Sludge, 0.5% to 3% solids				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 10	TEST: 15	TEST TYPE:	NORMAL: 70	MAX: 100
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
< 4"	Interior or Exterior	Steel, ASTM A53 Grade B, Sch 40 Type E, galvanized	Malleable iron, ASTM A197, ANSI B16.3, class 150, galvanized, threaded.	
	Buried	PVC, ASTM D1785, Sch 80	PVC, ASTM D2467, Sch 80 couplings and fittings. Solvent weld sockets, with threaded or flanged adaptors for valves.	
4-12"	Interior or Exterior	Steel, ASTM A53 Grade B, Sch 40 Type E, black, no lining.	Grooved end couplings, with flanged adaptors for valves. Grooved end fittings, ASTM A47 malleable iron, ASTM A234 steel, no lining.	
	Buried	Ductile Iron, AWWA C151 and AWWA C111; with epoxy coating; no lining.	Push-on couplings and fittings, ASTM A536 ductile iron, ASTM D1784 PVC.	
>12"	Interior or Exterior	Steel, AWWA C200, black, no lining	AWWA C208; see Steel Pipe Specification	
	Buried	Same as Buried 4-12".	Same as Buried 4-12".	
All	All	Flange Gaskets: Neoprene		
		Push-on/Mech. Couplings: Nitrile or Neoprene		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<6"	Interior or Exterior	Isolation	Eccentric plug valve, Type EP	MLQ
6" and up	Interior or Exterior	Isolation	Eccentric plug valve, Type EP	MGQ
<16"	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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Project Name

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PIPING SYSTEM SPECIFICATION				
SERVICE: Sulfur Dioxide Gas			SYMBOL: <b>SOG</b>	
FLUID: Dry Sulfur Dioxide Gas				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 125	TEST: 300	TEST TYPE: 1	NORMAL: 70	MAX: 110
TEST MEDIUM: Nitrogen		TEST DURATION: 120 minutes	CLEANING TYPE: 5	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Sulfur Dioxide Liquid			SYMBOL: <b>SOL</b>	
FLUID: Water-free liquid sulfur dioxide				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 7.5 – 75	TEST: 125	TEST TYPE:	NORMAL: 70	MAX: 110
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 5	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Sulfur Dioxide Solution			SYMBOL: <b>SOS</b>	
FLUID: Sulfur Dioxide and Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 125	TEST: 150	TEST TYPE: 225	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 5	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Sulfur Dioxide Vacuum			SYMBOL: <b>SOV</b>	
FLUID:				
<b>PRESSURE / VACUUM – PSIG / INCHES HG</b>			<b>TEMPERATURE - °F</b>	
MAX: / 15	TEST: 50 / 28	TEST TYPE: 2	NORMAL: 70	MAX: 85
TEST MEDIUM: Water / Vacuum		TEST DURATION: 2 hrs / 24 hrs	CLEANING TYPE: 5	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Screenings			SYMBOL: <b>SR</b>	
FLUID: 1-10% macerated screenings and wastewater				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 125	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Secondary Scum			SYMBOL: <b>SSC</b>	
FLUID: Sludge, 0.5% to 3% solids				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 80	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				



<b>PIPING SYSTEM SPECIFICATION</b>					
SERVICE: Storm Drain				SYMBOL: <b>STD</b>	
FLUID: Rainwater and Runoff					
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>		
MAX: Atmospheric	TEST:	TEST TYPE:	NORMAL: 20	MAX: 110	
TEST MEDIUM: None		TEST DURATION: None	CLEANING TYPE: 2		
<b>PIPE AND FITTING SPECIFICATION</b>					
SIZE	EXPOSURE	PIPE		FITTINGS AND JOINTS	
2"-12"	Buried	PVC Sewer pipe, ASTM D3034, SDR35.		PVC, ASTM D3034 with push on nitrile gasket	
	Interior or Exterior	Hubless Cast Iron Soil Pipe (CISPI 301); ASTM A74 service weight.		Stainless steel/ elastomeric hubless couplings, CISPI 310 hubless cast iron soil fittings, CISPI 301, service weight.	
>12"	Buried	Reinforced concrete drain pipe, ASTM C76, class III minimum		Tongue and groove, ASTM C443 with rubber gasket type	
All	All	Flange Gaskets: Neoprene			
		Push-on/Mech. Couplings: Nitrile or Neoprene			
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>					
SIZE	EXPOSURE	DUTY	SPECIFICATION		OPERATOR
N/A					
<b>REMARKS:</b> No test ports required for reinforced concrete drain pipe					

PIPING SYSTEM SPECIFICATION				
SERVICE: Steam Vent			SYMBOL: SV	
FLUID: Steam				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 5	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 400
TEST MEDIUM: Air		TEST DURATION: 120 minutes	CLEANING TYPE: 3	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Tank Drain			SYMBOL: TD	
FLUID: Sewage and Sludge				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 25	TEST:	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM:		TEST DURATION:	CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Thickener Effluent			SYMBOL: <b>TE</b>	
FLUID: Wastewater and Sludge				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 100	TEST: 150	TEST TYPE: 1	NORMAL: 90	MAX: 95
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				



PIPING SYSTEM SPECIFICATION				
SERVICE: Thickened Waste Activated Sludge			SYMBOL: <b>TWAS</b>	
FLUID: Sludge, 3% to 6% solids				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 100	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION				
SERVICE: Utility Air			SYMBOL: UA	
FLUID: Air				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 138	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 140
TEST MEDIUM: Air		TEST DURATION: 120 minutes	CLEANING TYPE: 3	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Waste Activated Sludge			SYMBOL: <b>WAS</b>	
FLUID: Sludge, 1% to 3% solids				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX:	TEST:	TEST TYPE: 150	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				



PIPING SYSTEM SPECIFICATION				
SERVICE: Fire Protection Water			SYMBOL: <b>WFP</b>	
FLUID: Reclaimed Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 130	TEST: 150	TEST TYPE: 1	NORMAL:	MAX:
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
16"	Buried	PVC AWWA C905, Pressure Class 235	Ductile iron restrained mechanical joint fittings, AWWA C153, with fusion bonded epoxy lining and coating. Pipe to pipe joints shall be push-on joints with restraining rods or push-on joints with restrained Rieber gasket	
All	All	Flange Gaskets: Neoprene		
		Push-on/Mech. Couplings: Neoprene or nitrile		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
16"	Buried	Isolation	Butterfly valve, Type AW150	MGQ
16"	Buried	Check	Silent check valve, Type CGSC	
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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<b>PIPING SYSTEM SPECIFICATION</b>				
SERVICE: Waste Heat Cooling Water Supply			SYMBOL: <b>WHWS</b>	
FLUID: Reclaimed Water				
<b>PRESSURE – PSIG</b>			<b>TEMPERATURE - °F</b>	
MAX: 60	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
<b>PIPE AND FITTING SPECIFICATION</b>				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
<b>GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE</b>				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

PIPING SYSTEM SPECIFICATION					
SERVICE: Non-Potable Water				SYMBOL: <b>WN</b>	
FLUID: Water					
PRESSURE – PSIG			TEMPERATURE - °F		
MAX: 130	TEST: 150	TEST TYPE: 1	NORMAL: 60	MAX: 120	
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2		
PIPE AND FITTING SPECIFICATION					
SIZE	EXPOSURE	PIPE		FITTINGS AND JOINTS	
≤ 2"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type E, galvanized. Or, copper tube, ASTM B88, Type L hard copper. Or stainless steel, Sch 40S, Type 316L.		Malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized steel. Or, wrought copper fittings, ANSI B16.22, with silver bearing solder or stainless steel	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.		HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
2½" – 4"	Interior or Exterior	Steel, ASTM A53, Grade B. Sch 40, Type E, galvanized.		Galvanized grooved end couplings. Galvanized grooved end fittings, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.		HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
6"	Interior or Exterior	Steel, ASTM A53, Grade B. Sch 40, Type E, galvanized with minimum thickness of 0.28"		Grooved end couplings, with flanged adapters for valves. Grooved end fittings, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel with epoxy lining.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11, PE 4710, IPS size, rated 200 psig working		HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
8"-12"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type E, black with epoxy lining.		Grooved end couplings, with flanged adapters for valves. Grooved end fittings, ASTM A47 malleable iron, ASTM A536 ductile iron, ASTM A234 steel with epoxy lining.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11, PE 4710, IPS size, rated 200 psig working		HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
14" – 16"	Interior or Exterior	Steel, ASTM A53 Grade B, standard weight, Type E, black with epoxy lining.		Grooved end couplings, with flanged adapters for valves. Grooved end fittings, ASTM A47 malleable iron, ASTM A536 ductile iron, or segmentally welded steel.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.		HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: EPDM Ring for HDPE. EPDM for copper, steel, & ductile.			
		Push-on/Mech. Couplings: EPDM			
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE					
SIZE	EXPOSURE	DUTY	SPECIFICATION		OPERATOR
≤ 2"	All	Isolation	Ball Valve, Type BR-2P		MLQ
2.5"-10"	All	Isolation	Resilient wedge gate valve, Type RW200		2" AWWA nut
>10"	Buried	Isolation	Butterfly valve, Type AW250		MGQ with 2" AWWA nut
All	All	Check	Silent check valve, Type CGSC		
4" – 10"	All	Control	Booster Pump Control valve		
4" – 10"	All	Sustaining	Pressure Sustaining valve		
All	All	Drain & Vent	Ball valve, Type BR-2P		MLQ
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.					

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Project Name

40 05 03 - A73

PIPING SYSTEM SPECIFICATION				
SERVICE: Non-Potable Water from Monitoring Wells			SYMBOL: <b>WNM</b>	
FLUID: Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 100	TEST: 150	TEST TYPE: 1	NORMAL: 60	MAX: 70
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
½" – 3"	All	HDPE, ASTM D3035 or F714, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
4" – 12"	All	HDPE, ASTM D3035 or F714, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: EPDM Ring		
		Push-on/Mech. Couplings: EPDM		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
≤ 2"	All	Isolation	Ball valve, Type BR-2P	MLQ
2.5" – 10"	All	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
>10"	Interior or Exterior	Isolation	Butterfly valve, Type AW150	MGQ
>10"	Buried	Isolation	Butterfly valve, Type AW150	MGQ with 2" AWWA nut
All	All	Check	Resilient flapper check valve, Type FDC	
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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Project Name

40 05 03 - A74

PIPING SYSTEM SPECIFICATION					
SERVICE: Potable Water				SYMBOL: <b>WP</b>	
FLUID: Water					
PRESSURE – PSIG			TEMPERATURE - °F		
MAX: 60	TEST: 100	TEST TYPE: 1	NORMAL: 60	MAX: 85	
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 1		
PIPE AND FITTING SPECIFICATION					
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS		
<4"	Interior or Exterior	Copper tube, ASTM B88, Type L hard copper.	Wrought copper fittings.		
	Buried	PVC, ASTM D1785, Schedule 80.	PVC, ASTM D2467, Sch. 80 couplings and fittings. Solvent weld sockets with threaded or flanged adapters for valves.		
4"-12"	Interior or Exterior	Steel, ASTM A53 Grade B, standard weight Sch 40, Type E, black with epoxy lining.	Galvanized grooved end couplings, galvanized grooved end fittings, ASTM A47 malleable iron, ASTM A536 ductile iron, or ASTM A234 steel.		
	Buried	PVC AWWA C900, Class 305	Ductile iron restrained mechanical joint fittings, AWWA C153, coated with asphaltic material and polyethylene encased. Pipe to pipe joints shall be push-on joints with restraining rods or push-on joints with restrained Rieber gasket		
12"-18"	Buried	PVC AWWA C900, Class 305	Ductile iron restrained mechanical joint fittings, AWWA C153, coated with asphaltic material and polyethylene encased. Pipe to pipe joints shall be push-on joints with restraining rods or push-on joints with restrained Rieber gasket		
All	All	Flange Gaskets: EPDM Ring			
		Push-on/Mech Couplings: EPDM			
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE					
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR	
≤ 2"	All	Isolation	Ball valve, Type BR-2P	MLQ	
2.05" – 10"	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut	
All	All	Check	Silent check valve, Type CGSC		
All	All	Drain & vent	Ball valve, Type SS-3P	MLQ	
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.					

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Project Name

40 05 03 - A75

PIPING SYSTEM SPECIFICATION				
SERVICE: Recycled Water			SYMBOL: <b>WRF</b>	
FLUID: Reclaimed Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 156	TEST: 200	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
12"-18"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type E galvanized.	Malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized, with threaded, flanged, or grooved end coupling connections.	
	Buried	PVC, AWWA C905, Pressure Class 200, DR21 Purple Pipe	Ductile iron restrained mechanical joint fittings, AWWA C153, with fusion bonded epoxy lining and coating. Pipe to pipe joints shall be push-on joints with restraining rods or push-on joints with restrained Rieber gasket	
18"	All	Flange Gaskets: EPDM full face		
		Push-on/Mech. Couplings: Neoprene or nitrile		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
≥6"	Interior or Exterior	Isolation	Butterfly valve, Type AW250	MGQ
<2.5"	Buried	Isolation	Ball valve, Type BR-2P	MLQ
2.5"-10"	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
≥12"	Buried	Isolation	Butterfly valve, Type AW250	MGQ with 2" AWWA nut
18"	Buried	Check	Silent check valve, Type CGSC	
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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Project Name

40 05 03 - A76

PIPING SYSTEM SPECIFICATION				
SERVICE: High Pressure Reclaimed Water			SYMBOL: <b>WRH</b>	
FLUID: Reclaimed Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 140	TEST: 150	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
≤ 2"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type E galvanized.	Malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized, with threaded, flanged, or grooved end coupling connections.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
2.5" – 4"	Interior or Exterior	Steel, ASTM A53 Grade B, Schedule 40, Type E, galvanized.	Galvanized grooved end couplings. Grooved end fittings with double thickness mortar lining, ASTM A47 malleable iron, ASTM A536 ductile iron, or ASTM A234 steel.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
6"-12"	Interior or Exterior	Steel, ASTM A53 Grade B, Sch. 40, Type E, black with epoxy lining.	Grooved end couplings. Grooved end fittings ASTM A47 malleable iron, ASTM A536 ductile iron, or ASTM A234 steel.	
	Buried	HDPE, ASTM D3035 or F714, SDR 11.0, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
18"	Buried	HDPE, ASTM D3035 or F714, SDR 11, PE 4710, IPS size, rated 200 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: Neoprene		
		Push-on/Mech. Couplings: Neoprene or nitrile		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
≤ 2"	All	Isolation	Ball valve, Type BR-2P	MLQ
≥2.5"	Interior or Exterior	Isolation	Butterfly valve, Type AW150	MGQ
2.5"-10"	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
≥12"	Buried	Isolation	Butterfly valve, Type AW150	MGQ with 2" AWWA nut
All	All	Check	Silent check valve, Type CGSC	
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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PIPING SYSTEM SPECIFICATION				
SERVICE: Low Pressure Reclaimed Water			SYMBOL: <b>WRL</b>	
FLUID: Reclaimed Water				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX: 60	TEST: 125	TEST TYPE: 1	NORMAL: 70	MAX: 85
TEST MEDIUM: Water		TEST DURATION: 120 minutes	CLEANING TYPE: 2	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
≤ 2"	Interior or Exterior	Steel, ASTM A53 Grade A, Schedule 40, Type E galvanized.	150# malleable iron, ANSI B16.3, screwed, galvanized.	
	Buried	HDPE, ASTM D3035 or F714, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
2.5" – 4"	Interior or Exterior	Steel, ASTM A53 Grade A, Schedule 40, Type E, galvanized.	Galvanized grooved end couplings. Grooved end fittings with double thickness mortar lining, ASTM A47 malleable iron, ASTM A536 ductile iron, or ASTM A234 steel.	
	Buried	HDPE, ASTM D3035 or F714, AWWA, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
6"-12"	Interior or Exterior	Steel, ASTM A53 Grade A, Sch. 40, Type E, black with epoxy lining.	Grooved end couplings. Grooved end fittings ASTM A47 malleable iron, ASTM A536 ductile iron, or ASTM A234 steel.	
	Buried	HDPE, ASTM D3035 or F714, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
18"	Buried	HDPE, ASTM D3035 or F714, SDR 13.5, PE 4710, IPS size, rated 160 psig working pressure.	HDPE molded fittings to match pipe. Joints: Butt-fusion or socket-fusion welded connections. Electrofusion joints are not acceptable.	
All	All	Flange Gaskets: Neoprene CI		
		Push-on/Mech. Couplings: Neoprene or nitrile		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
≤2"	All	Isolation	Ball valve, Type BR-2P	MLQ
≥2.5"	Interior or Exterior	Isolation	Butterfly valve, Type AW150	MGQ
2.5"-10"	Buried	Isolation	Resilient wedge gate valve, Type RW200	2" AWWA nut
≥12"	Buried	Isolation	Butterfly valve, Type AW150	MGQ with 2" AWWA nut
All	All	Check	Silent check valve, Type CGSC	
<b>REMARKS:</b> All pipe-to-pipe joints, plugs, caps, tees bends, all other fittings, and valves shall be restrained.				

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PIPING SYSTEM SPECIFICATION				
SERVICE:			SYMBOL:	
FLUID:				
PRESSURE – PSIG			TEMPERATURE - °F	
MAX:	TEST:	TEST TYPE:	NORMAL:	MAX:
TEST MEDIUM:		TEST DURATION:	CLEANING TYPE:	
PIPE AND FITTING SPECIFICATION				
SIZE	EXPOSURE	PIPE	FITTINGS AND JOINTS	
All	All	Flange Gaskets:		
		Push-on/Mech. Couplings:		
GENERAL VALVE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN VALVE SCHEDULE				
SIZE	EXPOSURE	DUTY	SPECIFICATION	OPERATOR
<b>REMARKS:</b>				

**\*\*END OF SECTION\*\***

## SECTION 40 05 07

### HANGERS AND SUPPORTS FOR PROCESS PIPING

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies requirements for design, selection, installation and inspection of hangers, supports, and seismic restraints for all piping systems specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03), except for fire sprinkler systems. The Drawings specify hangers, supports, and seismic restraints for piping larger than 12-inch nominal diameter that is outside the Contractor's design professional responsibility. All process piping supports and seismic restraints designed by the Contractor's design professional and all supports and seismic restraints specified in the Drawings shall be provided by the Contractor.

###### B. SEISMIC CRITERIA:

1. The design criteria for the seismic restraints for all piping systems shall be in accordance with the California Building Code and the seismic parameters shown on the Drawings. The component importance factor  $I_p$  shall be 1.50. The seismic restraint system shall be designed by a professional Engineer registered in the State of California.

##### 1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent that they are referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
AISC Manual	Manual of Steel Construction - 13th Edition
ASTM A193 / A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

<u>Reference</u>	<u>Title</u>
ASTM A575	Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A576	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A1011	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM D635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
CBC	California Building Code
FEDSPEC WW-H-171e	Hangers and Supports, Pipe
MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	Pipe Hangers and Supports - Selection and Application
OSHPD	California Office of Statewide Health Planning and Development
SAE J429	Mechanical and Material Requirements for Externally Threaded Fasteners

#### B. DEFINITIONS:

1. Longitudinal direction: direction parallel to the pipe axis.
2. Lateral/Transverse direction: direction perpendicular to the pipe axis.
3. Essential Facilities: buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.
4. Exposure location terms used in these specifications are defined as follows:
  - a. Interior: Inside of a building or structure.
  - b. Exterior: Outside of a building or structure and exposed to weather elements.
  - c. Buried: Below grade and in contact with backfill material or concrete encasement. Piping may or may not be insulated.
  - d. Submerged: Submerged or below the top elevation of structures or facilities containing liquids, such as: tanks, channels, digesters, manholes, sumps, basins, rivers, and other areas as indicated or shown on the drawings.

5. Exposure severity terms are defined as follows:
  - a. Mild Environment: Standard commercial facility conditions.
  - b. Moderate Environment: Industrial facility conditions where surfaces may be occasionally exposed to light-moderately aggressive liquids, solids or gases.
  - c. Harsh Environment: Industrial facility conditions where surfaces may be subject to aggressive liquids, solids or gases, or surfaces may be normally exposed to light-moderately aggressive liquids, solids or gases.

### **1.03 SUBMITTALS**

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
  1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. Manufacturer's information and catalog data showing compliance with this specification and a full description of the product.
  3. Hanger and support locations and hanger components, including elbow thrust restraints as required by the piping system, shall be indicated on the piping layout drawings required by the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03). Pipe hanger spacing shall not exceed the maximum spans shown on the Drawings. **[NTS – Include Standard Detail M1 in the Drawings]** Contractor shall provide a legend that includes support identification number, support type, pipe size and service, and support weight. Failure to include this information with pipe layout drawing submittal shall be cause for rejection of the layout drawings.
  4. Pipe hanger, thrust restraints and seismic restraint calculations prepared and stamped by a professional structural or civil engineer registered in the State of California. Calculations shall include the effects of thermal expansion and contraction of the piping system using the temperature ranges included in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
  5. Seismic restraint locations and components shall be indicated on the piping layout drawings required by the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

## PART 2 -- PRODUCTS

### 2.01 MATERIALS

#### A. GENERAL:

1. All hangers, supports, hardware and components shall be of the material and finish per the following table, unless specifically shown otherwise on the drawings:

	<b>Locations</b>			
	<b>Interior</b>	<b>Exterior</b>	<b>Buried</b>	<b>Submerged</b>
Mild Environment	HDGAF	HDGAF	N/A	N/A
Moderate Environment	HDGAF	HDGAF	304 SS	N/A
Harsh Environment (not Hypochlorite)	316 SS	316 SS	316 SS	316 SS
Harsh Environment (Hypochlorite)	FRP	FRP	FRP	FRP

HDGAF = Steel, Hot Dip Galvanized After Fabrication

SS = Stainless Steel

FRP = Fiberglass Reinforced Plastic

### 2.02 CHANNEL STRUT

#### A. ACCEPTABLE PRODUCTS:

1. Single channel: B-Line B22; Unistrut P1000; B-Line BFV22SH; or equal.
2. Double channel: B-Line B22A; Unistrut P1001; B-Line BFV22A; or equal.
3. Double deep channel: B-Line B12A; Unistrut P5501; or equal.

#### B. MATERIALS:

1. ASTM A1011 Grade 33 steel channel shall be 1-5/8 inches square, roll formed, 12-gage material. Channel shall have a continuous slot along one side with in-turned clamping ridges.
2. ASTM A240 stainless steel channel shall be 1-5/8 inches square, roll formed, 12-gage material. Channel shall have a continuous slot along one side with in-turned clamping ridges.
3. Fiberglass channel shall be 1-5/8 inches square, pultruded, ¼-inch thick material with vinyl ester resin. Channel shall meet ASTM E84 Class 1 Flame Rating, and self-extinguishing requirements of ASTM D635. Channel shall have a continuous slot along one side with in-turned clamping ridges. Channel profile shall match steel channel profile.

## 2.03 PIPE HANGERS AND SUPPORTS

### A. TYPE 1 - CLEVIS PIPE HANGER:

1. ACCEPTABLE PRODUCTS: B-Line B3100; Anvil Fig. 260; B-Line BFV3104; or equal.
2. MATERIALS:
  - a. Steel and stainless steel clevis hangers shall comply with MSS and FEDSPEC Type 1.
  - b. FRP hangers shall be glass reinforced polyurethane or glass reinforced vinyl ester.

### B. TYPE 4 - ADJUSTABLE ROLLER HANGER:

1. ACCEPTABLE PRODUCTS: B-Line B3110; Anvil Fig. 181; or equal.
2. MATERIALS: Rollers shall be cast iron, and shall comply with MSS Type 43 and FEDSPEC Type 44.

### C. TYPE 5 - SINGLE PIPE ROLLER:

1. ACCEPTABLE PRODUCTS: B-Line B3114; Anvil Fig. 171; or equal.
2. MATERIALS: Rollers and sockets shall be cast iron, and shall comply with MSS Type 41 and FEDSPEC Type 42.

### D. TYPE 6 - FRAMING CHANNEL ONE-BOLT PIPE CLAMP:

1. ACCEPTABLE PRODUCTS: B-Line B2000 series; Unistrut P 1109 series; B-Line BFV2000; or equal.
2. MATERIALS:
  - a. Gage of steel and stainless steel one-bolt clamps shall be as follows:
    - 1) Pipe sizes 3/8 inch and 1/2 inch shall be 16 gage.
    - 2) Pipe sizes 3/4 inch through 1 1/4 inches shall be 14 gage.
    - 3) Pipe sizes 1 1/2 inches through 3 inches shall be 12 gage.
    - 4) Pipe sizes 3 1/2 inches through 5 inches shall be 11 gage.
    - 5) Pipe sizes 6 and 8 inches shall be 10 gage.
  - b. FRP clamps shall be glass reinforced polyester or vinyl ester.

E. TYPE 7 - U-BOLT:

1. ACCEPTABLE PRODUCTS: B-Line B3188; Anvil Fig. 137; B-Line BFV501 series; or equal.
2. MATERIALS:
  - a. Steel and stainless steel U-bolts shall comply with MSS and FEDSPEC Type 24.
  - b. FRP U-bolts shall be glass reinforced polyurethane or glass reinforced polyester or vinyl ester.

F. TYPE 8 - ADJUSTABLE PIPE ROLLER SUPPORT:

1. ACCEPTABLE PRODUCTS: B-Line B3122; Anvil Fig. 177; or equal.
2. MATERIALS: Rollers and sockets shall be cast iron.

G. TYPE 9 - WELDED PIPE STANCHION:

1. MATERIALS: Minimum material thickness shall be standard schedule pipe, cut to match contour of the pipe elbow. Use of this support shall be limited to ambient systems only.

H. TYPE 10 - PIPE STANCHION SADDLE:

1. ACCEPTABLE PRODUCTS: B-Line B3090; Carpenter & Patterson Fig. 125; or equal.
2. MATERIALS: Saddles and yokes shall be steel or stainless steel, and shall comply with MSS type 37 and FEDSPEC Type 38. Include matching base stand.

I. TYPE 11 - OFFSET PIPE CLAMP:

1. ACCEPTABLE PRODUCTS: B-Line B3148; Anvil Fig. 103; or equal.
2. MATERIALS:
  - a. Pipe clamp shall be carbon or stainless steel.
  - b. Vertical pipe support applications shall be as specified above except that insulation shields shall not be used for insulated pipe. Clamp support directly to pipe and insulate supports same as the pipe.

J. TYPE 12 - RISER CLAMP:

1. ACCEPTABLE PRODUCTS: B-Line B3373; Anvil Fig. 261; B-Line B3373 CT; Anvil Figure 261C; or equal.



2. MATERIALS: Riser clamps shall comply with MSS and FEDSPEC Type 8.

K. TYPE 13 - CHANNEL STRUT SINGLE PIECE PIPE STRAP:

1. ACCEPTABLE PRODUCTS: B-Line 2400 series; Unistrut P2558 series; B-Line BFP2400 series; or equal.

2. MATERIALS:

a. Steel and Stainless Steel: Pipe straps shall comply with MSS Type 26.

b. FRP: Glass reinforced polyurethane or glass reinforced polyester or vinyl ester.

**2.04 RACK AND TRAPEZE SUPPORTS:**

A. GENERAL:

1. Trapeze and pipe rack components shall have a maximum deflection  $1/240$  of the span.

B. TYPE 20 - TRAPEZE PIPE SUPPORT:

1. MATERIALS: Trapeze pipe support cross members shall be channel strut with flat plate fittings square washer.

**C. TYPE 21 - PIPE SUPPORT RACK:**

**1. MATERIALS:**

- a. Post and cross members shall be channel strut. Channel fittings shall be manufactured by the channel strut manufacturer.
- b. 90-degree fittings shall have gussets. B-Line B844W; Unistrut P2484W; or equal.
- c. Channel strut post base fittings shall be as specified.

**D. CANTILEVER PIPE SUPPORT RACK:**

1. **ACCEPTABLE PRODUCTS:** Interlake Mecalux model Structural Cantilever; Bluff Manufacturing model Cantilever Rack; or equal, modified as required to meet the specifications.

**2. MATERIALS:**

- a. Cantilever rack components shall be fabricated from structural steel shapes. Roll formed cantilever rack components shall not be acceptable. Columns shall be fabricated from wide flange beams. Bases shall be fabricated from wide flange beams, and shall be welded to the columns. Arms shall be fabricated from structural steel shapes, and shall be bolted to the columns. Rack components shall be powder coated. See Standard Detail Drawing M82 for additional information.

**2.05 STRUCTURAL ATTACHMENTS**

**A. TYPE A - MALLEABLE IRON CONCRETE INSERT:**

1. **ACCEPTABLE PRODUCTS:** B-Line B3014; Anvil Figure 282; or equal.
2. **MATERIALS:** Concrete inserts shall be malleable iron and shall comply with MSS and FEDSPEC Type 18.

**B. TYPE B – CONTINUOUS CHANNEL STRUT CONCRETE INSERT:**

1. **ACCEPTABLE PRODUCTS:** B-Line B22-I series; Unistrut P3270 series; or equal.
2. **MATERIALS:** Concrete inserts shall include strut, Styrofoam filler, closure strips and end caps. Design capacity shall be 2000 lbs/ft with a safety factor = 3.

**C. TYPE C - MALLEABLE IRON BEAM CLAMP WITH EXTENSION PIECE:**

1. **ACCEPTABLE PRODUCTS:** B-Line B3054; Anvil Figure 218 with Figure 157 extension piece; or equal.

2. MATERIALS: Clamp and extension piece shall be malleable iron, and shall comply with MSS and FEDSPEC Type 30.

D. TYPE D – HEAVY DUTY STEEL BEAM CLAMP WITH EYE NUT:

1. ACCEPTABLE PRODUCTS: B-Line B3291 series; Anvil Figure 292; or equal.
2. MATERIALS: Beam clamp and eye nut shall be forged steel, and shall comply with MSS and FEDSPEC Type 28.

E. TYPE F - WELDED BEAM ATTACHMENT:

1. ACCEPTABLE PRODUCTS: B-Line B3083; Anvil Figure 66; or equal.
2. MATERIALS: Beam attachment shall comply with MSS and FEDSPEC Type 22.

F. TYPE G - ADJUSTABLE ROD BEAM ATTACHMENT:

1. ACCEPTABLE PRODUCTS: B-Line B3082; or equal.
2. MATERIALS: Steel or stainless steel.

G. TYPE H - DOUBLE CHANNEL BRACKET:

1. ACCEPTABLE PRODUCTS: B-Line B297 series; Unistrut P2542 series; or equal.
2. MATERIALS: Wall channel shall be single channel strut. Cantilever bracket shall be double-channel assembly.

H. TYPE J - SINGLE CHANNEL BRACKET:

1. ACCEPTABLE PRODUCTS: B-Line B409 series; Unistrut P2513 series; or equal.
2. MATERIALS: Wall channel shall be single channel strut. Cantilever bracket shall be single-channel assembly.

I. TYPE L - PIPE STANCHION BASE STAND:

1. ACCEPTABLE PRODUCTS: B-Line B3088S; or equal.
2. MATERIALS:
  - a. Steel or Stainless Steel: Baseplate shall be rated for seismic applications. Anchor bolt holes shall be 1/16 inch larger than the anchor bolt diameter. The space between the baseplate and the floor shall be filled with nonshrink grout.

J. TYPE M - WELDED STEEL BRACKET:

1. ACCEPTABLE PRODUCTS: B-Line B3066 or B3067; Anvil Figure 195 or 199; or equal.
2. MATERIALS: Brackets shall comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket. Heavy welded bracket shall comply with MSS type 33 and FEDSPEC Type 34. Bracket type as required for load.

K. TYPE P - CHANNEL STRUT POST BASE:

1. ACCEPTABLE PRODUCTS:
  - a. Single channel: B-Line B280; Unistrut P2072A SQ; B-Line BFV280SQ; or equal.
  - b. Double channel: B-Line B281; Unistrut P2073A SQ; B-Line BFV281SQ; or equal.
2. MATERIALS:
  - a. Steel or Stainless Steel: Post base shall be manufactured by the channel strut manufacturer.
  - b. FRP: Glass reinforced polyurethane or polyester or vinyl ester.

L. TYPE Q - SIDE BEAM BRACKET:

1. ACCEPTABLE PRODUCTS: B-Line B3060; Anvil Figure 206; or equal.
2. MATERIALS: Steel or stainless steel.

## 2.06 ACCESSORIES

A. HANGER RODS:

1. MATERIALS:
  - a. Rods shall be threaded on both ends or continuously threaded and sized as specified.
  - b. Steel: ASTM A575 & A576; SAE J429 Grade 2; or equal.
  - c. Stainless Steel: ASTM A193 B8 Class 1 or 2, Type 304 stainless steel, and ASTM A193 B8M Class 1 or 2, Type 316 stainless steel.
  - d. FRP: Glass reinforced vinyl ester.

B. WELDLESS EYE NUT:

1. ACCEPTABLE PRODUCTS: B-Line B3200; Anvil Figure 290; or equal.

2. MATERIALS: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17.

C. WELDED EYE ROD:

1. ACCEPTABLE PRODUCTS: B-Line B3211; Anvil Figure 278; or equal.
2. MATERIALS: Eye rod shall be welded closed. Inside diameter of eye shall accommodate a bolt diameter 1/8 inch larger than the rod diameter.

D. TURNBUCKLE:

1. ACCEPTABLE PRODUCTS: B-Line B3202; Grinnell Figure 230; or equal.
2. MATERIALS: Turnbuckle shall be forged steel and shall comply with MSS SP-58.

## **2.07 THERMAL PIPE HANGER SHIELD**

A. HOT PIPE SHIELDS:

1. ACCEPTABLE PRODUCTS: B-Line B3380-B3387; or equal.
2. MATERIALS: Asbestos-free, hydrous calcium silicate insert, treated for water resistance, and encased in a 360° galvanized steel jacket. The jacket thickness shall be as recommended by the manufacturer. Shield shall have butt connection to pipe insulation. Jacket and insulation shall be flush with end. Provide stainless steel band clamps to prevent slippage between the pipe wall and the thermal shield. Temperature range: 20° to 500° F.

B. COLD PIPE SHIELDS:

1. ACCEPTABLE PRODUCTS: B-Line B3380-3387; or equal.
2. MATERIALS: Asbestos-free, hydrous calcium silicate insert, treated for water resistance, and encased in a 360° galvanized steel jacket. The jacket thickness shall be as recommended by the manufacturer. Shield shall have butt connection to pipe insulation. Insulation shall extend 1 inch each side of steel jacket for vapor tight connection to pipe insulation vapor barrier. Provide stainless steel band clamps to prevent slippage between the pipe wall and the thermal shield. Temperature range: 20° to 500° F.

## **2.08 SEISMIC RESTRAINTS**

A. GENERAL:

1. Seismic restraint system shall be OSHPD approved for piping in essential facilities, and shall comply with the CBC.

2. Acceptable manufacturers include: Mason Industries Incorporated; Cooper B-Line/TOLCO; or equal.
3. Cable-type seismic bracing will not be acceptable for this project.

## **PART 3 -- EXECUTION**

### **3.01 GENERAL**

#### **A. HANGER AND SUPPORT SELECTION**

1. Select pipe hangers and supports as shown on the drawings and as specified here.
2. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consider the following conditions:
  - a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components and normal fluid contents.
  - b. Weight of hydrostatic test fluid or cleaning fluid if operating fluid contents are lighter. The type of fluids and testing pressure requirements are specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
  - c. Reaction forces due to the operation of safety or relief valves.
  - d. Reaction forces at bens and elbows due to internal pressures if the piping system is not fully restrained.
  - e. Thermal expansion and contraction due to temperature changes in the fluids conveyed by the piping systems.
  - f. Wind, snow or ice loading on outdoor piping.
3. Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.
4. Provide thermal shields at hanger, support and guide locations on pipe requiring insulation. The thermal shield shall be the same thickness as the piping system insulation specified in Process Piping and Equipment Insulation Specification Section.
5. There shall be no contact between a pipe and hanger or support component of dissimilar metals. Prevent contact between dissimilar metals by wrapping the pipe with three layers of UPC-listed 20-mil PVC pipe wrap or 1/8-inch-thick 40 durometer neoprene padding as necessary to ensure the isolation material covers the entire contact surface between the pipe and any metallic portion of the support or hanger. Isolation material must be compatible with the environment.

## 3.02 INSTALLATION

### A. HANGER AND SUPPORTS

1. Locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loads.
2. Do not use existing pipes and supports to support new piping.
3. Do not attach pipe support components to pressure vessels.
4. Provide at least one hanger or support within 2 feet from a pipe change in direction.
5. Locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.
6. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.
7. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of AISC Manual of Steel Construction. Do not drill or burn holes in the building structural steel without written authorization of the structural engineer of record.
8. Do not use hanger components for rigging or erection purposes.
9. Install thermal pipe hanger shields in accordance with the manufacturer's recommendations.
10. Remove burrs and sharp edges from hanger and support components.
11. Rollers shall roll freely without binding. Verify smooth operation prior to placing load on support.
12. Finished floor beneath floor mounted structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.
13. Provide manufacturer's plastic or rubber end caps at the exposed ends of all framing channels that are located within 7 feet of the floor or ground. Outside caps shall be UV and weather resistant.
14. Adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Adjust stanchions prior to grouting their baseplates.

15. Seal cut ends of hot dip galvanized after fabrication channel and components with ZRC Galvilite Galvanizing Repair Compound, or equal. Grind all sharp edges off. Solvent clean the surface to remove grease and oils. Apply two coats in accordance with the manufacturer's instructions.
16. Seal cut ends of FRP channel and components with UV-resistant sealant coating provided by the FRP channel manufacturer. Apply sealant coating in accordance with the manufacturer's instructions.

**B. SEISMIC RESTRAINT SELECTION AND INSTALLATION:**

1. Unless otherwise specified, the Contractor's design professional shall design, select, and locate seismic restraints for piping to be furnished in accordance with the contract documents.
2. Provide and install seismic restraints in accordance with the Mason Industries Seismic Restraint Guidelines for Suspended Piping, Ductwork and Electrical Systems and the CBC.
3. Piping systems shall not be braced to dissimilar parts of a building or to dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
4. Restraints shall be sized to fit the outside diameter of the pipe, tubing, or, where specified, the outside diameter of insulation.
5. There shall be no contact between a pipe, duct or raceway and restraint component of dissimilar metals.
6. Branch lines shall not be used to brace main lines.
7. Seismic bracing shall not limit the expansion and contraction of the piping system.

**3.03 TESTING (NOT USED)**

**3.04 TRAINING (NOT USED)**

**\*\*END OF SECTION\*\***



## SECTION 40 05 19

### DUCTILE IRON PROCESS PIPE

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies ductile iron pipe, ductile or gray iron fittings, connections, linings, and coatings.

##### 1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASME B1.1	Unified Inch Screw Threads (UN & UNR Thread Form)
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B18.2.1	Square and Hex Bolts and Screws Inch Series
ASME B18.2.2	Square and Hex Nuts (Inch Series)
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe With Threaded Flanges
AWWA C150	Thickness Design of Ductile-Iron Pipe

<u>Reference</u>	<u>Title</u>
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	Ductile Iron Compact Fittings 3” – 24” and 54” – 64” for Water service
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger
AWWA C600	Standard for Installation of Ductile-Iron Water Mains and their Appurtenances
NSF-61	National Sanitation Foundation, Drinking Water System Components – Health Effects
SAE J429	Mechanical and Material Requirements for Externally Threaded Fasteners, Standard
SSPC-SP 10	Near-White Blast Cleaning

B. DEFINITIONS: (Not Used)

**1.03 SUBMITTALS**

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. Manufacturer's information and catalog data showing compliance with this specification and a full description of the item.
  3. Contractor's shop drawings including fabrication, layout drawings and anchorage details.

**1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

**PART 2 -- PRODUCTS**

**2.01 PIPE**

A. AWWA C151:

1. Pipe class (wall thickness) shall be the minimum specified below:

Pipe	Class
3-12 inch diameter	350 or 53
14-18 inch diameter	350 or 53
All flanged end	53

## **2.02 FITTINGS**

### **A. AWWA C110:**

1. **SIZE RANGE:** 4 to 48 inches. Fittings 4 to 24 inches shall be rated 350 psi. Fittings 30 to 48 inches shall be rated 250 psi. Ends shall be push-on, mechanical joint, or flanged. Provide long radius fittings where shown on the drawings.

### **B. AWWA C153:**

1. **SIZE RANGE:** 4 to 24 inches. Fittings 4 to 24 inches shall be rated 350 psi.

## **2.03 FLANGES**

### **A. AWWA C115:**

1. Class 125 ductile iron flanges shall conform to AWWA C115 and ASME B16.1. Flanges shall have flat faces.

## **2.04 CONNECTIONS**

### **A. PUSH-ON AND MECHANICAL JOINTS:**

1. Push-on joints shall comply with AWWA C151.
2. Mechanical joints shall comply with AWWA C151.
3. Gaskets shall comply with AWWA C111.

### **B. FLANGE CONNECTIONS:**

#### **1. FLANGE GASKETS:**

- a. Gaskets shall be as designated in COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

#### **2. FASTENERS:**

- a. Unless otherwise specified, fasteners for ductile iron joints shall be high-strength, low-alloy steel as specified in AWWA C111 for interior, exterior, and buried exposures. Fasteners for submerged exposures shall be Type 316 stainless steel.

#### **3. INSULATING FLANGE SET:**

- a. Unless otherwise specified, insulating flange sets shall be as specified in CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).
- b. **ACCEPTABLE PRODUCTS:** PSI, or equal.

- c. Flange insulation sets shall be suitable for 225°F continuous operating temperature.
- d. Insulating gaskets shall be plain phenolic, Type “E” full flange diameter type. Sealing gaskets shall be 1/16-inch thick, type as specified in COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
- e. Insulating sleeves and washers shall be either one-piece or two-piece type. Sleeves and washers shall be phenolic or spiral-wound Mylar.
- f. Metallic flat washer shall be steel or stainless steel to match the cap screw material.

C. SLEEVE-TYPE COUPLINGS:

- 1. Sleeve-type couplings shall be constructed of ductile iron or steel per the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

D. RESTRAINT DEVICES:

1. PUSH-ON JOINTS:

a. ACCEPTABLE PRODUCTS:

- 1) Flex-Ring or Lok-Ring Joint as manufactured by American Cast Iron Pipe Company;
- 2) TR Flex Joint as manufactured by US Pipe;
- 3) Or equal.

- b. Restrained joints shall be capable of being deflected after full assembly. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations. No field cuts of restrained pipe are permitted without prior approval of the District Representative.

2. MECHANICAL JOINTS:

a. ACCEPTABLE PRODUCTS:

- 1) Romac Industries model GripRing;
- 2) EBAA Iron MegaLug Series 1100 or MegaFlange 2100;
- 3) Or equal.

- b. Ductile iron construction with either full wedge action circumferential gripping surface or multiple wedge action gripping surfaces. Restraints shall be rated for the full working pressure of the pipe.

**E. JOINT BONDS**

- 1) Joint bonds shall be employed at each non-welded non-isolation flanged joint to provide electrical continuity of the pipeline. Joint bonds shall be as specified in the CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).

**2.05 LINING**

**A. CEMENT MORTAR LINING:**

- 1. Unless otherwise specified in COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03), pipe and fittings shall be lined with double thickness cement mortar as specified in AWWA C104.

**B. GLASS LINING:**

**1. ACCEPTABLE PRODUCTS:**

- a. US Pipe Fabrication FerroRock MEH-32,
- b. Vitco SG-14,
- c. Or equal.

- 2. Where specified in COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03), pipe and fittings shall be glass lined with a vitreous material to a minimum thickness of 10 mils. Thickness to be measured in accordance using a magnetic-type film thickness gage such as Mikrotest Model FM, Elcometer Model 211/1E, or equal. Glass lining shall provide continuous coverage as tested by a Tinker and Rasor Model M1 nondestructive type holiday detector, K-D Bird Dog, or equal low voltage holiday detector. The unit shall operate at less than 75 volts. Voids shall be cause for rejection. Glass-lined pipe shall be prefabricated. Field cut pieces will only be allowed if no damage occurs to the glass lining. Ends shall be coated.

- 3. Pipe shall be bored, machined, or grit blasted to remove any voids, protrusions or surface irregularities to obtain a smooth continuous surface for glass lining. Fittings shall be ground or grit blasted to remove any voids, protrusions or surface irregularities.

## **2.06 COATINGS**

### **A. BELOW GRADE COATING:**

1. Unless otherwise specified, below grade pipe and fittings shall be factory coated with asphaltic material as specified in AWWA C151 for ductile iron pipe, AWWA C115 for flanged pipe, and AWWA C110 and AWWA C153 for fittings.

### **B. ABOVE GRADE EPOXY COATING:**

1. Unless otherwise specified, above grade pipe and fittings shall be coated with an epoxy primer coat by the pipe and fitting manufacturer and shall not be coated with asphaltic coating. Primers shall be a universal primer either Tnemec 140-1211 or Tnemec 37H or Wasser MC FerroClad.
2. Refer to the PAINTING AND COATING Section (09 90 00) for finish epoxy coating of pipe and fittings.

## **PART 3 -- EXECUTION**

### **3.01 GENERAL (NOT USED)**

### **3.02 INSTALLATION**

#### **A. PIPE INSTALLATION:**

1. Install pipe in accordance with the drawings, the manufacturer's instructions and recommendations, and AWWA C600.

#### **B. FITTING INSTALLATION:**

1. Install fittings in accordance with the manufacturer's instructions and recommendations.

#### **C. CONNECTION INSTALLATION:**

1. All connections shall be installed in accordance with manufacturer's instructions and recommendations.
2. RESTRAINT DEVICES:
  - a. Remove any pipe coatings in contact with the gripping surfaces. Tighten all bolts with a torque wrench to the manufacturer's specifications. Breakaway bolt heads designed for the required torque may be used.

3. BONDING OF JOINTS:

- a. All pipe joints, other than welded joints or isolation flange joints, shall be bonded as specified in the CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).

D. LINING INSTALLATION:

1. Linings shall be installed and patched in accordance with the manufacturer's instructions and recommendations.

E. CORROSION PROTECTION INSTALLATION:

1. BELOW GRADE:

- a. Polyethylene encase all ductile iron pipe, metallic appurtenances, specials, and fittings per AWWA C105.
- b. Coat all buried non-cathodically protected metallic appurtenances, specials, rods, bolts, glands, plugs, caps, tees, bends, and all other fittings, with a wax tape coating system as specified in the CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42). Wax tape shall be provided to both bare metallic surfaces and factory coated surfaces.

2. ABOVE GRADE:

- a. Refer to the PAINTING AND COATING Section (09 90 00) for finish epoxy coating of pipe and fittings.

**3.03 DISINFECTION**

- A. Disinfection shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

**3.04 TESTING**

A. PRE-OPERATIONAL TESTING:

1. Testing shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
2. Pipeline electrical continuity testing shall be performed as specified in the CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).

**3.05 TRAINING (NOT USED)**

**\*\*END OF SECTION\*\***

## SECTION 40 05 23

### STAINLESS STEEL PROCESS PIPE AND TUBING

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies stainless steel pipe, fittings, and connections.

##### 1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASNI B16.5	Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard
ANSI B31.1	Power Piping
ANSI B31.3	Process Piping
ANSI B1.20.1	Pipe Threads, general purpose
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Qualifications
ASTM A182/A182M Rev A	Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M Rev B	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A240/240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications



<u>Reference</u>	<u>Title</u>
ASTM A312/ A312M	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A351/ A351M	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A380/ A380M	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A403/ A403M	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A733	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A774/ A774M	Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
ASTM A778	Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

### **1.03 SUBMITTALS**

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. Manufacturer's information and catalog data showing compliance with this specification and a full description of the item. A copy of the ASME Certification of Welders and current work history.
  3. Welding procedure for stainless steel.
  4. Calculations for proposed alternative anchorage details.
  5. The Contractor's shop drawings (including fabrication), layout drawings and anchorage details.

## **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

### **PART 2 -- PRODUCTS**

#### **2.01 GENERAL (NOT USED)**

#### **2.02 MATERIALS AND EQUIPMENT**

##### **A. PIPE:**

1. ASTM A312/312M:
  - a. Sizes 1/8 to 2-1/2 inches. Minimum thickness Schedule 40S seamless. Type TP316L. Yield strength 25,000 psi minimum. Tensile strength 75,000 psi minimum.
2. ASTM A778:
  - a. Sizes 3 to 48 inches. Wall thickness shall be equivalent to Schedule 10S or 40S as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03). Type 316L. Yield strength 25,000 psi minimum. Tensile strength 75,000 psi minimum.
3. Additional requirements shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03) or as shown on the drawings.

##### **B. PIPE FITTINGS:**

1. ASTM A182/A182M Rev A Grade F316L forged stainless steel fittings, ANSI B16.5 Class 150.
2. ASTM A351/A351M Grade CF8M cast stainless steel fittings, Class 150. Threaded or socket weld.
3. ASTM A403/A403M WP-W Type 316 stainless steel fittings. Grooved end. Wall thickness shall equal or exceed pipe wall thickness.
4. ASTM A733 Type TP316L seamless stainless steel nipples, Schedule 40S. Threaded.
5. ASTM A774/A774M TP316L as-welded stainless steel. Butt weld or belled end. Elbows, tees, crosses, laterals, wyes, and reducers shall be fabricated from ASTM A240/A240M plate. Elbows shall be smooth flow style. Wall thickness shall equal or exceed pipe wall thickness.

C. PIPE CONNECTIONS:

1. GENERAL:

- a. Connections shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

2. THREADED CONNECTIONS:

- a. Pipe thread dimensions and size limits shall conform to ANSI B1.20.1.
- b. PIPE THREAD SEALANT:
  - 1) ACCEPTABLE PRODUCTS FOR OXYGEN PIPING: Fluoramics LOX-8 oxygen-safe thread sealant for wet locations, or equal.
  - 2) ACCEPTABLE PRODUCTS FOR NON-OXYGEN PIPING: Teflon tape or Teflon bearing thread compound compatible with the intended service.

3. PIPE FLANGE CONNECTIONS:

a. FLANGES:

- 1) ASTM A182/A182M Rev B Grade F316L. ANSI B16.5 Class 150.
- 2) For piping 3 inches and smaller, provide weld-neck flanges. For piping larger than 3 inches, provide weld-neck or slip-on flanges. Slip-on flanges shall be double welded per ANSI B31.3.

b. FLANGE GASKETS:

- 1) Gaskets shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

c. FASTENERS:

- 1) Fasteners shall be ASTM F593 Type 316 stainless steel cap screws with matching washers and nuts, coarse thread.

4. PIPE SLEEVE-TYPE COUPLINGS:

- a. Sleeve-type couplings shall be constructed of stainless steel per the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

5. PIPE GROOVED END COUPLINGS:

- a. ACCEPTABLE PRODUCTS: Victaulic Style 77S, or equal.
- b. Couplings shall be flexible-type, Type 316 stainless steel.

- c. Bolts, washers and nuts shall be ASTM A193/A193 M Rev B Type 316 Grade B8M stainless steel.
  - d. Gaskets shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
6. PIPE RESTRAINT DEVICES:
- a. Restraint devices shall be welded stainless steel harness assemblies.

D. PIPE OUTLETS:

- 1. ACCEPTABLE PRODUCTS: Bonney Forge model Sockolet, or equal.
- 2. Outlets shall be Type 316L standard weight stainless steel.
- 3. Welded outlets shall be socket-weld style or butt-weld style.
- 4. Threaded outlets shall comply with ANSI B1.20.1.

**PART 3 -- EXECUTION**

**3.01 GENERAL (NOT USED)**

**3.02 INSTALLATION**

A. PIPE:

- 1. GENERAL:
  - a. Pipe shall be installed in as shown on the drawings.
- 2. ANCHORAGE:
  - a. Supports and anchorage shall be provided as shown on the drawings and as specified in the HANGERS AND SUPPORTS FOR PROCESS PIPING Section (40 05 07). Calculations and drawings for proposed alternative anchorage shall be submitted in accordance with the SUBMITTAL PROCEDURES Section (01 33 00).

B. FITTINGS:

- 1. Fittings shall be installed in accordance with the manufacturer's recommendations.

C. CONNECTIONS:

1. THREADED CONNECTIONS:

- a. Pipe cutting, threading, and jointing shall conform to the requirements of ANSI B31.1 and the fitting manufacturer's installation recommendations.
- b. Lubricate pipe threads in accordance with the lubricant manufacturer's instructions.

2. FLANGED:

- a. Pipe cutting, threading, and jointing shall conform to the requirements of ANSI B31.1 and the fitting manufacturer's installation recommendations.

3. MECHANICAL COUPLING:

- a. Mechanical couplings shall be installed in accordance with the coupling manufacturer's installation recommendations.

4. WELDED:

a. PREPARATION OF SURFACES TO BE WELDED:

- 1) Surfaces of joints to be welded shall be free from mill scale, slag, grease, oil, paint, rust, and other foreign material. Joints to be welded shall be wire-brushed with stainless steel wire brushes and precisely fitted before welding.
- 2) Nicks, gouges, notches, and depressions in the base metal in the area of the joint shall be repaired before the joint weld is made

b. PROCEDURES:

- 1) Piping shall be properly beveled and have a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW) process. The same technology shall be employed for all welding passes. Filler wire of L grade only shall be added to all welds to provide a cross section at the weld equal to or greater than the parent metal. Weld deposit shall be smooth and evenly distributed and have a crown of no more than 1/16-inch on the I.D. and 3/32-inch on the O.D. of the piping. Concavity, undercut, cracks, or crevices shall not be allowed. Butt welds shall have full penetration to the interior surface, and inert gas shielding shall be provided to the interior and exterior of the joint. Excessive weld deposits, slag, spatter, and projections shall be removed by grinding. Welds on gasket surfaces shall be ground smooth.

- 2) The welding procedure shall be submitted to engineer for approval prior to performing the work.
  - 3) Only weld procedures that have been qualified under ASME Section IX and only welders who have successfully completed performance qualification tests per ASME Section IX on these qualified procedures shall be utilized.
  - 4) The whole surface of the piping and welding areas shall be cleaned, descaled, and passivated per ASTM A380.
- c. FIELD WELDING:
- 1) Field welding shall be minimized to the greatest extent possible by use of prefabrication of pipe systems at the shop or factory.
  - 2) Welding shall be done only when the surfaces are completely free of any moisture. Welding of the pipe shall not be done during periods of high winds or rain unless the areas being welded are properly shielded.
  - 3) Joint shall be continuously purged with inert gas during welding procedure.
  - 4) Remove all residue, oxide, and heat stain from the welds and the heat affected areas with stainless steel wire brushes or flexible abrasive pads.
- d. TACK WELDS, CLIPS, AND OTHER ATTACHMENTS:
- 1) Tack welds, clips, and other attachments shall be removed and defects repaired, except where the tack welds occur within the weld area and these tack welds do not exceed the size of the completed weld. Cracked tack welds shall be removed. Areas to be repaired shall be ground to clean metal and then repaired by building up with weld metal. The repaired areas shall be ground smooth to form a plane surface with the base metal.
- e. DEFECTS AND REPAIRS:
- 1) The quality control program for welding and necessary heat treatment shall be submitted for engineer review and approval prior to manufacturing and field installations.
  - 2) Welds with cracks, slag inclusions, porosity, undercutting, incomplete penetration, or which are otherwise deficient in quality or made contrary to any provisions of these specifications shall be removed by chipping or grinding throughout their depth to clean base metal. Caulking or peening of welds to correct defects shall not be done. Welds found deficient in dimension but not in quality shall be enlarged by additional welding after thoroughly cleaning the surface of previously deposited metal and the adjoining plate. Weld deposits, slag, weld spatter, and projections into the interior of the pipe shall be removed by grinding.

- 3) The heat affected zone of welding shall be free of intergranular defects. A random metallurgical examination shall be completed by the District to ensure the welding procedure is acceptable.

**D. TAKEDOWN COUPLINGS:**

1. Takedown couplings shall be installed where indicated on the drawings. They shall be flanged or grooved end mechanical coupling type joints as shown on the drawings.

**E. RESTRAINT DEVICES:**

1. Restraint devices shall be installed in accordance with manufacturer's instructions and recommendations to prevent joint separation.

**F. FLEXIBILITY:**

1. Piping passing from concrete to earth or across structural expansion joints shall be provided with flexible couplings or flexible joints where indicated on the drawings. Where required for resistance to pressure, mechanical couplings shall be restrained.

**3.03 TESTING**

- A. Testing of stainless steel pipe shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

**3.04 TRAINING (NOT USED)**

**\*\*END OF SECTION\*\***

## SECTION 40 05 24

### STEEL PROCESS PIPE

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies steel pipe, fittings, flanges, connections, linings, and coatings.

##### 1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASME B1.1	Unified Inch Screw Threads
ASME B1.20.1	Pipe Threads, General Purpose
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	Malleable Iron Threaded Fittings
ASME B16.4	Gray Iron Threaded Fittings
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.12	Cast Iron Threaded Drainage Fittings
ASME B16.14	Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads
ASME B16.39	Malleable Iron Threaded Pipe Unions Classes 150, 250 and 300
ASME B16.42	Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300
ASME B31.1	Power Piping
ASME B31.3	Chemical Plant and Petroleum Refinery Piping



<u>Reference</u>	<u>Title</u>
ASME Section IX	Certification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High- Temperature Service
ASTM A126	Gray Iron Castings for Valves, Fittings, and Pipe Fittings
ASTM A193	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A197	Cupola Malleable Iron
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A395	Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A536	Ductile Iron Castings
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
AWWA C200	Steel Water Pipe--6 Inches (150 mm) and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4-In. and Larger, Shop Applied
AWWA C207	Steel Pipe Flanges for Waterworks Services Sizes 4-In. Through 144-In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA M11	Steel Pipe A Guide for Design and Installation
NSF 61	National Sanitation Foundation, Drinking Water System Components – Health Effects
SAE J429	Mechanical and Material Requirements for Externally Threaded Fasteners, Standard
SSPC-SP 10	Near-White Blast Cleaning

B. DEFINITIONS: (Not Used)

### **1.03 SUBMITTALS**

- A. The following information shall be submitted for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
  2. Manufacturer's information and catalog data showing compliance with this specification and a full description of the item.
  3. A copy of the ASME Certification of Welders and current work history.
  4. Contractor's shop drawings including fabrication and layout drawings.
  5. Anchorage and pipe support and calculations and details.

### **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

## **PART 2 -- PRODUCTS**

### **2.01 GENERAL (NOT USED)**

### **2.02 PIPE MATERIAL**

A. ASTM A53:

1. **SIZE RANGE:** 1/8 to 26 inches. Unless otherwise specified, ASTM A53 pipe shall be Grade B, Type E, electric resistance welded or Type S, seamless pipe. The minimum wall thickness for ASTM A53 pipe shall be Schedule 40 for pipe 10 inch diameter and less and 3/8 inch for pipe 12 inch through 26 inch diameter. Increased shell thickness shall be provided where specified.

B. ASTM A106:

1. **SIZE RANGE:** 1/8 to 48 inches. Unless otherwise specified, ASTM A106 pipe shall be Grade B, Schedule 40 for pipe 10 inch diameter and less and 3/8 inch wall thickness for pipe 12 inch through 48 inch diameter. Increased wall thickness shall be provided where specified.

C. AWWA C200:

1. **SIZE RANGE:** 6 inches and larger. AWWA C200 pipe shall be straight or spiral seam. The minimum wall thickness shall be 7 gage for pipe 6 inch through 24 inch diameter and 1/4 inch for pipe 26 inch diameter and larger. Increased shell thickness shall be provided where specified. Yield strength  $\geq$  35,000 psi. Tensile strength  $\geq$  60,000 psi.

## **2.03 FITTING MATERIAL**

### **A. ASTM A105:**

1. Class 3000 forged steel fittings shall conform to ASTM A105 and ASME B16.11. Fittings shall be threaded or socket weld.

### **B. ASTM A126:**

1. Class 125 cast iron fittings shall conform to ASTM A126 Class B; and ASME B16.1, ASME B16.4, ASME B16.12, or ASME B16.14. Tensile strength  $\geq$  31,000 psi. Fittings shall be threaded or flanged.

### **C. ASTM A197:**

1. Class 150 malleable iron fittings shall conform to ASTM A197; and ASME B16.3 or B16.39. Yield strength  $\geq$  30,000 psi. Tensile strength  $\geq$  40,000 psi. Fittings shall be threaded.

### **D. ASTM A234:**

1. Wrought steel butt weld fittings shall conform to ASTM A234 Grade WPB or WPB-W; and ASME B16.9. Fitting wall thickness shall match pipe wall thickness.
2. Wrought steel grooved fittings shall conform to ASTM A234 Grade WPB. Fitting wall thickness shall match pipe wall thickness.

### **E. ASTM A395:**

1. Class 150 ductile iron fittings shall conform to ASTM A395 and ASME B16.1. Fittings shall be flanged.

### **F. ASTM A536:**

1. Ductile iron fittings shall conform to ASTM A536. Fittings shall be threaded, grooved or flanged.

### **G. AWWA C208:**

1. Fabricated steel fittings shall conform to AWWA C208.

## **2.04 FLANGE MATERIAL**

### **A. ASTM A126:**

1. Class 125 cast iron flanges shall conform to ASTM A126 class B and ASME B16.1. Tensile strength  $\geq$  31,000 psi. Flanges shall be threaded with flat face.

B. ASTM A234:

1. Class 150 forged steel flanges shall conform to ASTM A235; and ASME B16.5.
2. Class 300 forged steel flanges shall conform to ASTM A235; and ASME B16.5.
3. Flanges shall be threaded, weld neck, slip-on, or socket weld.
4. Flanges shall be raised face with continuous spiral groove.

C. ASTM A395:

1. Class 150 ductile iron flanges shall conform to ASTM A395 and ASME B16.5. Flanges shall be threaded with flat face.

D. AWWA C207:

1. Class B (86 psi); Class D (150 psi); and Class E (275 psi) steel flange thickness shall conform to AWWA C207.
2. Class B bolt-circle diameter shall conform to AWWA C207.
3. Class D and Class E bolt-circle diameter shall conform to ASME B16.1 Class 125.
4. Flanges shall be slip-on with flat face.

## **2.05 CONNECTION MATERIAL**

A. THREADED CONNECTIONS:

1. Pipe thread dimensions and size limits shall conform to ASME B1.20.1.

B. FLANGED CONNECTIONS:

1. Gaskets shall be as designated in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

C. FASTENERS:

1. Fasteners for buried, submerged, or gas exposures subject to temperatures less than 200°F shall be ASTM F593 Type 316 stainless steel cap screws with matching washers and nuts, coarse thread.
2. Fasteners for other exposure subject to temperatures less than 200°F shall be SAE J429 Grade 5 hex head zinc-plated carbon steel cap screws with matching washers and nuts, coarse thread.

3. Fasteners for all exposures subject to temperatures greater than or equal to 200°F shall be ASTM A193 Grade B7, with matching washers and nuts.

D. INSULATING FLANGE SET:

1. Unless otherwise specified, insulating flange sets shall be as specified in CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).
2. Flange insulation sets shall be suitable for 225°F continuous operating temperature.
3. Insulating gaskets shall be plain phenolic, Type “E” full flange diameter type. Sealing gaskets shall be 1/16” thick, type as specified in the COMMON WORK RESULTS FOR PROCESS PIPING Section (40 05 03).
4. Insulating sleeves and washers shall be either one-piece or two-piece type. Sleeves and washers shall be phenolic or spiral-wound Mylar.
5. Metallic flat washer shall be steel or stainless steel to match the cap screw material.
6. Flange insulation sets shall be manufactured by PSI, or equal.

E. SLEEVE-TYPE COUPLINGS:

1. Sleeve-type couplings shall be constructed of ductile iron or steel per the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

F. PLAIN END COUPLINGS:

1. ACCEPTABLE PRODUCTS: Gruvlok 7005; Victaulic Style 99; or equal.
2. Plain end couplings shall be ASTM A536 Grade 65-45-12 ductile iron. Size range: 1½ to 14”.
3. Bolts, washers and nuts for buried and submerged exposure locations, or severe exposure severity shall be Type 316 stainless steel regardless of any other protective coatings.
4. Gaskets shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

G. GROOVED END COUPLINGS:

1. FLEXIBLE-TYPE COUPLINGS:
  - a. ACCEPTABLE PRODUCTS: Gruvlok 7001; Victaulic Style 77; or equal.
  - b. Flexible-type couplings shall be ASTM A536 Grade 65-45-12 ductile iron. Size range: ¾ to 24”.

2. RIGID-TYPE COUPLINGS:

- a. ACCEPTABLE PRODUCTS: Gruvlok 7004HPR; Victaulic Style HP-70; or equal.
- b. Rigid-type couplings shall be ASTM A536 Grade 65-45-12 ductile iron. Size range: ¾ to 24”.

3. FLANGED COUPLING ADAPTERS:

- a. ACCEPTABLE PRODUCTS: Gruvlok 7012; SPF model F-3; or equal.
- b. Flanged coupling adapters shall be ASTM A536 Grade 65-45-12 ductile iron. Size range: 2 to 24”.

4. STEEL TO DUCTILE IRON TRANSITION COUPLING:

- a. ACCEPTABLE PRODUCTS: Victaulic Style 307, or equal.
- b. Grooved steel to grooved ductile iron pipe transition couplings shall be ASTM A536 Grade 65-45-12 ductile iron. Size range: 3 to 12”.

5. Bolts, washers and nuts for buried, submerged, and gas exposures shall be Type 316 stainless steel regardless of any other protective coatings.

6. Gaskets shall be as specified in COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

H. PUSH-ON JOINTS:

1. Gaskets shall be as specified in COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

I. RESTRAINT DEVICES:

1. Restraint devices shall be welded steel harness assemblies. Unless restrained joints on the drawings are excluded, joints using sleeve-type couplings shall be provided with tie bolts and harness lugs. The harnessing system shall be in accordance with Chapter 13 of the AWWA Manual M11 and shall be designed for the test pressure specified in COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

**2.06 LINING MATERIAL**

A. EPOXY LINING:

1. Where specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03), pipe (including butt ends) and fittings shall be epoxy lined with

at least 10 mils of epoxy. Surfaces shall be prepared in accordance with SSPC-SP 10 Near White Blast Cleaning, and the lining applied as recommended by the manufacturer.

2. Epoxy lining for all piping systems, except WP system, shall be Carboline 891, Ameron Amerlock 400, or equal.
3. Epoxy lining for WP system shall be Carboline 891, Ameron Amerlock 400, or equal. Primers and paint shall conform to the requirements of NSF-61.

**B. FUSION EPOXY LINING:**

1. ACCEPTABLE PRODUCTS: 3M Scotchkote 206N, or equal.
2. Where specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03), pipe (including butt ends) and fittings shall be fusion epoxy lined in accordance with AWWA C213. Surface preparation shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Application shall be by the fluidized bed method and shall attain a dry film thickness of at least 12 mils.
3. Fusion epoxy lining shall conform to the requirements of NSF-61.

**C. CEMENT MORTAR LINING:**

1. Where specified in COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03), pipe (including butt ends) and fittings shall be lined with cement mortar as specified in AWWA C205. Fittings and specials larger than 24 inches, not fabricated from centrifugally lined straight sections, shall require 2-inch by 4-inch by 13-gage self-furring wire mesh reinforcement for hand-applied lining.

**D. GLASS LINING:**

1. ACCEPTABLE PRODUCTS: US Pipe Fabrication Ferrolock MEH-32; Vitco SG-14; or equal.
2. Where specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03), pipe and fittings shall be glass lined with a vitreous material to a minimum thickness of 10 mils. Thickness to be measured in using a magnetic-type film thickness gage such as Mikrotest Model FM, Elcometer Model 211/1E, or equal. Glass lining shall provide continuous coverage as tested by a Tinker and Rasor Model M1 nondestructive type holiday detector, K-D Bird Dog, or equal low voltage holiday detector. The unit shall operate at less than 75 volts. Voids shall be cause for rejection. Glass-lined pipe shall be prefabricated. Field cut pieces will only be allowed if no damage occurs to the glass lining. Ends shall be coated.
3. Pipe shall be bored, machined, or grit blasted to remove any voids, protrusions or surface irregularities to obtain a smooth continuous surface for glass lining. Fittings

shall be ground or grit blasted to remove any voids, protrusions or surface irregularities.

## **2.07 COATING MATERIAL**

### **A. EPOXY COATING:**

1. Refer to the PAINTING AND COATING Section (09 90 00) for epoxy coating of pipes.

### **B. FUSION EPOXY COATING:**

1. ACCEPTABLE PRODUCTS: 3M Scotchkote 206N, or equal.
2. Where specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03), pipe and fittings shall be fusion epoxy coated in accordance with AWWA C213. Surface preparation shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. The application method shall be by the fluidized bed method and shall attain a dry film thickness of at least 12 mils. For buried pipe the minimum dry film thickness shall be 20 mils.

## **PART 3 -- EXECUTION**

### **3.01 GENERAL (NOT USED)**

### **3.02 INSTALLATION**

#### **A. PIPE INSTALLATION:**

1. Install pipe in accordance with the drawings, the manufacturer's instructions and recommendations and AWWA M11, Chapter 16. Pipe shall be installed in accordance with AWWA M11, Chapter 16.

#### **B. FITTING INSTALLATION:**

1. Install fittings in accordance with the manufacturer's instructions and recommendations.

#### **C. CONNECTION INSTALLATION:**

##### **1. THREADED CONNECTIONS:**

- a. Cut, thread and join in accordance with the fitting manufacturer's instructions and recommendations, and ASME B31.1.

##### **2. FLANGED CONNECTIONS:**



- a. Cut, thread and join in accordance with the fitting manufacturer's instructions and recommendations, and ASME B31.1.
3. MECHANICAL COUPLING CONNECTIONS:
- a. Install in accordance with the coupling manufacturer's instructions and recommendations.
4. PUSH-ON CONNECTIONS:
- a. Install in accordance with the fitting manufacturer's instructions and recommendations.
5. WELDED CONNECTIONS:
- a. Weld in accordance with ASME Section IX, ASME B31.1, or ASME B31.3. Welders shall be ASME-certified.
6. TAKEDOWN COUPLINGS:
- a. Install screwed unions, flanged or grooved end mechanical coupling type joints where indicated on the drawings. Use flanged or grooved end joints on pipelines 2-1/2 inches in diameter and larger.
7. RESTRAINT DEVICES:
- a. Install in accordance with the manufacturer's instructions and recommendations to prevent joint separation.
8. DIELECTRIC CONNECTIONS:
- a. Provide dielectric connections for dissimilar metal pipe connections.
- D. LINING INSTALLATION:
- 1. Linings shall be applied and patched in accordance with the manufacturer's recommendations and instructions.
- E. COATING INSTALLATION:
- 1. Coatings shall be applied and patched in accordance with the manufacturer's instructions and as specified in the PAINTING AND COATING Section (09 90 00).

**F. PIPE ANCHORAGE:**

1. Anchorage shall be provided as specified in the HANGERS AND SUPPORTS FOR PROCESS PIPING Section (40 05 07) and shown in the drawings.

**G. CLEANING AND FLUSHING:**

1. The cleaning, disinfection, and flushing of steel pipe shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

**3.03 TESTING**

**A. FACTORY TESTING:**

1. Factory testing shall conform to the requirements of ASTM A53, ASTM A106, or AWWA C200 as applicable.

**B. PRE- OPERATIONAL TESTING:**

1. Testing pipe shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

**3.04 TRAINING - (NOT USED)**

**\*\*END OF SECTION\*\***

**Note to Specifier:**

1. Corrosive areas must be shown on the drawings or adequately described.
2. Locations of flexible couplings shall be shown on the drawings.
3. Show all locations of takedown couplings.
4. Show all locations of pipe material changes.
5. Be aware of pressure limitations of cast iron fittings and flanges.
6. Coordinate with Section 09 90 00 Painting and Coating or remove coating section from this specification.

## SECTION 40 05 32

### POLYETHYLENE PROCESS PIPE

*Notes to the Specifier: In 2002 ASTM D3350 was revised and many PE2406 compounds were reclassified as PE2708 and PE3408 was reclassified to PE4710. The Plastic Pipe Institute (PPI) increased the design factor from 0.32 to 0.4 to bring the ASTM and ISO pressure rating methods closer together. Pipe design pressures did not change. The higher design factor allows for a thinner wall which results in lower cost for the price of pipe and an increase in inside diameter and flow capacity.*

#### PART 1 -- GENERAL

##### 1.01 GENERAL REQUIREMENTS

###### A. SCOPE:

1. This section specifies high density polyethylene (HDPE) and medium density polyethylene (MDPE) pipe, fittings, and appurtenances for piping 0.5 inches to 36 inches in nominal diameter.

##### 1.02 REFERENCES:

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publication in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM A774/A774M	Standard Specification for As-Welded Wrought Austenitic Stainless Steel fittings for General Corrosive Service at Low and Moderate Temperatures
ASTM D2513 Rev A	Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
ASTM D3035	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Material

<u>Reference</u>	<u>Title</u>
ASTM F2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.
8CCR462 [CCR Title 8, Chapter 4, Subchapter 1, Article 3, Section 462]	California Code of Regulations for Unfired Pressure Vessel Safety Orders – Air Tanks – Field Inspections and Reports
ISO 9001	Quality Management Systems – Requirements
ISO 9002	Quality Systems – Model for quality assurance in production, installation and servicing.
ISO 12162	Thermoplastics Materials for Pipes and Fittings for Pressure Applications – Classification, designation, and design coefficient
PPI	Plastic Piping Institute
SSPC SP 10	Near-White Metal Blast Cleaning

B. DEFINITIONS: (Not Used)

### 1.03 SUBMITTALS

- A. The following submittals shall be provided for review in accordance with the SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification section, with addendum updates, with each paragraph check-marked to show specification compliance or marked to show deviations.
  2. Manufacturer's information and catalog data showing compliance with this specification and a full description of the item.
  3. Contractor's shop drawings including fabrication, layout drawings and anchorage details.

4. Manufacturer's equipment certification that the fusion equipment is appropriate for the polyethylene material and pipe size, and complies with ASTM F2620.
5. Qualifications for the equipment operators and fusion inspector including certifications that they have been trained by certified fusion technicians, received training in the manufacturer's recommended procedure within the last 12 months of commencing construction, and have had at least 3 years current experience in the heat fusion butt welding process.

#### **1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)**

### **PART 2 -- PRODUCTS**

#### **2.01 ACCEPTABLE PRODUCTS**

- A. Pipe manufacturers shall be ISO 9001 or 9002 certified.
- B. HDPE pipe, ASTM D3035, ASTM F714, shall be Performance Pipe 4100 series and 5100 series; PolyPipe; or equal.
- C. HDPE pipe, 8CCR462, shall be Asahi-America Air-Pro; or equal.
- D. MDPE pipe shall be Performance Pipe 6500 series; PolyPipe; or equal.

#### **2.02 MATERIALS/EQUIPMENT**

##### **A. PIPE**

##### **1. HDPE:**

##### **a. ASTM D3035:**

- 1) **ACCEPTABLE SIZES:** SDR11.0 rated 200 psi working pressure. SDR9.0 rated 250 psi working pressure. SDR7.3 rated 317 psi working pressure. SDR13.5 rated 160 psi working pressure. SDR19 rated 111 psi working pressure.
- 2) HDPE piping components shall be manufactured from materials that meet or exceed the requirements of the Plastic Piping Institute designation PE4710 and ASTM D3350 cell classification 445474C. Piping shall contain 2% carbon black and shall be UV protected.

##### **b. ASTM F714:**

- 1) **ACCEPTABLE SIZES:** SDR11.0 rated 200 psi working pressure. SDR9.0 rated 250 psi working pressure. SDR7.3 rated 317 psi working pressure.

SDR13.5 rated 160 psi working pressure. SDR19 rated 111 psi working pressure.

- 2) HDPE piping components shall be manufactured from materials that meet or exceed the requirements of the Plastic Piping Institute designation PE4710 and ASTM D3350 cell classification 445474C. Piping shall contain 2% carbon black and shall be UV protected.

c. 8CCR462:

- 1) ACCEPTABLE SIZES: ½ to 4 inches nominal; rated 230 psig @ 68°F working pressure, and 150 psig @ 140°F working pressure.
- 2) HDPE piping components shall be manufactured from materials that meet or exceed the requirements of ISO 12162 designation PE100 and ASTM D3350 cell classification 445474C. Piping color shall be blue.
- 3) Components shall meet or exceed compliance with Cal-OSHA CCR Title 8, Chapter 4, Subchapter 1, Article 3, Section 462 (8CCR462) for thermoplastic piping used in unprotected compressed air applications.

2. MDPE:

a. ASTM D2513 Rev A:

- 1) ACCEPTABLE SIZES: ¾ inch IPS SDR11.0; 1 inch IPS SDR11.0; 1¼ inches IPS SDR10; 2 inches IPS SDR11.0; 3 inch IPS SDR11.5; 4 inches IPS SDR11.0; 6 inches IPS SDR11.5.
- 2) MDPE piping components shall be manufactured from materials that meet or exceed the requirements of the Plastic Piping Institute designation PE2708 and ASTM D3350 cell classification 234373E. Components shall be color coded yellow.
- 3) Piping components shall be IAPMO listed for yard gas piping and LPG gas service.

B. FITTINGS:

1. HDPE:

- a. Fittings shall be injection molded or fabricated from the same material as the pipe and shall meet the same specification as the pipe,
- b. Molded butt fittings shall comply with ASTM D3261.

2. MDPE:

- a. Fittings shall be injection molded or fabricated from the same material as the pipe, shall meet the same specification as the pipe, and shall be manufactured by the pipe manufacturer.
- b. Molded butt fittings shall comply with ASTM D3261.

3. DUCTILE IRON: See DUCTILE IRON PROCESS PIPE Section (40 05 19).

4. STAINLESS STEEL:

- a. Fittings shall be ASTM A774/A774M Type 316 stainless steel with flanges.

C. FLANGE ADAPTERS:

1. HDPE flange adapters shall be long neck HDPE flange adapters with ANSI Class 150 epoxy coated (per AWWA C116), convoluted, ductile iron backing flange, and flange gasket. Stub ends are not acceptable. Flat face HDPE flanges are not acceptable.
  - a. COATING: Backup ring coating application method shall be by the fluidized bed method and shall attain at least 12 mils dry film thickness.
  - b. FLANGE GASKETS: Gaskets shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
  - c. FASTENERS: Fasteners shall be as specified for sleeve type couplings in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
  - d. CORROSION PROTECTION: Install a wax tape coating system as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03) and CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).

D. FUSION CONNECTIONS:

1. Thermal connections shall be socket fusion or butt fusion. Electrofusion connections are not acceptable.

E. FLANGED COUPLING ADAPTERS (FCA):

1. Flanged Coupling Adapters shall be as specified for sleeve type couplings, flange adapter in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
  - a. FLANGE GASKETS: Gaskets shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

- b. FASTENERS: Fasteners shall be as specified for sleeve type couplings in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
  - c. CORROSION PROTECTION: Install a wax tape coating system as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03) and CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).
2. FCA ring stiffeners are required for restrained FCA use on HDPE pipe, see COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).

F. VALVES:

- 1. See Drawings for required valves to be installed on HDPE pipelines, and refer to applicable Division 40 Section for each valve type.
- 2. Valves connected to HDPE pipe shall be flanged.
  - a. Butterfly valves installed on 18-inch HDPE pipe shall be installed with ductile iron spacer flange or beveled HDPE flange adapter. Field shaving of flange adapter is not permitted.
- 3. CORROSION PROTECTION: Install a wax tape coating system as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03) and CATHODIC PROCESS CORROSION PROTECTION Section (40 46 42).

## **PART 3 -- EXECUTION**

### **3.01 GENERAL (NOT USED)**

### **3.02 INSTALLATION**

A. PIPE:

- 1. Install pipe in accordance with the drawings and the manufacturer's instructions and recommendations.

B. FITTING:

- 1. Install fittings in accordance with the manufacturer's instructions and recommendations.

C. CONNECTION:

- 1. Pipe and fittings shall be joined into continuous lengths on the job site above ground. Joints shall be the butt-fusion method or socket-fusion method performed



in accordance with the pipe manufacturer's recommendations and ASTM F2620. Extrusion welding and hot gas welding shall not be used.

2. The pipe manufacturer shall be consulted to obtain machinery and expertise for the joining by butt-fusion and socket-fusion of polyethylene pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are adequately trained and qualified in the techniques involved. Fusion joining shall yield a joint strength equal to or greater than the tensile strength of the pipe.
  - a. HEAT FUSION TRAINING SERVICES: The manufacturer shall provide training in the manufacturer's recommended butt fusion procedures to the Contractor's installation personnel, and to the inspector(s) representing the Owner, prior to the start of construction.
  - b. The Contractor shall certify, in writing, that persons making heat fusion joints have received training in the manufacturer's recommended procedure and have had at least 3 years current experience in the heat fusion butt welding process.
  - c. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction.
3. Flanged joining may be used to make connections to differing piping materials, to equipment, valves and other appurtenances.

**D. LINING:**

1. Linings for ductile fittings shall be applied and patched in accordance with the manufacturer's instructions and recommendations.

**E. COATING:**

1. Coatings for ductile fittings shall be applied and patched in accordance with the manufacturer's instructions and recommendations.

**F. CATHODIC PROTECTION WAX TAPE COATING SYSTEM:**

1. Wax Tape Coating System shall be applied in accordance with the manufacturer's instructions and recommendations.

**3.03 FIELD QUALITY CONTROL**

**A. BUTT FUSION TESTING:**

1. Every day butt fusions are to be made, the first fusion of the day shall be a trial fusion.
2. The trial fusion shall be allowed to cool completely.

3. Fusion test straps shall be cut out.
4. The test strap shall be 12 inches (minimum) or 30 times the wall thickness in length with the fusion in the center, and 1 inch (minimum) or 1.5 times the wall thickness in width.
5. Bend the test strap until the ends of the strap touch.
6. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested.
7. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.

**B. DATA LOGGING:**

1. A data logger shall be installed on the fusion heated joining machine. Data on each joint shall be recorded by the data logger. Data to be recorded shall be minimum temperature of joint fusion and interface pressure of the fused joint.

**C. ULTRA-SONIC TESTING:**

1. Joints smaller than 14 inches diameter shall be tested utilizing ultra-sonic testing.
2. Test results shall be transmitted to District Representative on a daily basis.

**3.04 TESTING**

- A. Testing of HDPE and MDPE piping shall be as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03) using the test pressures specified, and the manufacturer's instructions and recommendations.

**3.05 TRAINING (NOT USED)**

**\*\*END OF SECTION\*\***