

**SECTION 03 15 00
CONCRETE ACCESSORIES**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of waterstops and construction joints.
- B. Refer to Section 33 05 37 for concrete accessories around pipe penetrations.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 74 00: Cleaning and Waste Management
- H. Section 03 10 00: Concrete Forming
- I. Section 03 20 00: Concrete Reinforcing
- J. Section 05 50 00: Metal Fabrications
- K. Section 33 05 37: Wall Pipes, Seep Rings and Penetrations

1.3 System Description

- A. Furnish and install concrete accessories where shown, including waterstops and construction joints materials.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. California Building Code (CBC)

1.6 Submittals

- A. Furnish the following submittals:

SUBMITTAL	DESCRIPTION	
Catalog Data	Required for waterstops and other accessories per catalog data requirements.	
Installation Instructions	Required for accessories per installation instruction requirements.	
Certificate of Compliance	At least 24 hours before placing concrete, submit certification from each trade having embedded items in concrete to be placed stating embedded items for each trade are properly located, placed and braced.	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. In addition to requirements of ACI, refer to Section 01 33 00 for definition of requirements for catalog data, installation instructions, and certificates of compliance.

Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of concrete accessories shall be strictly followed.
- C. Storage of materials shall conform to requirements of ACI 301.
- D. Store materials to prevent damage by moisture or breakage.
- E. Do not use aluminum embedments in concrete.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Detectable Warning Surfaces on Curbs and Curb Access Ramps	ADA Solutions, Inc.	North Billerica, MA
	Accepted equal	
Joint Filler	DFC “Denver Foam”	
	Sonneborn Building Producte, Inc. “Sonofoam”	
	Accepted equal	
Waterstops	Greenstreak Inc.	St Louis, MO
	Vinylex Corp.	Knoxville, TN
	Accepted equal	
Waterstops for Chemical Containment	J.P Specialties, Inc.	Lake Elsinore, CA
	Accepted equal	
Waterstops for Retrofit	J.P Specialties, Inc.	Lake Elsinore, CA
	Accepted equal	
Waterstops, Stainless Steel	J.P Specialties, Inc.	Lake Elsinore, CA
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Concrete accessories shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Joint Filler - Preformed		ASTM D1751 Nonextruding resilient bituminous type

ITEM	MATERIAL	SPECIFICATION
Joint Sealer - Mastic	Asphalts or similar materials blended with lubricants or plasticizers	No evaporating solvents or volatile oils or lubricants permitted Shall tenaciously adhere to concrete surfaces Shall remain permanently resilient and pliable Shall not be affected by continuous presence of water Shall in no way contaminate potable water Shall effectively seal joints from moisture infiltration even when joints are subject to expansion or contraction movements

- C. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION
Waterstops	Corners Provide shop-made corner fittings. Do not splice corners in field.

- D. All materials furnished for Work must be classified by Environmental Protection Agency as acceptable for potable water use within 30 days of application.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install concrete accessories before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Before placing concrete within forms, each trade having embedded items, including water stops within forms and affected by pour shall certify all items are properly located, placed and braced.
- C. Construction joints shown on Contract Documents and accepted shop drawings may be made as shown with provision of keys or other locking shapes to secure proper union with subsequent work.
- D. Before placing concrete, verify location of embedded items with affected trades. Accuracy of placement of embedded items is Contractor's responsibility.

3.2 Installation/Application

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install concrete accessories at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. California Building Code Chapter 19 "Concrete"
 4. Other applicable building code requirements
 5. ACI 301 Structural Concrete for Buildings Chapter 8.

6. ACI 318 Building Code Requirements for Reinforced Concrete

- D. Refer variances between above documents and Contract Documents to Owner's Representative.

END OF SECTION

**SECTION 03 20 00
CONCRETE REINFORCING**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of steel reinforcement in concrete and masonry, including reinforcing bar, welded wire fabric, couplers, concrete inserts, wires, clips, supports, chairs, spacers, epoxy embedment, and other embedded accessories.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 03 10 00: Concrete Forming
- H. Section 03 30 00: Cast-in-Place Concrete
- I. Section 09 90 00: Painting and Coating
- J. Section 33 05 16: Precast Concrete Utility Structures

1.3 System Description

- A. Furnish and install complete steel reinforcement including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Steel Reinforcement	Material Properties	ASTM A615	As required by Owner	Owner	Contractor
Steel Reinforcement Welding	Compliance with AWS D1.4	AWS D1.4	As required by Owner	Owner	Contractor
	Radiographic testing	AWS D1.4	As required by Owner	Owner	Contractor

1.5 References

- A. ACI 117 Standard Tolerances for Concrete Construction Materials
- B. ACI 315 Details and Detailing of Structural Reinforcement
- C. ACI 318 Building Code Requirements for Reinforced Concrete
- D. ASTM A82 Steel Wire, Plain, for Concrete Reinforcement
- E. ASTM A185 Welded Steel Wire Fabric, Plain, for Concrete Reinforcement

- ASTM A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- G. ASTM A706 Low-Alloy Steel Deformed Bars for Concrete Reinforcement
- H. ASTM A775 Epoxy-Coated Reinforcing Steel Bars
- I. ASTM A934 Epoxy-Coated Prefabricated Steel Reinforcing Bars
- J. ASTM C1116 Fiber-Reinforced Concrete
- K. ASTM D3963 Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
- L. AWS D1.4 Structural Welding Code – Reinforcing Steel
- M. California Building Code (CBC)
- N. CRSI MSP Concrete Reinforcing Steel Institute Manual of Standard Practice
- O. SSPWC Standard Specifications for Public Works Construction (Greenbook) Section 201-2 “Reinforcement for Concrete”
- P. WRI Manual of Standard Practice for Welded Wire

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
CBC Chapter 17 Special Inspection Required Contractor Statement of Responsibility	As required in CBC Section 1706	
Shop Drawings	Shop bending diagrams, placing lists and drawings of reinforcing steel required per structural shop drawing requirements. Comply with ACI 315.	
	Show actual bar lengths to nearest inch measured to intersection of tangent extensions of outside bar surface. Bar placement diagrams shall clearly show dimensions of each bar splice. Show location of any coupler used with details of how they are installed in formwork.	
	Show locations of construction and expansion joints. Show locations of all embedded items including anchor bolts, wall sleeves, conduit and piping which may conflict with steel reinforcing	
Catalog Data	Required for mechanical couplers with ICBO test reports per catalog data requirements.	
Installation Instructions	Submit written welding procedure for each type of rebar weld for each size of bar intended to be spliced by welding. (A mere statement that AWS procedures will be followed is unacceptable.)	
Test Record Transcripts	For each load of steel reinforcement delivered, submit mill certificates and Manufacturer’s certification of chemical and physical properties of steel as needed to verify steel materials. Also, submit information needed to determine carbon equivalent of any steel to be welded in accordance with AWS D1.4 and per test record transcript requirements. For epoxy-coated steel reinforcing, submit evidence plant is certified under CRSI Fusion-Bonded Epoxy Coating Applicator Plant Certification Program.	
Material Samples	Required from each heat of reinforcing steel upon Owner’s Representative’s request. Sample quantities required if requested shall conform to SSPWC Section 201-2.4 Required for each type of welded splice upon Owner’s Representative’s request.	
Welder Qualification Certificates	Required as specified in AWS D1.4 for all welders performing welding of steel reinforcement. Also submit certifications of procedure qualifications for each welding procedure used.	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, test record transcripts, and material samples.

Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. CRSI recommendations included in Manual of Standard Practice for delivery, storage and handling of steel reinforcement shall be strictly followed.
- C. Bundle reinforcement and tag with suitable identification to facilitate sorting, placing and transport.
- D. Bars with kinks or bends not shown on shop drawings shall be removed from site.
- E. Bars with rust, scale, oil or any other coating that would reduce or destroy bond between concrete and steel shall be removed from site.
- F. Epoxy-coated reinforcing bars shall be stored, transported and placed in accordance with ASTM D3963 and in such a manner to avoid chipping of epoxy coating.
 - 1. Use nonabrasive fabric slings for handling.
 - 2. Repair any chips in epoxy coating with compatible epoxy repair material accepted by bar supplier before placing concrete.
 - 3. Use plastic-headed concrete vibrators during concrete placement around epoxy-coated rebar.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 – PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Dowel System (alternate to slip dowels)	Greenstreak (Speed Dowel)	St Louis, MO
	Accepted equal	
Mechanical Bar Couplers	Dayton Superior (Dowel Bar Splicer System)	Dayton, OH
	Erico Products, Inc. (Lenton Form Saver)	Solon, OH
	Richmond Screw Anchor Company (Dowel Bar Splicer System)	Fort Worth, TX
	Accepted equal	
Rebar Anti-Corrosion Coating	Pecora Corporation	Harleysville, PA
	Accepted equal	
Epoxy Grout Systems for Rebar Dowels into Existing Concrete	Edoco "BurkEpoxy NS"	Kansas City, KS
	Master Builders Inc. "Concresive Paste LPL"	Cleveland, OH
	Pecora Corporation "Dynapoxy EP430 Fast"	Harleysville, PA
	Sika Corporation "Sikadur 31 Hi-Mod Gel" (vertical or overhead applications)	Lyndhurst, NJ
	Sika Concrete Restoration Systems SikaDur 32, Hi-Mod LPL	Lyndhurst, NJ
	Simpson Strong Tie Co.	Dublin, CA
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Epoxy-Coated Rebars	Obtain from plant certified under CRSI Fusion-Bonded Epoxy Coating Applicator Plant Certification Program.	
Rebar Supports	Dayton Superior	Dayton, OH
	Accepted equal	

2.2 **Materials**

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Materials which remain or leave residues on or within concrete shall be classified as acceptable for potable water use by Environmental Protection Agency within 30 days of application or use.
- C. Steel reinforcement shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Steel Bar Reinforcement	Steel	ASTM A615 Grade 60 Billet Steel Deformed Bars
Steel Bar Reinforcement - Welded	Low Alloy Steel	ASTM A706 Grade 60 Deformed Bars
Steel Bar Reinforcement – Epoxy Coated	Epoxy-Coated Steel	ASTM A775 or ASTM A934 Grade 60
Welded Wire Fabric	Steel Wire	ASTM A185 For wires smaller than W4 size, provide in flat sheets. Do not use roll mesh. For wires larger than W4 size, provide in flat sheets only
Wire Reinforcement	Cold Drawn Steel Wire	ASTM A82
Tie Wire	Annealed Steel	14 gauge minimum
Fiber Reinforcement	Steel Fiber	ASTM C1116 Type I
	Glass Fiber	ASTM C1116 Type II
	Polypropylene or Other Synthetic Fibers	ASTM C1116 Type III

- A. Bar supports, chairs or dobies shall comply with CRSI Manual of Standard Practice Chapter 3 and shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Concrete Blocks (Dobies) (Do not use in slabs or walls less than 6 inches thick, or where architectural finish is to be applied.)	Concrete	Minimum 28-day compressive strength f'_c equal to that of concrete but not less than 4000 psi. Embed wire ties in concrete block bar supports.
Plastic Bar Supports (Do not use on grade)	Plastic	CRSI Class 1 gray
Wire Bar Supports (Do not use in wastewater environments or environments exposed to continuous moisture, water or corrosion.)	Steel Wire	CRSI Class 1 (with 1/8-inch-thick gray plastic coating)

- B. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION
Mechanical Couplers	Provide where shown on approved shop drawings. Couplers shall develop 125% of yield strength of reinforcement being spliced. Do not reduce bar cross section to accommodate couplers. Threaded couplers require use of next larger size of reinforcing.

ITEM	DESCRIPTION
	Supply all components needed for complete splice.
Welded Splices	Provide where shown on approved shop drawings. Splices shall develop 125% of yield strength of reinforcement being spliced. Provide all materials required to meet AWS D1.4.
Bending and Forming Bars	Conform to ACI 315 and ACI 318. Fabricate to tolerances shown in ACI 117. Reinforcing for masonry shall be shop fabricated, ready for installation by masons.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install steel reinforcement before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish, accurately position and install steel reinforcement at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. California Building Code Chapter 19 "Concrete" Section 1907 "Modifications to Reinforcement" and Section 1908 "Modifications to ACI 318"
 4. Other applicable building code requirements
 5. ACI 315 Details and Detailing of Structural Reinforcement
 6. ACI 318 Building Code Requirements for Reinforced Concrete
 7. For epoxy-coated rebar, comply with ASTM D3963
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Minimum cover for non-pre-stressed steel reinforcement per ACI 318 shall be as follows:

LOCATION	BAR SIZE	MINIMUM COVER
Concrete Cast Against and Permanently Exposed to Earth	#4- #18	3.0 inches
Formed Concrete Exposed to Earth or Weather	#3-#5	1.5 inches
	#6-#18	2.0 inches
Formed Concrete Not Exposed to Weather or Earth: Beams, Girders or Columns	#4- #18	1.5 inches
Formed Concrete Not Exposed to Weather or Earth: Slabs, Walls or Joists	#3-#11	0.75 inches
	#14-#18	1.5 inches
Concrete Exposed to Saltwater	#4- #18	4.0 inches

Minimum spacing between parallel bars per ACI 318 shall be 1 inch or 1 bar diameter, whichever is greater.

G. Installation of steel reinforcement bars shall proceed as follows:

1. Install steel reinforcement to tolerances shown in ACI 117 and Section 7.5 of ACI 318.
2. Do not straighten or re-bend reinforcing steel in manner that will damage material. Do not use bars with bends not shown on Plans. Bends shall be cold-bent. Do not use heat.
3. Reinforcing shall be supported and wired together to prevent displacement using annealed iron wire ties or suitable clips at intersections. Use concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent displacement of steel during concrete placement.
4. Where concrete is placed against earth, use supporting concrete dobies in sufficient numbers to support bars without settlement, but in no case shall support be continuous. Tie reinforcing steel to dobies with wire ties embedded in blocks.
5. Where concrete is placed over formwork, furnish concrete, metal, plastic or other acceptable bar chairs and spacers.
6. Bend tie wires away from forms to provide specified concrete cover.
7. Accessories used to support reinforcing bars shall be placed and spaced such that deflections of supports due to weight of supported bars is within tolerances specified by ACI 117 and ACI 318.
8. Where additional bars are provided by Contractor for any reason, they shall be provided at no additional cost to Owner unless Owner's preapproval is evidenced by written change order issued prior to placing steel reinforcement.
9. Bars may be moved as necessary to avoid conflicts with other reinforcement steel, conduits or embedded items. If bars are moved by more than one bar diameter or enough to exceed specified tolerances, secure approval from Owner's Representative before placing concrete.
10. Provide additional reinforcing bars around sleeves and openings as shown on Drawings.

H. Installation of welded wire fabric reinforcement shall proceed as follows:

1. Welded wire fabric placed over horizontal forms shall be supported on slab bolsters. Space slab bolsters no greater than 30 inches on centers, Bolsters shall extend continuously across entire width of reinforcing mat and shall support mat in plane indicated.
2. Welded wire fabric placed over ground shall be supported on wired concrete dobies spaced not more than 36 inches on center in any direction.
3. The construction practice of placing welded wire fabric on ground and hooking it into place in freshly placed concrete shall not be used.
4. Straighten mesh to lie in flat plane and bend mesh as shown or required to fit work.

5. Provide laps of at least one complete mesh, unless otherwise detailed. Tie every other wire at laps.
- I. Splices shall be made as follows:
 1. Splicing shall meet requirements of ACI 318 and applicable building codes unless noted otherwise on drawings.
 2. Splicing of vertical bars in concrete is not permitted, except at indicated or approved horizontal construction joints or as detailed on plans or shop drawings.
 3. Splicing of horizontal bars in concrete is not permitted, except as detailed on plans or shop drawings.
 4. Use of mechanical couplers is not permitted, except as detailed on plans or shop drawings.
 5. Welding of reinforcing bars is not permitted, except as detailed on plans or shop drawings.
 - J. Dowelling and epoxying of rebar into hardened concrete shall proceed as follows:
 1. Hole diameter shall be as recommended by epoxy Manufacturer but shall be at least $\frac{1}{4}$ inch greater in diameter than outer surface of reinforcing bar deformations.
 2. Depth of hole shall be as recommended by epoxy Manufacturer, but shall not be less than 12 bar diameters, unless noted otherwise or unless required to prevent penetration through opposite surface of existing concrete member.
 3. Drill hole using methods that do not interfere with proper bonding of epoxy.
 4. Field locate reinforcement in existing concrete before drilling using pachometer or other approved locator device. Adjust location of holes to be drilled to avoid drilling through or nicking any existing reinforcing bars.
 5. Use compressed air to remove all dust and loose material from freshly drilled holes.
 6. Inject epoxy into hole through tube placed at bottom of hole. Withdraw tube as epoxy is placed but keep injection tip immersed to prevent air pockets from forming.
 7. Fill hole to a depth that ensures excess material will be expelled from hole during dowel placement.
 8. Twist dowels during insertion into partially filled hole to guarantee full wetting of bar surface with epoxy. Insert bar slowly to prevent air pockets from forming.

Field Quality Control

- A. Special inspection and field testing required by Chapter 17 of CBC (Table 1704.3 and 1704.4) shall be completed by an ICBO-certified special inspector selected by Owner and shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Steel Reinforcement	Size Grade and Type	Compliance with Contract Documents	Periodic per CBC Table 1704.3	Owner	Contractor to reimburse Owner for costs of first deputy inspector if re-inspection is required
	Verification of Weldability (for Steel Other than ASTM A706)	AWS D1.4, & ACI 318 Sec 3.5.2	Periodic special inspection per CBC Table 1704.3		
	Welding	AWS D1.4 & ACI 318 Sec 3.5.2	Periodic per CBC Table 1704.3		
	Welding for Special Moment Frames, Boundary Elements of Special Reinforced Concrete Shear Walls and Shear Reinforcement	Also inspect for proper dimensions and absence of cracks, undercutting, surface holes or slag inclusions	Continuous per CBC Table 1704.3		
	Placement	ACI 318 Sec 3.5, & 7.1-7.7 & CBC 1913.4	Periodic per CBC Table 1704.3		
	Epoxy Embedded Dowels	Epoxy Manufacturer's Requirements	All dowels		
Prestressing Tendons	Size Grade and Type	Compliance with Contract Documents	Periodic per CBC Table 1704.3		
	Placement	ACI 318 Sec 3.5, & 7.1-7.7 & CBC 1913.4	Periodic per CBC Table 1704.3		

- B. Additional field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Welded Wire Fabric	Placement	Prepour photographs (with yardstick) showing support system and separation from grade	All welded wire fabric	Contractor	Contractor

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of concrete for buried and above-ground cast-in-place structures, flatwork and paving.
- B. Refer to Section 03 15 00 for concrete accessories, including waterstops, construction joints, and cast-in-concrete anchors.
- C. Floor hardener shall be applied to entire concrete slab around pump cans and in shop area.
- D. In accordance with CALGreen Code Section A5.405.5, cement and concrete shall be made with recycled products such as fly ash or pozzolan, and shall comply with requirements of Section CALGreen Code Section A5.405.5.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 74 00: Cleaning and Waste Management
- H. Section 03 15 00: Concrete Accessories
- I. Section 09 90 00: Painting and Coating
- J. Section 31 23 00: Excavation and Fill
- K. Section 33 05 16: Precast Concrete Utility Structures
- L. Section 33 39 13: Manholes and Structures

1.3 System Description

- A. Furnish and install complete concrete structural system including appurtenant structural, mechanical and/or electrical mountings, embedments or connections required for compliance with Manufacturer's installation requirements of other trades and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Installers of floor surface hardeners shall have minimum of 3 years specialized experience in application of dry shake surface hardeners.
- C. Proportion mixes either by laboratory trial batch or field experience methods, using specified materials acceptable for each type of concrete required, and complying with ACI 211.1.

Plant testing of aggregate shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Aggregate	Ratio of Silica Released to Reduction in Alkalinity	ASTM C33	As directed	Owner	Contractor
	Loss with Sodium Sulfate	ASTM C33	As directed	Owner	Contractor
	Sieve Analysis	ASTM C136	1 each trial batch	Owner	Contractor
Coarse Aggregate	Abrasion Loss	ASTM C33	As directed	Owner	Contractor
Fine Aggregate	Sand Equivalent	ASTM D2419	As directed	Owner	Contractor
	Organic Impurities	ASTM C40	As directed	Owner	Contractor
	Color of Supernatant on Washing	ASTM C33	As directed	Owner	Contractor

E. Plant testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Concrete	Certification of Mix Design	ACI 301 certified by independent testing laboratory	1 per mix	Contractor	Contractor
Ready-Mix Concrete Materials	Materials Inspection	See Paragraph 2.2 below	As directed	Owner	Owner

1.5 References

- A. ACI 117 Standard Tolerances for Concrete Construction Materials
- B. ACI 211.1 Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- C. ACI 214 Evaluation of Strength Test Results for Concrete
- D. ACI 301 Structural Concrete for Buildings
- E. ACI 304 Measuring, Mixing, Transporting, and Placing Concrete
- F. ACI 305 Hot Weather Concreting
- G. ACI 309 Consolidation of Concrete
- H. ACI 315 Details and Detailing of Concrete Reinforcement
- I. ACI 318 Building Code Requirements for Reinforced Concrete
- J. ACI 350 Environmental Engineering Concrete Structures
- K. ASTM A820 Steel Fibers for Fiber-Reinforced Concrete
- L. ASTM C31 Making and Curing Concrete Test Specimens in Field
- M. ASTM C33 Concrete Aggregates
- N. ASTM C39 Compressive Strength of Cylindrical Concrete Specimens
- O. ASTM C40 Organic Impurities in Fine Aggregates for Concrete
- P. ASTM C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- Q. ASTM C78 Flexural Strength of Concrete Using Simple Beam with Third Point Loading
- R. ASTM C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- S. ASTM C94 Ready-Mixed Concrete
- T. ASTM C117 Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing

- ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
- V. ASTM C138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
- W. ASTM C143 Slump of Hydraulic Cement Concrete
- X. ASTM C150 Portland Cement
- Y. ASTM C156 Water Retention by Concrete Curing Materials
- Z. ASTM C157 Length Change of Hardened Hydraulic Cement Mortar and Concrete
- AA. ASTM C172 Sampling Freshly Mixed Concrete
- BB. ASTM C173 Air Content of Freshly Mixed Concrete by Volumetric Method
- CC. ASTM C191 Time of Setting of Hydraulic Cement by Vicat Needle
- DD. ASTM C192 Making and Curing Concrete Test Specimens in Laboratory
- EE. ASTM C231 Air Content of Freshly Mixed Concrete by Pressure Method
- FF. ASTM C260 Air Entraining Admixtures for Concrete
- GG. ASTM C266 Time of Setting of Hydraulic Cement Paste by Gillmore Needles
- HH. ASTM C289 Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
- II. ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete
- JJ. ASTM C330 Lightweight Aggregates for Structural Concrete
- KK. ASTM C494 Chemical Admixtures for Concrete
- LL. ASTM C595 Blended Hydraulic Cement
- MM. ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- NN. ASTM C881 Epoxy-Resin-Base Bonding Systems for Concrete
- OO. ASTM C932 Surface-Applied Bonding Compounds for Exterior Plastering
- PP. ASTM C989 Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
- QQ. ASTM C1017 Chemical Admixtures for Use in Producing Flowing Concrete
- RR. ASTM C1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
- SS. ASTM C1116 Fiber-Reinforced Concrete
- TT. ASTM C1157 Performance Specification for Hydraulic Cement
- UU. ASTM C1240 Silica Fume Used in Cementitious Mixtures
- VV. ASTM D1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- WW. ASTM D2419 Sand Equivalent Value of Soils and Fine Aggregate
- XX. ASTM E119 Fire Tests of Building Construction and Materials
- YY. California Building Code (CBC)
- ZZ. California Green Building Standards Code (CALGreen Code)
- AAA. Caltrans Standard Specifications – Section 90 Portland Cement Concrete
- BBB. California Test Method 214 Soundness of Aggregates
- CCC. California Test Method 227 Cleanness Value
- DDD. California Test Method 229 Durability
- EEE. California Test Method 515 Relative Mortar Strength of Portland Cement Concrete Sand
- FFF. California Test Method 530 Effect of Water-Reducing and Set-Retarding Admixtures on Drying Shrinkage of Concrete
- GGG. Fed Spec UU-B-790A Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellent and Fire Resistant)
- HHH. SSPWC Standard Specifications for Public Works Construction (Greenbook) Section 201 “Concrete, Mortar, and Related Materials
- III. SSPWC Standard Specifications for Public Works Construction (Greenbook) Section 303 “Concrete and Masonry Construction.”

1.6 Submittals

- A. Furnish the following submittals in accordance with ACI 301 and California Building Code.

SUBMITTAL	DESCRIPTION	
CBC Chapter 17 Special Inspection Required Contractor Statement of Responsibility	As required in CBC Section 1704	

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per structural shop drawing requirements. In addition to requirements listed under steel reinforcement, show construction joints and placement schedule.	
Catalog Data	Required for admixtures and curing compounds per catalog data requirements.	
Installation Instructions	Required for admixtures per installation instruction requirements.	
	Submit materials and methods for curing per installation instruction requirements.	
Certificate of Compliance	Submit certification from independent testing laboratory mix design complies with these specifications.	
	Submit mill test certification including fineness for each shipment of cement per ACI 301.	
	Submit aggregate gradation and certification per ACI 301.	
	Submit admixture certification including chloride ion content per ACI 301.	
	For cementitious materials, admixtures and curing compounds used in walls, floor, roof, columns, and interior concrete appurtenances of potable water storage or treatment tanks. Submit certification of compliance with NSF 61 requirements Requirement for NSF 61-certified cement will be waived if no NSF 61-certified cement is available within 25-mile radius of project site.	
	At least 24 hours before placing concrete, submit certification from each trade having embedded items in concrete to be placed stating embedded items for each trade are properly located, placed and braced and equipment pads are properly sized.	
Engineering Calculations (Mix Design)	Required for concrete mix design per engineering calculations requirements sealed by California-licensed Civil Engineer.	
	In addition to original mix design, provide new mix design if change in brand or type of cement or change in source or gradation of aggregates is permitted or if defective concrete occurs.	
Brand and Type of Cement/Source of Aggregate	Submit brand and type of cement and source of aggregates to allow sampling and testing by Owner's Representative.	
Welder Qualification Certificates	Required for all welders performing reinforcement welding	
Product Samples	Provide mock-up for all architectural finishes and all colored or textured concrete.	
Delivery Tickets	<p>Required for ready-mix concrete as needed to document delivery quantities. In accordance with ASTM C94 Sections 16.1 and 16.2, each ticket shall show</p> <ul style="list-style-type: none"> • Name of ready-mix batch plant, • Serial number of ticket, • State certified equipment used in preparing mix, • Truck number, • Name of purchaser & name & location of job • Mix number, • Quantities by weight of cement, sand, each class of aggregate, admixtures and water added in batching plant, • Type and brand of cement & admixtures, • Source & identification of aggregates, • Amount of water allowed to be added at site for specified mix, • Total yield in cubic yards, • Date & time of day to nearest minute corresponding to time batch was dispatched, time batch left plant, time batch arrived on site, time unloading began and time unloading was completed. • Reading of revolution counter at first addition of water <p>Certificates shall be from public weighmaster. Owner's Representative will not accept concrete in absence of certificate.</p>	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. In addition to requirements of ACI, refer to Section 01 33 00 for definition of requirements for Shop Drawings, Catalog Data, Installation Instructions, Certificates of Compliance, Engineering Calculations, Test Record Transcripts, and Material Samples.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of concrete admixtures and curing compounds shall be strictly followed.
- C. Storage of materials shall conform to requirements of ACI 301 or SSPWC.
- D. Store materials to prevent damage by moisture or breakage.
- E. Store sacked cement in manner permitting access for inspection and sampling.
- F. Use cement in sequence of receipt of shipments.
- G. Coarse aggregate with maximum size greater than ¾” shall be prepared, stored, and handled in 2 or more size groups. When aggregates are proportioned for each batch of concrete, the 2 size groups shall be combined.
- H. Do not use any aluminum materials for handling concrete.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Admixtures – Dampproofing – Integral Hydrophobic Waterproofing (Alternate to crystalline waterproofing)	Hycrete	Carlstadt, NJ
	Accepted equal	
Admixtures – Set Accelerating (Use when air temperature is less than 40°F)	Grace Concrete Products “Daraset”	Cambridge, MA
	Master Builders Inc. “Pozzutec 20”	Cleveland, OH
	Sika Corporation “Plastocrete 161FL”	Lyndhurst, NJ
	Accepted equal	
Admixtures – Set Retarding (Use when air temperature exceeds 80°F)	Grace Concrete Products “Daratard”	Cambridge, MA
	Master Builders Inc. “Pozzolith 300R”	Cleveland, OH
	Sika Corporation “Plastocrete”	Lyndhurst, NJ
	Accepted equal	
Admixtures – Water Reducing (Normal Range)	Grace Concrete Products “WRDA 79”	Cambridge, MA
	Master Builders Inc. “Pozzolith 322-N”	Cleveland, OH
	Sika Corporation “Plastocrete 161”	Lyndhurst, NJ
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Admixtures – Water Reducing (High Range)	Grace Concrete Products “WRDA 19 or Duracem 100”	Cambridge, MA
	Master Builders Inc. “Rheobuild 716 or Rheobuild 1000”	Cleveland, OH
	Sika Corporation “Sikament FF or Sikament 86”	Lyndhurst, NJ
	Accepted equal	
Bonding Agent (Hardened Concrete to Fresh Concrete)	Edoco “BurkEpoxy MV”	Kansas City, KS
	Concresive Div BASF 1001 LPL	Freeport, TX
	Epoxitile 2391	
	Euco Epoxy 463	
	Master Builders Inc. “Concresive Liquid LPL”	Cleveland, OH
	Pecora Corporation “Dynapoxy EP420”	Harleysville, PA
	Sika Corporation “Sikadur 32 Hi-Mod” or “Sikadur 32 Hi-Mod (LPL)” Epoxy Adhesive	Lyndhurst, NJ
	Accepted equal	
Epoxy Bonding Adhesive for Rebar	Edoco “BurkEpoxy NS”	Kansas City, KS
	Master Builders Inc. “Concresive Paste LPL”	Cleveland, OH
	Pecora Corporation “Dynapoxy EP430 Fast”	Harleysville, PA
	Sika Corporation “Sikadur 31 Hi-Mod Gel” (vertical or overhead applications)	Lyndhurst, NJ
	Sika Concrete Restoration Systems SikaDur 32, Hi-Mod LPL	Lyndhurst, NJ
	Simpson Strong Tie Co.	Dublin, CA
	Accepted equal	
Cement – NSF 61-certified for structures holding potable water	Robertson Ready Mix Concrete	Riverside, CA
	Accepted equal	
Curing Compounds Use where air quality regulations do not prohibit use of solvent based compounds	Edoco “Spartan Cote Cure-Seal Hardener”	Kansas City, KS
	Euclid Chemical Company “Aqua-Cure”	Cleveland, OH
	Master Builders Inc. “Masterkure-W”	Cleveland, OH
	Accepted equal	
Curing Compounds (Water-Based Resin Type) Use where air quality regulations prohibit use of solvent based compounds	Edoco “Aqua Resincure”	Kansas City, KS
	Euclid Chemical Company “Super Rez Seal”	Cleveland, OH
	Master Builders Inc. “MB429”	Cleveland, OH
	Accepted equal	
Dampproofing Agent	Euclid Chemical Company	Cleveland, OH
	W. R. Meadows Inc. “Sealmastic”	Hampshire, IL
	Sonneborn Div. Chemrex Inc. “Hydrocide 600”	Shakopee, MN
	Accepted equal	
Evaporation Retardant for Curing	Euclid Chemical Company “Eucobarl”	Cleveland, OH
	Master Builders Inc. (Confilm)	Cleveland, OH
	Accepted equal	
Floor Hardener (Surface-Applied)	Euclid Chemical Company “Diamon-Plate”	Cleveland, OH
	Master Builders Inc. “Lumiplate”	Cleveland, OH
	Accepted equal	

- B. Use only one brand of cement.
- C. All admixtures shall be compatible and by one Manufacturer capable of providing qualified field service representation.

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.

Concrete structural systems shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Cement	Standard Brand Portland Cement	ASTM C150 Type II/V Modified Low Alkali/Sulfate Resisting Also meet Table 2 optional requirements At least 85% of cement by weight shall pass 325 screen. NSF 61-certified for potable water tanks where finished concrete will contact potable water, and NSF 61-certified cement is available within 25-mile radius of project site.
	Supplementary Cementitious Materials	ASTM C595 and California Green Building Standards Code Section A5.405.5 (See below)
Water	Clean, Clear Potable Water	TDS<1000 mg/l
Coarse Aggregate	Specification	Meet ASTM C33 requirements Gravel, crushed gravel, crushed rock or combination From pits acceptable to Owner's Representative
	Cleanness Value per California Test Method 227	75 minimum
	Percentage Wear per ASTM C131	Abrasion loss < 10.5% after 100 revolutions
		Abrasion loss < 42% after 500 revolutions
	Specific Gravity per ASTM C127	2.58 minimum
Ratio of Silica Released to Reduction in Alkalinity	1.0 maximum	
Fine Aggregate	Specification	Meet ASTM C33 requirements Nonreactive clean, hard durable washed material From pits acceptable to Owner's Representative
	Organic Impurities per ASTM C40	Satisfactory Resultant color of testing solution shall not be darker than ASTM C40 standard
	Mortar Strength Relative to Ottawa Sand per California Test Method 515	100% minimum
	Sand Equivalent	>75% average for 3 samples >70% for any one sample
	Percent Clay, Silt, Loam per ASTM C117	<3%
	Soundness per California Test Method 214	<10% Soundness requirement will be waived if durability index D>60 per California Test Method 229.
		Ratio of silica released to reduction in alkalinity <1.0 Lightweight sand not permitted
Aggregate for Exposed Aggregate Concrete	Pea Gravel	1/4" to 5/8" water washed pea rock with smooth edges
Lightweight Aggregate		ASTM C330 all-lightweight (110 pcf) aggregate
Surface-Applied Bonding Agent	Surface-Applied Bonding Compound	ASTM C932
Epoxy Bonding Agent	Epoxy Resin	ASTM C881
Curing Blankets	Polyethylene Sheet	White 10-mil nominal PE thickness Loss of moisture per ASTM C156<0.055 grams/cm ²
	Polyethylene-Coated Burlap	White opaque polyethylene film impregnated or extruded onto one side of burlap 4-mil nominal PE thickness Burlap weight 9oz/sy or greater Loss of moisture per ASTM C156<0.055 grams/cm ²

ITEM	MATERIAL	SPECIFICATION
	Polyethylene-Coated Waterproof Paper Sheeting	White polyethylene sheeting 2- mil nominal PE thickness Permanently bond to waterproof paper per Fed Spec UU-B-790A Loss of moisture per ASTM C156<0.055 grams/cm ²
Curing Compounds		ASTM C309 White pigmented, resin based Do not use sodium silicate compounds. Meet requirements of floor hardener Manufacturer where applicable NSF 61-certified for potable water tanks where finished concrete will contact potable water.
Curing Mats	Heavy Shag Rugs, Carpets or Cotton Mats Quilted at 4" on center	Minimum dry weight of 12 oz/sy
Dampproofing	Coal Tar	Two coats of single-component self-priming heavy duty material.
Grout for Smooth Concrete Finish		1 part Portland cement (½ gray & ½ white Portland cement) White Portland cement to be Atlas white or equal. 1 part fine sand passing No. 16 sieve Calcium chloride (add amount equal to 5% of cement by volume.) Sufficient water to provide consistency of thick paint. NSF 61-certified for potable water tanks where finished grout will contact potable water.
Ready-Mix Concrete		ASTM C94
Repair Mortar	Two-Component Cement Based Product	Low shrinkage. Designed for repairing damaged concrete surfaces. Use medium slump repair mortar on horizontal surfaces. Use non-sag low-slump repair mortar on vertical or overhead surfaces. NSF 61-certified for potable water tanks where finished mortar will contact potable water.

- C. Concrete aggregate will be designated by letter per Standard Specifications for Public Works (Greenbook) Section 201 and shall conform to the following gradations:

PERCENTAGE PASSING SIEVES BY WEIGHT					
SIEVE SIZE	GRADING A (For concrete street paving not integral with curb)	GRADING B (For concrete channel and box inverts)	GRADING C (For Class AA, A, A2 or B concrete not used for paving or channel or box inverts. May be used for Class C Concrete)	GRADING D (May be used for Class B extruded curbs and gutters or for gunite)	GRADING E (For trench backfill, slurry and masonry grout May be used for Class C concrete.)
2"	100%	100%			
1½"	95-100%	95-100%	100%		
1"	64-80%	80-96%	95-100%		
¾"	55-71%	64-80%	77-93%	100%	100%
⅝"	37-53%	40-52%	50-70%	92-100%	90-100%
No. 4	32-42%	35-46%	39-51%	42-60%	60-80%
No. 8	25-35%	28-38%	31-41%	33-47%	50-70%
No. 16	18-28%	21-31%	22-32%	22-38%	33-53%
No. 30	10-18%	10-20%	12-22%	17-25%	19-35%
No. 50	3-9%	3-10%	3-15%	6-15%	5-15%
No 100	0-4%	0-4%	0-5%	1-6%	2-7%
No. 200	0-2%	0-2%	0-2%	0-3%	0-4%

Concrete mix shall be designed to meet properties and proportions specified. In general, mix shall be designed to minimize shrinkage, surface flaws, honeycombing and rock pockets around steel reinforcing. Limiting parameters specified are not intended to be a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by Contractor's methods and aggregates. Contractor is responsible for any costs associated with furnishing concrete with required workability, density and strength.

E. Admixtures shall consist of the following materials:

ITEM	MATERIAL	SPECIFICATION
Admixtures	General Requirements	Do not use to reduce cement requirement Shall be free from thiocyanates Chloride ion <0.05% NSF 61-certified for potable water tanks where finished concrete will contact potable water.
Air-Entraining Agents (Use when freeze-thaw cycles are expected)		ASTM C260
Coloring Agents	Commercially Pure Mineral Pigments	Weight of pigments < 10% of cement content Color selected by Owner's representative
Fly Ash and other SCM's		Shall not exceed 700 lbs per cubic yard
Fly Ash and other SCM's (Meet requirements of California Green Building Standards Code Section A5.405.5 using supplementary cementitious materials (SCM's))	Fly Ash	ASTM C618
	Ultra Fine Fly Ash (UFFA)	ASTM C618
	Metakaolin	ASTM C618
	Natural Pozzolan	ASTM C618
	Slag Cement (GGBFS)	ASTM C989
	Silica Fume	ASTM C1240
	Blended Cement	ASTM C595 or ASTM C1157
	Mix Design Equation	Use any combination of one or more SCM's satisfying equation $F/25+SL/50+UF/12=1$ where F=% of fly ash or pozzolan in mix, SL =% slag cement in mix and UF =% silica fume, metakaolin or UFFA in mix)
Plasticizing Agents		ASTM C1017
Set Accelerating Agents (Use when air temperature is less than 40°F)		ASTM C494 Type C Do not use calcium chloride or other chloride-based accelerators in concrete having steel reinforcing or embedments.
Set Retarding Agents (Use when air temperature exceeds 80°F)		ASTM C494 Type B
Water Reducing Agents (High Range)		ASTM C494 Type F or G Only one water-reducing admixture shall be used
Water Reducing Agents (Normal Range)		ASTM C494 Type A Only one water-reducing admixture shall be used
Water Reducing and Set Accelerating Agents		ASTM C494 Type E Only one water-reducing admixture shall be used
Water Reducing and Set Retarding Agents		ASTM C494 Type D Only one water-reducing admixture shall be used

The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Class AA "Premium" Concrete Greenbook 680-CW-5000 (Use for box culvert, valve vault and bridge top decks, and for prestressed concrete such as core walls and shotcrete.)	f_c	5000 psi per ASTM C39
	Cement Content	680 lb cement per cubic yard minimum but \leq 700 lb cement per cubic yard
	Maximum Water/Cement Ratio	0.40 by weight
	Aggregate	SSPWC Greenbook Grading C
	Maximum Aggregate Size	1 $\frac{1}{2}$ "
	Slump	4" maximum per ASTM C143
	Water Reducing Admixture	Required
	Maximum Transit Time	60 minutes (250 revolutions maximum)
Class A "Structural" Concrete Greenbook 600-CW-4000 (Use for foundations, footings, ring walls, retaining walls, slabs on grade, beams, columns, walls, roof and floor slabs, and other structural concrete.)	f_c	4000 psi per ASTM C39
	Cement Content	600 lb cement per cubic yard minimum but \leq 700 lb cement per cubic yard
	Maximum Water/Cement Ratio	0.45 by weight
	Aggregate	SSPWC Greenbook Grading C
	Maximum Aggregate Size	1 $\frac{1}{2}$ "
	Slump	4" maximum per ASTM C143
	Water Reducing Admixture	Required
	Maximum Transit Time	60 minutes (250 revolutions maximum)
Class A2 "Premium Non- Structural" Concrete Greenbook 600-C-2500 (Use for pads and minor structures where Owner elects to waive CBC Special Inspection requirements.)	f_c	2500 psi per ASTM C39
	Cement Content	600 lb cement per cubic yard minimum but \leq 700 lb cement per cubic yard
	Maximum Water/Cement Ratio	0.45 by weight
	Aggregate	SSPWC Greenbook Grading C
	Maximum Aggregate Size	1 $\frac{1}{2}$ "
	Slump	4" maximum per ASTM C143
	Water Reducing Admixture	Optional
	Maximum Transit Time	60 minutes (250 revolutions maximum)
Class B "Street Paving" Concrete (Use for street pavement not integral with curb and gutter.) Greenbook 520-A-2500	f_c	2500 psi per ASTM C39
	Cement Content	520 lb cement per cubic yard minimum but \leq 700 lb cement per cubic yard
	Maximum Water/Cement Ratio	0.55 by weight
	Aggregate	SSPWC Greenbook Grading A
	Maximum Aggregate Size	2"
	Slump	3" maximum per ASTM C143
	Water Reducing Admixture	Optional
	Maximum Transit Time	90 minutes
Class B "Site Paving" Concrete (Use for curbs, gutters, sidewalks, and non-vehicular paving.) Greenbook 520-B-2500	f_c	2500 psi per ASTM C39
	Cement Content	520 lb cement per cubic yard minimum but \leq 700 lb cement per cubic yard
	Maximum Water/Cement Ratio	0.55 by weight
	Aggregate	SSPWC Greenbook Grading B
	Maximum Aggregate Size	2"
	Slump	4" maximum per ASTM C143
	Water Reducing Admixture	Optional
	Maximum Transit Time	90 minutes
Class B "Site Paving" Concrete (Use for extruded curbs and gutters.) Greenbook 520-D-2500	f_c	2500 psi per ASTM C39
	Cement Content	520 lb cement per cubic yard minimum but \leq 700 lb cement per cubic yard
	Maximum Water/Cement Ratio	0.55 by weight
	Aggregate	SSPWC Greenbook Grading D
	Maximum Aggregate Size	$\frac{3}{4}$ "
	Slump	2" per ASTM C143
	Water Reducing Admixture	Optional
	Maximum Transit Time	90 minutes

ITEM	DESCRIPTION	
Class C "Utility" Concrete (Use for encasement, thrust blocks, fence and guardrail posts, and mass concrete.) Greenbook 520-C-2500	f_c	2500 psi per ASTM C39
	Cement Content	520 lb cement per cubic yard minimum but \leq 700 lb cement per cubic yard
	Maximum Water/Cement Ratio	0.55 by weight
	Aggregate	SSPWC Greenbook Grading C
	Maximum Aggregate Size	1½"
	Slump	3-6" per ASTM C143
	Water Reducing Admixture	Optional
	Maximum Transit Time	90 minutes
Class D "Slurry Backfill" Concrete (Use for trench backfill.) Greenbook 94-E-100	f_c	100 psi per ASTM C39
	Cement Content	94 lb cement per cubic yard
	Maximum Water/Cement Ratio	0.60 by weight
	Aggregate	¾"
	Maximum Aggregate Size	SSPWC Greenbook Grading E
	Slump	6" maximum per ASTM C143
	Water Reducing Admixture	Optional
	Maximum Transit Time	120 minutes
Class E _l "Low Sulfate Exposure" (Use for concrete exposed to 0.10-0.20% water soluble SO ₃ in soil samples or 150-1500ppm in water samples whichever requires mix of most severe exposure) Greenbook 650-CLE-4000	f_c	4000 psi per ASTM C39
	Cement Content	650 lb per cubic yard minimum but \leq 700 lb cement per cubic yard 80%Type II/V cement +20% Class F Fly Ash
	Maximum Water/Cement Ratio	0.50 by weight
	Aggregate	1½"
	Maximum Aggregate Size	SSPWC Greenbook Grading C
	Slump	4" maximum per ASTM C143
	Water Reducing Admixture	Required
	Calcium Chloride Admixtures	Prohibited
Class E _m "Moderate Sulfate Exposure" (Use for concrete exposed to 0.20-2.00% water soluble SO ₃ in soil samples or 1500-10,000ppm in water samples whichever requires mix of most severe exposure) Greenbook 650-CME-4500	f_c	4500 psi per ASTM C39
	Cement Content	650 lb per cubic yard minimum but \leq 700 lb cement per cubic yard 80%Type II/V cement +20% Class F Fly Ash
	Maximum Water/Cement Ratio	0.45 by weight
	Aggregate	1½"
	Maximum Aggregate Size	SSPWC Greenbook Grading C
	Slump	4" maximum per ASTM C143
	Water Reducing Admixture	Required
	Calcium Chloride Admixtures	Prohibited
Class E _s "Severe Sulfate Exposure" (Use for concrete exposed to >2.00% water soluble SO ₃ in soil samples or >10,000ppm in water samples whichever requires mix of most severe exposure) Greenbook 750-CSE-5000	f_c	5000 psi per ASTM C39
	Cement Content	750 lb per cubic yard 80%Type II/V cement +20% Class F Fly Ash
	Maximum Water/Cement Ratio	0.40 by weight
	Aggregate	1½"
	Maximum Aggregate Size	SSPWC Greenbook Grading C
	Slump	4" maximum per ASTM C143
	Water Reducing Admixture	Required
	Calcium Chloride Admixtures	Prohibited
Reinforcing Steel	f_y	60 ksi See Section 03 20 00.
	Slump	<4", except where ambient temperatures are below 65°F, use slump < 3".
Additional Requirements for Concrete to which Floor Hardener is to Be Applied	Air Content	<3%
	Other Requirements	Do not use set-accelerating admixtures containing calcium chloride.
		Do not use admixtures that increase bleeding.

ITEM	DESCRIPTION	
Floor Hardener	Manufacture	Premeasured, premixed and prepackaged at factory
	Application Rate	1.8-2.5 lb per square foot.
	Evaporation Retarder	Monomolecular film evaporation retarder recommended by floor-hardener Manufacturer to maintain moisture during early curing

- G. With addition of high range water reducer, slump shall be 7" +/- 2".
- H. All materials furnished for Work shall comply with requirements of Sections 201, 203, and 204 of ACI 301 as applicable.
- I. Cement shall be clean and free from contaminants. Do not use cement reclaimed from cleaning bags or leaking containers. Do not use lumpy cement.
- J. All materials furnished for Work must be classified by Environmental Protection Agency as acceptable for potable water use within 30 days of application.

2.3 Mixes

- A. Proportioning shall meet requirements of ACI 301 Chapter 3 "Proportioning."
- B. Quantity of water shall be just sufficient to produce workable batches of concrete which can be worked into place without segregation or other flaws and compacted using vibratory methods to provide desired density, impermeability, and smoothness of surface. Adjust water quantity added if needed to adjust for variations in moisture content of aggregate while providing uniform consistency between batches. Determine consistency of batches by slump testing as described below.
- C. Mixing shall meet requirements of ACI 301 Chapter 7 "Mixing."
- D. Apply admixtures according to Manufacturer's installation and warranty requirements.
- E. Set controlling and water reducing admixtures shall be applied as follows:
 - 1. Use or addition of admixtures shall be at Contractor's option to increase workability and shall result in no increase in cost to Owner.
 - 2. Use or addition of admixtures shall be subject to approval by Owner's Representative.
 - 3. Concrete containing admixture shall be first placed at location determined by Owner's Representative.
 - 4. High range water reducing admixtures shall be added to concrete on site after all other ingredients have been mixed and initial slump has been verified. Do not use more than 14 ounces of water reducer per sack of cement. Water reducer shall be considered as part of mixing water when calculating water cement ratio.
 - 5. If high-range water reducer is added to concrete on site, it may be used in conjunction with same water reducer added at batch plant. Concrete shall have slump of 3" ± ½" before adding high range water reducing admixture at job site.

1. High-range water-reducing admixture shall be accurately measured and pressure injected into mixer as single dose by experienced technician. Standby system shall be provided and tested before each day's operation of job site system.
 2. Mix concrete at mixing speed for at least 30 mixer revolutions after adding high-range water reducer.
- F. Retempering of partially hardened concrete or mortar will not be permitted.
- G. Trial batch testing shall proceed as follows:
1. Before placing any concrete, testing laboratory designated by Owner's Representative shall prepare trial batch of each class of "structural" or "premium" concrete based on preliminary concrete mixes submitted by Contractor and using aggregates, cement and admixtures proposed.
 2. During trial batch, testing laboratory may adjust aggregate proportions to obtain required properties. Such adjustments shall be considered refinements to mix design and shall not justify extra compensation to Contractor.
 3. All concrete shall meet specified requirements whether aggregate proportions are from Contractor's preliminary mix design, or whether proportions have been adjusted during trial batch process.
 4. Trial batch materials shall be sufficient to yield 3 drying shrinkage and 10 compression test specimens from each batch.
 5. Test 5 cylinders at 7 days to establish 7-day average compressive strength.
 6. Test remaining 5 cylinders no more than 28 days after molding.
 7. Required average compressive strengths shall be as follows:
- | SPECIFIED
COMPRESSIVE
STRENGTH (f'_c) | 28-DAY LABORATORY TRIAL BATCH
COMPRESSIVE STRENGTH MINIMUM
TEST RESULTS | | 28-DAY FIELD TEST
COMPRESSIVE STRENGTH
MINIMUM TEST RESULTS |
|---|---|-----------------|---|
| | 5-CYLINDER
AVERAGE | ANY SINGLE TEST | 5-CYLINDER AVERAGE |
| $0 < f'_c < 3000$ psi | $f'_c + 1000$ psi | f'_c | $f'_c + 600$ psi |
| $3000 \text{ psi} \leq f'_c < 5000$
psi | $f'_c + 1200$ psi | f'_c | $f'_c + 600$ psi |
| $5000 \leq f'_c$ | $f'_c + 1400$ psi | f'_c | $f'_c + 600$ psi |
8. Do not place "structural" or "premium" concrete until mix design has been qualified under test criteria above. Should source of materials or established procedures change, Owner may require new trial batch testing.
 9. Field trial batches may be placed in Work at designated locations accepted by Owner's Representative where concrete of lower quality is required. For payment purposes, concrete so placed will be considered to be type of concrete specified at that location.
- H. Measure cement and aggregate for mixing concrete using direct weighing equipment accessible to Owner's Representative.

Tolerances of measurement equipment shall be as follows:

1. Cement: Use weighing equipment accurate to $\pm 1\%$ of total weight
 2. Aggregate: Use weighing equipment accurate to $\pm 3\%$ of total weight
 3. Admixtures: Use weighing equipment accurate to $\pm 3\%$ of total weight
 4. Water: Use metering equipment accurate to $\pm 3\%$ of total volume
- J. Water feed control mechanism shall be capable of being locked in position to deliver constant flow of water to each batch of concrete. Use positive quick-acting valve for cut-off in water line to mixer. Operating mechanism shall not allow leakage to occur when valves are closed.
- K. Ready mixed concrete shall meet ASTM C94 and requirements below.
1. Materials used in ready-mixed concrete shall be subject to continuous inspection at batching plant by Owner's Representative.
 2. Transport and deliver all ready-mixed concrete to site using agitating equipment. Do not use non-agitating equipment or combination truck and trailer equipment to transport or deliver ready-mixed concrete.
 3. Deliver ready-mixed concrete to site and complete discharge within "maximum travel time" specified above after addition of cement to aggregates. Also, deliver mixed concrete to site and complete discharge before drum has been revolved specified maximum number of revolutions.
 4. Truck mixers shall have electrically actuated counters to record number of revolutions of drum or blades. Counter shall be resettable recording type, and shall be mounted in driver's cab. Counters shall be actuated at time of starting mixers at mixing speeds.
 5. Completely empty mixer of any previously mixed load before adding new concrete.
 6. Each batch of concrete shall be mixed in truck mixer for at least 70 revolutions of drum or blades at rotation rate designated by equipment manufacturer. Additional mixing, if any, shall be at agitating speed designated by equipment manufacturer. All materials, including mixing water shall be in mixer drum before actuating counter to count rotations.
 7. Truck mixers and their operation shall ensure concrete throughout mixed batch is discharged within acceptable limits of uniformity of consistency, mix and grading.
 8. Slump tests taken at approximately $\frac{1}{4}$ point and $\frac{3}{4}$ points of load during discharge shall give slumps within 2" of each other. Mixers failing to meet this requirement shall not be used on job until causing condition is corrected and satisfactory performance is verified on-site using additional slump tests. All mechanical parts of failing mixer, including water measurement and discharge apparatus, blades, rotation speed and drum clearances shall be serviced and checked before further attempt to use equipment.
 9. Each delivery of ready-mixed concrete shall be accompanied by delivery ticket furnished to Owner's Representative as described in Paragraph 1.6 above.

3.1 Preparation

- A. Make field measurements needed to install Concrete structural systems before submitting Shop Drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Before placing concrete within forms, each trade having embedded items, including water stops within forms and affected by pour shall certify all items are properly located, placed and braced.
- C. Thoroughly wet earth surfaces by sprinkling before placing concrete. At time of concrete placement, ground surface shall be moist, but free from standing water, mud and debris.
- D. Cold joints in concrete shall be deemed to occur whenever placement of concrete is interrupted for any reason so new concrete is neither incorporated integrally with previously placed concrete in opinion of Owner's Representative nor keyed in place with preformed construction joint shown on Contract Documents or accepted Shop Drawings. Prepare horizontal surfaces of cold joints as follows:
 - 1. Compacting and roughen horizontal with minimum ¼" amplitude profile for good bond.
 - 2. Clean tooled joint surface of all laitance, loose or defective concrete and foreign matter by hydroblasting or sandblasting to expose aggregate.
 - 3. Thoroughly wash hydro-blasted or sandblasted surface with clean water.
 - 4. Remove all ponded water from surface of construction joints.
 - 5. Coat joint surface with epoxy-bonding agent unless otherwise shown.
- E. Construction joints shown on Contract Documents and accepted Shop Drawings may be made as shown with provision of keys or other locking shapes to secure proper union with subsequent work.
- F. Before placing concrete, verify location of embedded items with affected trades. Accuracy of placement of embedded items is Contractor's responsibility.
- G. Before placing concrete, secure inspection of steel reinforcement and obtain acceptance by Owner's Representative at least 4 hours before placing concrete.
- H. Before placing concrete, provide dewatering, runoff diversion and protection as needed to ensure proper and water-free environment suitable for concrete hardening and curing. Do not place concrete underwater or in spaces where standing water is present. Protect uncured concrete from exposure to rain, runoff or groundwater.
- I. Notify Owner's Representative in writing at least 24 hours before placing any concrete. Do not place concrete except when Owner's Representative or his duly authorized representative is present.
- J. Order of placement of concrete shall be acceptable to Owner's Representative. To minimize shrinkage effects, place concrete in units bounded by construction joints shown in Shop Drawings. Placement shall occur such that each unit shall cure at least 7 days for hydraulic structures and 3 days for all other structures before contiguous units are placed,

except corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for all other structures.

- K. Provide sufficient illumination in interior of all forms so concrete at places of deposit is visible from deck or runway.
- L. Schedule concrete placement during evening or morning hours or provide ice or pre-cooled aggregate as needed to maintain temperature of concrete within the following ranges immediately before placement.
 - 1. Concrete less than 12" thick: 55°F to 90°F
 - 2. All other concrete: 50°F to 90°F
 - 3. When concrete temperature exceeds 80°F, only set retarding admixtures shall be used.
 - 4. When concrete temperature exceeds 85°F, time between introducing cement to aggregates and discharge shall not exceed 45 minutes.
 - 5. No additional compensation will be made to contractor for measures used to maintain concrete temperature within specified limits.
- M. Hot weather placement shall proceed as follows:
 - 1. Comply with ACI 305.
 - 2. From initial placement through curing, protect concrete from adverse effects of high temperature, low humidity and wind.
- N. All ends of chutes, hopper gates, and all other points of concrete discharge shall be arranged so concrete passing from them will flow continuously into receiving vessel without separation. Conveyor belts, if used, shall be wiped clean by device operated so mortar adhering to belt is not wasted and shall be of type acceptable to Owner's Representative. Chutes shall be no longer than 50' long. Slopes of chutes shall permit free and continuous flow of concrete being placed.

3.2 Installation/Application

- A. Refer to Sections 01 73 00 for basic execution and installation requirements.
- B. Furnish and install concrete at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. California Building Code Chapter 19 "Concrete"
 - 4. Other applicable building and CalGreen code requirements
 - 5. ACI 301 Structural Concrete for Buildings Chapter 8.
 - 6. ACI 318 Building Code Requirements for Reinforced Concrete

7. Standard Specifications for Public Works Construction Section 303 “Concrete and Masonry Construction.”
- D. Where hydrophobic waterproofing admixtures are added, admixture Manufacturer’s installation and warranty requirements shall also be followed.
- E. Refer variances between above documents and Contract Documents to Owner’s Representative.
- F. Pumping of concrete will only be permitted if satisfactory end results are obtained.
1. For redundancy, provide standby pump on site or provide pumping equipment with two cylinders, designed to operate with one cylinder only.
 2. Replace pumping equipment or hoses that fail to function properly.
 3. Minimum diameter of hose and conduits shall be in accordance with ACI 304
 4. Do not use aluminum conduits to convey concrete.
 5. Concrete samples for slump, air content and test cylinders will be taken at placement (discharge) end of line.
- G. Do not drop concrete through reinforcing steel or into any deep form, nor place concrete in any form in manner permitting accumulation of mortar on surfaces above placed concrete. If necessary, use hoppers or vertical ducts of canvas, rubber or metal to convey concrete to place of final deposit without separation or splashing. Free fall shall not exceed 4’ below ends of ducts, chutes or buggies except in column forms. In no case shall concrete be displaced horizontally in forms by more than 6’ after depositing. Deposit concrete in uniform horizontal layers not deeper than 2’. Avoid inclined layers or inclined construction joints except where required for sloping members. Place each layer while previous layer is still soft. Rate of placement in forms shall not exceed 5 vertical feet of rise per hour.
- H. Thrust blocks shall be placed behind all non-welded, non-flanged or non-restrained valves, fittings, reducers, tees, crosses, bends and dead ends. Place thrust blocks as follows:
1. Wrap fittings and valves, leaving stainless steel bolts exposed. Do not allow concrete to contact flanges or bolts.
 2. Owner’s Representative shall inspect formwork and be present throughout placement of concrete.
 3. Unless otherwise shown on Plans, provide bearing surface not less than 3 times pipe diameter in all directions.
 4. Thrust block shall bear against undisturbed soil.
 5. In soft or disturbed soil, increase bearing surface as directed by Owner’s Representative.
- I. Concrete in ramps and sloping slabs shall be placed uniformly from bottom to top for full width of placement. As work progresses, vibrate concrete and carefully work it around reinforcement. Screed ramp surface in an up-slope direction.

Thoroughly settle, compact and consolidate concrete in forms or excavations throughout entire depth of concrete layer being placed.

1. Consolidate concrete into dense, homogeneous mass, filling all corners and angles, thoroughly embedding reinforcement and embedments, eliminating all rock pockets and bringing only a slight excess of water to exposed concrete surface during placement.
 2. Vibrators shall be Group 3 per ACI 309. Use high-speed power vibrators (8,000 rpm to 12,000 rpm) of immersion type in sufficient number and with (at least one) standby units as required to accomplish specified results within 15 minutes after concrete is deposited. Group 2 vibrators may be used only at specific locations when accepted by Owner's Representative.
 3. When placing concrete around waterstops, carefully rod and vibrate concrete to eliminate all air and rock pockets. Where flat-strip waterstops are placed horizontally, work concrete under waterstops by hand, making sure all air and rock pockets are eliminated. Concrete surrounding waterstops shall receive additional vibration over and above that used for adjacent concrete to assure complete embedment of waterstops in concrete.
 4. Concrete in walls shall be internally vibrated and at same time, rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills forms or excavations and closes snugly against all surfaces. Do not place subsequent layers of concrete until previously placed layers have been worked thoroughly as specified. Keep vibrating head from contact with form surfaces.
 5. Do not vibrate concrete excessively or work it in any manner causing segregation of its constituents.
- K. Horizontal surfaces of concrete shall be level whenever run of concrete is stopped. To ensure level, straight joint on exposed surfaces of walls, tack wood strip at least $\frac{3}{4}$ " thick to forms on these surfaces. Carry concrete about $\frac{1}{2}$ " above underside of strip. About one hour after concrete is placed, remove wood strip. Using trowel, remove irregularities in edge formed by strip, and remove all laitance.
- L. Concrete finishing shall proceed as follows:
1. As soon as forms are removed, examine all exposed surfaces and rub or grind all fins, bulges or ridges in satisfactory method to provide smooth, uniform and continuous surface.
 2. Do not plaster or coat surfaces to be smoothed.
 3. Do not use aluminum finishing tools.
 4. Finished surfaces shall present finished, smooth, continuous hard surface.
 5. Owner's Representative will inspect finished surface for voids, holes, honeycombing, rock pockets or similar depression defects. Damage shall be repaired as specified.
 6. Repair surface defects within 2 hours of form removal.

7. Surface defect repairs that cannot be made within 2 hours following form removal shall be delayed until after curing compound has been applied. In such case, area involved shall then be wet sandblasted to remove curing compound following which repairs shall be made as specified, and curing compound shall be reapplied over repaired area.

M. Repair defective work at Contractor's expense as follows:

SURFACE DEFECTS	
DEFECT	REPAIR METHOD
Tie Rod Cone Holes	Ream circular holes with suitable toothed reamers to leave surfaces of holes clean and rough. Do not ream rectangular holes or holes deeper than their least surface dimension. Repair holes in approved manner with dry-packed cement grout.
Cracks in Retaining Walls and Walls in Contact with Backfill	Apply waterproofing membrane to cover fill side of wall. Fill with construction joint sealant designed for water-bearing structures
Cracks in Water-bearing Structures	Vee cracks on water-bearing face with suitable tools. Fill with construction joint sealant designed for water-bearing structures.
Minor Voids, Holes or Honeycombing	Cut back from true line at least 1/2" over entire area. Use chipping and cutting tools as needed. Do not feather edges. Remove 1/32" of surface film from hardened and cured portions by wet sandblast. Remove all laitance or soft material before bonding. Moisten exposed surface but do not wet it enough to overcome suction needed for bond. Mix for repair shall be 1 sack cement to 3 cubic feet sand with Atlas white Portland cement added as needed on interior walls to make patch match finish. Apply bonding agent if required. Apply repair mix.
HOLES EXTENDING THROUGH CONCRETE	
DEFECT	REPAIR METHOD
Small Holes less than 12" in least dimension	Fill hole with non-shrink grout. Where face of repaired surface is exposed to view, hold grout back 2" from finished surface. Patch remaining 2" as described above for "Minor Voids, Holes or Honeycombing." For water bearing structures, apply bentonite or other accepted waterstop material around perimeter of hole.
Large Holes greater than 12" in least dimension	Chip keyway into edge of opening. Repair keyed opening as described above for "Small Holes."
Large Holes greater than 24" in least dimension	Chip keyway into edge of opening If reinforcing is not present, dowel and epoxy reinforcing of size matching reinforcing in existing wall across opening in both directions. Repair keyed and reinforced opening as described above for "Small Holes."

- N. Perform all repairs using approved methods that do not disturb bond or cause sagging or horizontal fractures. Finished surfaces shall be cured using methods and duration similar to that for adjacent concrete.

O. Concrete finishing of unformed surfaces shall proceed as follows:

1. After proper and adequate vibration and tamping, bring unformed surfaces of slabs, floors, walls and curbs to uniform surface with suitable tools.
2. Screed concrete and then immediately treat with liquid evaporation retardant. Reuse retardant as needed after each operation to prevent drying shrinkage cracks.

3. Classes of unformed surfaces shall be as follows:

FINISH	LOCATION	DESCRIPTION
U1 (screeded finish)	Grade slabs and foundations to be covered with concrete or fill material	Sufficient leveling and screeding to produce even, uniform surface with surface irregularities not exceeding $\frac{3}{8}$ ". No further special finish.
U2 (float finish)	Floors to be covered with grouted tile or topping grout Slabs to be covered with built-up Roofing	After sufficient stiffening of concrete, float finish surface with wood or metal floats or with finishing machine using float blades. Do not excessively float surfaces while concrete is plastic. Floating shall be minimum necessary to produce uniform-texture surface free from screed marks. Do not dust dry cement or sand on concrete surface to absorb excess moisture. Surface irregularities shall not exceed $\frac{1}{4}$ ".
U3 (steel trowel finish)	Interior slabs to receive architectural finish Top surface of walls Water-bearing slabs with slopes of 10% or less	After floated finish U2 hardens sufficiently to prevent excess of fine material from being drawn to surface, steel trowel surface with firm pressure to flatten sandy texture of floated surface and produce dense uniform surface free from blemishes, ripples and trowel marks. Finish shall be smooth and free from all irregularities.
U4 (hairbroom finish)	Non water-bearing slabs Water bearing slabs with slopes >10%	After completing steel trowel finish U3, add light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. Resulting surface shall be rough enough to provide nonskid finish.

P. Do not backfill against walls until concrete has obtained 100% of specified 28-day compressive strength.

Q. Concrete floor slab surface hardeners shall be applied as follows:

1. Notify surface hardener Manufacturer at least 3 days before initial use of product.
2. Place job mockup of 100 square feet using materials proposed for project as follows.
3. After concrete has been leveled and as soon as concrete will support operator and machine without disturbing level or working up excessive fines, float surface of slab using mechanical float fitted with float shoes.
4. Following floating, apply $\frac{1}{2}$ to $\frac{2}{3}$ of total amount of dry shake surface hardener so uniform distribution of surface hardener is obtained. Use of mechanical spreader is recommended.
5. Do not place dry shake on concrete surface when bleed water is present.
6. Once shake has absorbed sufficient moisture (indicated by darkening of shake), float the surface.
7. Immediately apply remaining $\frac{1}{3}$ to $\frac{1}{2}$ of shake and allow to absorb moisture.
8. Use finishing machines with detachable floor shoes. Compact surface by a third mechanical floating if time and set of concrete allow this. Do not add water to surface.
9. As surface further stiffens, indicated by loss of sheen, hand or mechanically trowel with blades set relatively float. Remove all marks and pinholes in final raised trowel operation.
10. Cure finished floors using fill-forming curing compound recommended by surface hardener Manufacturer. Uniformly apply curing compound over entire surface at coverage providing moisture retention in excess of requirements of ASTM C309.

11. Maintain ambient temperature of at least 50°F throughout curing period.
12. Factory-trained full-time representative of surface hardener shall be present during installation of mockup and initial period of installation to advise on proper use of product.
13. After review of mockup, revise materials and procedures as recommended by surface hardener representative to obtain acceptable surface finish.
14. Complete application of floor hardener using same controls and procedures used in mockup with revisions recommended by surface hardener representative to obtain acceptable surface finish.
15. Keep floors covered and free of traffic and loads for at least 14 days after completion.

R. Concrete curing shall proceed as follows:

SURFACE	DESCRIPTION
Unstripped Forms	Method 1: Wet wood forms completely after concrete has been placed, and keep wet with water until forms are removed. For steel forms, keep exposed concrete surfaces continuously wet until forms are removed. If forms are removed within 14 days of placing concrete, continue curing as described for surfaces with forms removed
Construction Joints between Footings & Walls & between Floor Slab & Columns	Method 2: Cover surface with burlap mats. Wet mats with water for duration of curing period until concrete in walls has been placed. Do not apply curing compound to these surfaces.
Encasement Concrete & Thrust Blocks	Method 3: Cover surface with moist earth 4 to 24 hours after concrete is placed. Earthwork operations that may damage concrete shall not begin until at least 7 days after concrete is placed.
Concrete Surfaces not Described Elsewhere	Method 4: As soon as concrete hardens enough to prevent marring on unformed surfaces, and within 2 hours after form removal, spray surface with liquid curing compound in accordance with Manufacturer's application instructions. Cover no more than 200 square feet of surface per gallon with uniform film that seals thoroughly. Do not damage seal during curing. If seal is damaged or broken, apply additional curing compound over damaged portion. Where curing compound is accidentally applied to surfaces against which concrete is to be subsequently placed, remove curing compound by wet sandblasting just before placing new concrete. Where concrete is placed adjacent to panel coated with curing compound, apply curing compound to all previously coated panel areas within 6' of joint and apply to any other location where curing membrane is disturbed. Following curing, remove all visible traces of curing compound in such manner that surface finish is not damaged.
Floor Slabs on Grade	Method 5: Before curing medium is applied, keep entire surface damp using nozzles that atomize flow so surface is not marred or washed. Apply curing material using Method 4 described above. After 1 hour but not more than 4 hours have elapsed after applying curing material, wet surface with water delivered through fog nozzle. Place concrete curing blankets on slab, with edges butted together and with joints between strips sealed with 2" wide strips of sealing tape or with edges lapped at least 3" and fastened with waterproof cement to form continuous watertight joint. During first 3 days of curing, no traffic and no depositing of materials shall be permitted on curing blankets. After 3 days, any traffic or material deposits shall only occur on top of 5/8" minimum plywood sheets laid over curing blankets. Leave curing blankets in place for 14 days. Add water under curing blanket as often as necessary to maintain damp concrete surfaces. Do not remove curing blankets until after concrete for adjacent work has been placed. Should curing blankets tear or become damaged, replace damaged sections.

SURFACE	DESCRIPTION
Surfaces with Forms Removed & Slabs not on Grade	<p>Keep concrete continuously wet by applying water for at least 14 consecutive days beginning immediately after concrete reaches final set or after forms are removed. Before curing medium is applied, keep entire surface damp using nozzles that atomize flow so surface is not marred or washed.</p> <p>Use heavy curing mats secured in place with weights along all edges to continuously retain moisture during curing period. Use sprinklers or other means to maintain moist surface condition during and after normal working hours.</p> <p>At end of curing period, remove curing medium. Rewet any dry spots and apply curing compound in accordance with Method 4 above.</p>

- S. Excess curing water shall be disposed of in manner that avoids damage to Work.
- T. Dampproofing of exterior surfaces of all buried roof slabs shall proceed as follows:
1. Immediately after curing, spray surface with dampproofing agent consisting of asphalt emulsion. Application shall be in 2 coats.
 2. First coat shall be diluted to half-strength by adding water and shall be sprayed on to provide coverage rate no thinner than 100 square feet per gallon of dilute solution.
 3. Second coat shall consist of application of specified material, undiluted, and shall be sprayed on to provide coverage rate no thinner than 100 square feet per gallon.
 4. As soon as asphalt emulsion has taken initial set, coat entire area thus coated with whitewash. Any formula for mixing whitewash may be used which produces uniformly coated white surface and which so remains until backfill is placed. Should whitewash fail to remain on surface until backfill is placed, apply additional whitewash.
- U. Concrete finishing of formed surfaces shall proceed as follows:
1. Repair surface defects.
 2. Immediately after stripping forms, inspect concrete surface. Repair all poor joints, voids, rock pockets and other defective areas.
 3. Allow concrete to cure at least 14 days before applying architectural finishes.
 4. All architectural finishes shall conform to accepted sample required herein in texture, color and quality. Sample for smooth concrete finish shall be 200 square foot panel prepared as described below. Sample for sandblasted finish shall be 3-square foot sample.
 5. Classes of architectural finishes shall be as follows:

FINISH	LOCATION	DESCRIPTION
Smooth Concrete Finish	All exposed formed surfaces of buildings except where otherwise shown	<p>Concrete surface shall be wetted and smooth concrete finish grout described above shall be brush applied. Vigorously rub grout into concrete surface with wood float to fill all small air holes. Then remove surface grout with steel trowel. Allow to dry, then vigorously rub surface with burlap to remove remaining surface grout so no visible paint-like film remains. (Complete all work on same panel within one 8-hour day. Do not leave grout on surface overnight.)</p> <p>Finished surface should be light-colored concrete surface of uniform color and texture with no appearance of paint or grout film.</p>

FINISH	LOCATION	DESCRIPTION
		If procedures above result in inferior finish, rub inferior areas with carborundum bricks.
Sandblasted Concrete Finish	As shown on Plans	Remove laitance and produce uniform fine aggregate surface texture with approximately 1/32 to 1/16" of surface sandblasted off. Corners, patches, form panel joints and soft spots shall be sandblasted with care. Finished surface should match 3 square foot sample panel. Protect adjacent finishes and surfaces from damage. After sandblasting, wash concrete surfaces with clean water and remove excess sand.

3.3 Field Quality Control

- A. Field testing and inspection of concrete accessories, waterstops and joints shall be per Section 03 15 00.
- B. Field testing and inspection of steel reinforcement shall be per Section 03 20 00.
- C. Field testing and inspection of embedded steel bolts shall be per Section 05 12 00.
- D. CBC Chapter 17 special inspection shall only be required for Class AA "premium" concrete, Class A "structural" concrete and concrete having specified compressive strength f_c exceeding 2500 psi.
- E. Maintain placing record on-site showing time and date of placement of all concrete having specified compressive strength f_c exceeding 2500 psi as required in CBC Section 1704.4.2.
- F. Special inspection and field testing of Class AA and Class A concrete required by Chapter 17 of CBC (Table 1704.4) shall be completed by ICBO-certified special inspector selected by Owner and shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Class AA Concrete, Class A Concrete and Concrete having f_c exceeding 2500 psi	Design Mix Verification	ACI 318, Ch 4 & 5.2-5.4, CBC 1904.25.25, 1913.2, & 1913.3	Periodic per CBC Table 1704.4	Owner	Contractor to reimburse Owner for costs of first deputy inspector if re- inspection is required
	Slump	ACI 318 Sec. 5.6& 5.8, ASTM C31, ASTM C172 & CBC 1913.10 Slump per ASTM C143	Continuous per CBC Table 1704.4 taken at at ¼ point and ¾ point of batch and at time fresh concrete is sampled to fabricate cylinders for strength tests		
	Air Content	ACI 318 Sec. 5.6& 5.8, ASTM C31, ASTM C172 & CBC 1913.10 Air content per ASTM C173 or C231			
	Temperature	ACI 318 Sec. 5.6& 5.8, ASTM C31, ASTM C172 & CBC 1913.10			
	Proper Placement of Concrete	ACI 318 Sec. 5.9-5.10, CBC 1913.6, 1913.7, & 1913.8	Continuous per CBC Table 1704.4		
	Verification of in-situ Concrete Strength Prior to Removal of Shores and Forms	ACI 318, Sec. 6.2 See below for concrete strength test requirements	Periodic per CBC Table 1704.4		

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Curing Temperature and Techniques	ACI 318, Sec. 5.11-5.13, & CBC 1913.9	Periodic per CBC Table 1704.4		
Prestressed Concrete	Prestressed Concrete Application of Prestress	ACI 318, Sec. 18.20	Continuous per CBC Table 1704.4 (Applies to reservoir only)		
	Prestressed Concrete Grouting of Bonded Prestressed Tendons	ACI 318, Sec. 18.18.4			
Post- Tensioned Concrete	Verification of in-situ Concrete Strength Prior to Stressing Tendons in Posttensioned Concrete	ACI 318, Sec. 6.2 See below for concrete strength test requirements.	Periodic per CBC Table 1704.4 (Applies to reservoir only)		
Precast Concrete Members	Erection	Contract Documents, ACI 318, Ch. 16	Periodic per CBC Table 1704.4		
Shotcrete	Proper Application	ACI 318 Sec. 5.9-5.10, CBC 1913.6, 1913.7, & 1913.8	Continuous per CBC Table 1704.4 (Applies to reservoir only)		

G. Additional field testing of concrete shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY	
Concrete Compressive Strength f_c	Trial Batch	1 st 3 cylinder tests at 7 days 2 nd 3 cylinder tests at 28 days average compressive strength at 28 days shall exceed 125% of specified compressive strength f_c	3 drying shrinkage samples and 6 compression test cylinders for each class or mix of concrete used	Contractor	Contractor	
	Cylinder Sampling	ASTM C172	Sample each 100 cy concrete and each separate mix design placed on any day	Contractor	Contractor	
	Cylinder Testing of Compressive Strength f_c	Field Cylinders per ASTM C31 Section 9.2	Laboratory Cylinders per ASTM C192 Testing per ASTM C39 Average of two cylinders Evaluation per ACI 214 & ACI 318 Chapter 5 "Concrete Quality"	Make six 6" diameter x 12" high cylinders per 100 cy concrete and separate mix design placed on any day 1 st test at 7 days	Owner	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
		Standard deviation of test results shall not exceed 640 psi.	2 nd test at 28 days Save remaining cylinders to verify test results as directed.		
	Test Core Testing of Compressive Strength f_c	Take test cores per ASTM C42 if minimum strengths fall below those specified. Concrete tested by coring shall be acceptable if average f_c of 3 cores equals 85% of specified f_c and no single core strength is less than 75% of specified f_c .	3 cores per test as directed	Contractor	Contractor
Concrete	Flexural Strength	ASTM C78	As directed	Contractor	Contractor
	Unit Weight Yield	ASTM C138	As directed	Contractor	Contractor
	Drying Shrinkage	California Test 530	As directed	Contractor	Contractor
Mortar	Setting of Mortar	ASTM C191 or C266	As directed	Contractor	Contractor
	Mortar Cube Test	California Test 515	As directed	Contractor	Contractor
Concrete Finishing	Dimensional Tolerance	ACI 117 and Section 03 10 00	Inspection at Owner's discretion	Owner	Owner
	Surface Defects	Holes larger than 1/2" diameter or greater than 1/4" deep are defined as surface defects. More stringent requirements exist for some specified finishes.	As directed	Owner	Owner
	Permeability and Cracking in Water-Bearing Structures	Section 03 08 50	As directed	Owner	Owner
	Cracking in Flatwork and Non-Water-bearing Structures	No cracks wide enough to stick a dime in except at expansion or contraction joints.	As directed	Owner	Owner
Concrete	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

- H. Concrete samples for batch testing shall be furnished in steel drums at no cost to Owner.
- I. In lieu of trial batch testing, Contractor may submit previously designed, tested and successfully used concrete mixes using materials similar to those intended for this project, together with at least 3 certified test reports of 28-day strength of proposed concrete mix.
- J. Laboratory used for field testing shall meet or exceed requirements of ASTM C1077.

Contractor shall provide concrete for testing at no charge to Owner, and shall assist Owner's Representative and laboratory personnel in obtaining samples, and disposal and cleanup of excess material.

- L. Statistical analysis of compression test results will be performed according to ACI 214. Standard deviation of test results shall not exceed 640 psi when ordered at equivalent water content as estimated by slump. When said standard deviation exceeds 640 psi, increase average strength for which mix is designed as needed to satisfy statistical requirement that
 - 1. Probability of any test being more than 500 psi below specified strength < 1%.
 - 2. Probability of average of any 3 consecutive tests being below specified strength <1%.

Required average strength shall be calculated using Criterion Number 3 of ACI 214 using actual standard deviation.

- M. All concrete which fails to meet ACI requirements and these Specifications is subject to removal and replacement at no increase in cost to Owner.
- N. In lieu of removing and replacing slightly deficient concrete having 85% or more of specified strength, Owner may, at their sole discretion, elect to reduce payment due to Contractor for substandard concrete as described in Caltrans Standard Specification Section 90-9 "Compressive Strength."

3.4 Cleaning

- A. Wash out chutes, shovels, finishing trowels and all other equipment that has been in contact with wet concrete at a designated concrete washout area.
- B. Do not discharge or deposit wet concrete, debris, or other concrete washout effluent on bare ground, on area tributary to storm drain or natural channel or in any storm drain facility.
- C. Dispose of concrete and concrete waste in accordance with all pollution prevention laws and regulations.
- D. Refer to Section 01 74 00 for cleanup and disposal requirements.

3.5 Protection

- A. Protect all concrete against injury until final acceptance by Owner.
- B. Fresh concrete shall be protected from damage due to impact, overstress, vandalism and weather, including precipitation or extremes in temperature or humidity until final acceptance.
- C. Any new concrete not complying with these specifications shall be repaired or removed and replaced prior to final acceptance except where Owner agrees to reduce payment as described above.

END OF SECTION

**SECTION 05 51 00
STAIRS AND LADDERS**

PART 1 - GENERAL

1.1 Work Included

A. This section includes materials, testing, and installation of stairs and ladders.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 03 30 00: Cast-in-Place Concrete
- H. Section 07 72 33: Roof and Floor Hatches
- I. Section 09 90 00: Painting and Coating
- J. Section 09 96 56: Epoxy Linings and Coatings

1.3 System Description

A. Furnish and install complete stairs and ladders where shown including appurtenant mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. ANSI / ASC A14.3 Ladders - Fixed - Safety Requirements
- B. ASTM A36 Carbon Structural Steel
- C. ASTM A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- D. ASTM B6 Zinc
- E. California Mechanical Code (CMC) Section 904.10
- F. OSHA Standard 29 CFR1910.24 Fixed Industrial Stairs
- G. OSHA Standard 29 CFR1910.27 Fixed Ladders

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required for fabricated stairs and ladders per structural shop drawing requirements	.
Catalog Data	Required for all manufactured products per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements	
Certificate of Compliance	Submit coating system and application certification per certificate of compliance requirements.	

SUBMITTAL	DESCRIPTION	
Foundry or Test Record Transcripts	Submit for factory tests upon request per foundry or test record transcript requirements.	
Material Samples	Required on request	
Welder Qualification Certificates	Required for all welders performing work on this project. Also submit certifications of procedure qualifications for each welding procedure used.	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, certificates of compliance, foundry or test records and material samples.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of stairs and ladders shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Fall Prevention System	Capital Safety Group DBI Sala "Lad-Saf"	Red Wing, MN
	Inwesco "Safety Ladder Assistant"	Azusa, CA
	Miller Equipment "Sure Track"	Porterville
	North Safety Products Div Honeywell "Saf-T-Climb"	Cranston, RI
	Accepted equal	
Ladder - Fiberglass	R D Werner Co. Inc.	Greenville, PA
	Ultra Fiberglass Systems	Milwaukee, WI
	Accepted equal	
Ladders – Coating on Rungs	McMaster-Carr Supply Company (6901-T18)	Los Angeles, CA
	Accepted equal	
Ladder Safety Post	Bilco Company "Ladder Up"	New Haven, CT
	Inwesco "Safety Ladder Assistant"	Azusa, CA
	Accepted equal	
Stair Treads	McNichols Company	Tampa, FL
	Keene Building Products	Libertyville, IL
	SlipNOT Div. W S Molnar Co.	Detroit, MI
	Accepted equal	

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Ladders shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION	
Interior Ladders - Fiberglass	Fiberglass	Dimensions	See plans and OSHA Std CFR1910.27
		Rung Diameter	1-inch minimum
		Clear Length of Rung or Cleat	16 inches minimum
		Distance Between Rungs	12 inch maximum
		Clearance Between Rungs and Walls or Obstructions Behind Ladder	7-inch minimum
Exterior Ladders – Steel	Welded Steel	Dimensions	See plans and OSHA Std CFR1910.27
		Stringer	2½-inch x ¼-inch steel bar
		Rung Diameter	¾-inch minimum
		Clear Length of Rung or Cleat	16 inches minimum
		Distance Between Rungs	12 inch maximum
		Clearance Between Rungs and Walls or Obstructions Behind Ladder	7-inch minimum
	Exterior Cage	Required – See Plans	
	Powder-Coated Epoxy Coating	Section 09 96 56	
	Coating on Rungs	Coarse grain epoxy Color - gray	
Fall Prevention System (Required on all ladders more than 8 feet high)	Stainless Steel	SAE Type 316	
		Standards	ANSI / ASC A14.3
		Cable Size	⅜"
		Rated User Weight	300 lbs
Ladder-Top Safety Post (Interior Ladders)	Stainless Steel	SAE Type 316 Removable	
Ladder-Top Handrail Extensions (Exterior Ladders)	Stainless Steel	SAE Type 316	

- C. Stairs shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION	
Interior Stairs - Fiberglass	Fiberglass	Dimensions	22-inch minimum required by OSHA Std CFR1910.24
		Minimum Width	30° to 50° above the horizontal required by OSHA Std CFR1910.24
		Allowable Slope	8-inch minimum slip-resistant tread required by OSHA Std CFR1910.24
		Tread	7-foot minimum required by OSHA Std CFR1910.24
		Vertical Clearance	As shown / 30-inch minimum on one side required by OSHA Std CFR1910.24
		Platforms or Landings	30-34 inches high required by OSHA Std CFR1910.24
		Railings	22-inch minimum required by OSHA Std CFR1910.24

ITEM	MATERIAL	SPECIFICATION	
Exterior Stairs – Steel	Welded Steel	Dimensions	See plans and OSHA Std CFR1910.24
		Minimum Width	22-inch minimum required by OSHA Std CFR1910.24
		Allowable Slope	30° to 50° above the horizontal required by OSHA Std CFR1910.24
		Tread	8-inch minimum slip-resistant tread required by OSHA Std CFR1910.24
		Vertical Clearance	7-foot minimum required by OSHA Std CFR1910.24
		Platforms or Landings	30-inch minimum on one side required by OSHA Std CFR1910.24
		Railings	30-34 inches high required by OSHA Std CFR1910.24
	Powder-Coated Epoxy Coating	Section 09 96 56	
	Coating on Rungs	Coarse grain epoxy Color - gray	

- D. Zinc coatings shall be applied by the hot-dipped or electro-depositing process. Zinc shall comply with ASTM B6.
- E. Before leaving the shop, all steel not shown or specified to be galvanized or stainless shall receive one coat of pigmented primer recommended by Manufacturer of the final paint system. Parts inaccessible after assembly shall be given a second coat of the same primer. Final painting shall be as specified in Section 09 90 00/09 96 56.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to fabricate and install stairs and ladders before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Clean surfaces of work to be in contact with concrete, removing all rust, dirt, grease and other foreign substances before concrete is placed.
- C. Aluminum surfaces to contact concrete shall be coated with heavy alkali-resistant bituminous paint or one coat of zinc chromate.
- D. Aluminum surfaces to contact dissimilar metals shall be insulated from dissimilar metals using neoprene gaskets or washers.
- E. All embedded metalwork shall be secured accurately in position when concrete is placed to prevent displacement or undue vibration during or after placement of concrete.
- F. Where work is to be installed in recesses in formed concrete, said recesses shall be made, work installed, and recesses filled with dry-pack mortar in conformance with the specifications in Division 3 Concrete.

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install stairs and ladders at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations.
 - 3. Applicable building and fire code requirements
- D. Refer variances between the above documents and Contract Documents to Owner's Representative.
- E. Install stairs and ladders to tolerances recommended by Manufacturer. Unless otherwise shown, install stairs and ladders true, plumb and level using precision gauges and levels.
- F. Welding shall comply with Section 05 12 00. Permanent connections shall be continuously welded along the entire area of contact.
- G. Bolting shall comply with Section 05 12 00. Conceal fastenings whenever possible.
- H. Joints shall have a close fit with corner joints coped or mitered and in true alignment.
- I. Built-up parts shall be free of warp.
- J. Exposed ends and edges of work shall be slightly rounded.
- K. Mount ladders so clearance from back of ladder to wall behind ladder at all times exceeds 7 inches.

3.3 Field Quality Control

- A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Stairs and Ladders	No bends, twists or open joints No projecting edges or corners at intersections	Visual inspection	All work	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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**SECTION 07 72 33
ROOF AND FLOOR HATCHES**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of roof and floor hatches.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 03 30 00: Cast-in-Place Concrete
- H. Section 05 12 00: Structural Steel Framing
- I. Section 05 50 00: Metal Fabrications
- J. Section 09 90 00: Painting and Coating

1.3 System Description

- A. Furnish and install complete operating roof and/or floor hatch including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. California Building Code (CBC)
- B. California Fire Code (CFC)
- C. California Mechanical Code (CMC)

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per structural shop drawing requirements.	.
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements. Include rough-in diagrams.	
O & M Instructions	Required per operation and maintenance instruction requirements	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, and O&M instructions.

Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of roof and floor hatches shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Roof Hatches	Access Manufacturing Inc.	New York, NY
	Acralight International Skylights	Santa Ana CA
	Babcock Davis Div Cierra Products Company	Arlington, MA
	Bilco Co.	New Haven, CT
	Dur-Red Products	Cudahy CA
	Inryco	
	Nystrom	Minneapolis, MN
	U.S. Foundry and Manufacturing Co.	Medley, FL
	Accepted equal	
Traffic-Rated Hatches	Access Manufacturing Inc.	New York, NY
	Babcock Davis Div Cierra Products Company	Arlington, MA
	Bilco Co.	New Haven, CT
	Dur-Red Products	Cudahy CA
	Inryco	
	Nystrom	Minneapolis, MN
	U.S. Foundry and Manufacturing Co.	Hialeah, FL
		Accepted equal

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Roof and floor hatches shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Hatch – Galvanized Steel	Steel	ASTM A36
	Galvanized Coating	ASTM A123 - 3.4 mil thickness - 2.00 ounce/ft ²
Hatch - Aluminum	Aluminum	
Hatch – Stainless Steel	Stainless Steel	SAE Type 316
Hatch Hardware	Stainless Steel	SAE Type 316

- C. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Hatch	Construction	Double Leaf
	Size	See plans
	Design Load	H-20 Loading
	Loading Condition	High Density Traffic (in paved right of way) Density Traffic (outside paved public right-of-way)

ITEM	DESCRIPTION	
	Maximum Deflection under Design Load	Span/150
	Lid Design for Traffic	Lids subjected to any vehicle traffic shall be capable of being bolted down
	Lid Finish	¼" Diamond Pattern Checker Plate
	Channel Frame	¼" frame with anchor flange around perimeter and 1½" drainage coupling on corner where required to prevent ponding.
	Door Operator	Compression or Torsion Assist Spring Required
	Hold-Open Arm	Provide automatic hold open arm with release handle
	Safety Chains	Provide minimum 2 straight link 3/16" diameter 12-link per inch (minimum) safety chains on each door with harness snap on one end to allow chain to be removed. Space chains approximately half door height apart.
	Locking Hardware	Provide recessed padlockable hasp and heavy duty padlock keyed to Owner's requirements
	Factory Finish Aluminum	Mill finish with bituminous coating on aluminum frame exterior
	Factory Finish Stainless Steel	Mill finish
	Factory Finish Steel	Hot dip galvanized
	Intrusion Alarm	Coordinate with instrumentation as required regarding intrusion alarms

- D. Roof hatches for access to appliances on roofs shall comply with California Mechanical Code Section 904.10, and shall in no case be smaller than 22 inches x 24 inches. In the event less than 6 feet of clearance is available between access opening and roof edge, provide rigidly fixed rails or guards at least 42 inches high around opening.
- E. Hatch opening dimensions refer to clear opening space available without obstruction by any portion of the leaves, framing, reinforcement or attached hardware except for spring operators which may occupy no more than a 2"x3" square area in each corner when the hatch doors are fully open. If Manufacturers' standard design does not provide such clear openings, then their standard design shall be modified as required to comply with the Contract Documents at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install roof and floor hatches before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install roof and floor hatches at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements

2. Applicable OSHA and Cal OSHA regulations
 3. Applicable building, fire, plumbing, and electrical code requirements
- D. Refer variances between the above documents and Contract Documents to Owner's Representative.
- E. Install roof and floor hatches to tolerances recommended by Manufacturer. Unless otherwise shown, install roof and floor hatches true and level using precision gauges and levels.
- F. Connect 1-inch stainless steel pipe to drains required on hatch frames to prevent ponding and extend to drain freely. Drain roof hatches to drains or gutters where available or off edge of roof where drains or gutters are not available.

3.3 **Field Quality Control**

- A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Roof and Floor Hatches	No bends, twists or open joints No projecting edges or corners at intersections	Visual inspection	All metalwork	Owner	Owner
	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

**SECTION 09 90 00
PAINTING AND COATING
IN SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT**

PART 1 - GENERAL

1.1 Work Included

- A. Requirements for preparation of surfaces and subsequent application of protective coatings. Furnish all labor, materials and equipment required for satisfactory completion of all Work described herein.
- B. Requirements for waterproofing of buried concrete surfaces are specified in Section 071300.
- C. Requirements for fusion-bonded epoxy systems are specified in Section 09 96 56.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 74 00: Cleaning and Waste Management
- H. Section 07 13 00: Sheet Waterproofing
- I. Section 09 96 56: Fusion-Bonded Epoxy Linings and Coatings

1.3 System Description

- A. Furnish and install complete functional coating system for specified surface in compliance with applicable local air quality management regulations and NSF requirements for use with potable water where applicable. Comply with Manufacturer's application requirements and applicable codes and standards.
- B. The term dry film thickness or DFT shall refer to thickness of fully cured coat of paint measured in mils (1/1000 inch)

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Offsite Surface Preparation and Priming for Prefabricated Steel Structures	Offsite Inspection of Priming Operation	Applicable standards	As directed	Contractor to pay travel expenses for Inspector hired by Owner	Contractor to pay travel expenses and Inspection costs for Inspector hired by Owner

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Paint from Proposed "equals"	Spectrographic and Durability Tests	Applicable ASTM standards	As directed	Contractor	Contractor
Valve, Pump, Hydrant, Meter and Pipeline Appurtenance Interiors	Holidays	Certify as holiday free using low voltage (22.5-80V with approximately 80,000 ohm resistance) holiday detector and a sponge saturated with a 0.5% sodium chloride solution	Each lined item	Contractor	Contractor
	Lining Thickness	Verify thickness with magnetic-type dry film thickness gauge.	Each lined item	Contractor	Contractor

- C. All surface preparation and priming operations accomplished offsite for prefabricated structural members will be monitored 100% by an Owner-appointed quality control inspector at Owner's option. All additional costs incurred by offsite inspection shall be borne by Contractor. These include but are not limited to travel, lodging, food, auto rental (where applicable) and any other expenses directly related to offsite inspection.
- D. Contractor shall provide with his bid a schedule of shop activities including hours of work per day, days of work per week and total hours required for performance of all shop cleaning and priming operations. Contractor shall notify Owner's Representative at least 7 days in advance of shop cleaning and priming operations.
- E. If shopwork is not scheduled on a consecutive basis to facilitate scheduling of an offsite inspector, expenses incurred by multiple trips to shop will be borne by Contractor.
- F. Failure by Owner to exercise option for shop inspection shall in no way relieve Contractor of his duty to meet Contract requirements.

1.5 References

- A. ANSI/NSF 61 Drinking Water System Components – Health Effects
- B. ASTM D16 Terminology Relating to Paint, Varnish, Lacquer and Related Products
- C. ASTM D449 Asphalt Used in Dampproofing and Waterproofing
- D. ASTM D6386 Surface Preparation of Galvanized Surfaces
- E. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- F. California Green Building Standards Code (CALGreen Code)
- G. SSPC PA1 Shop, Field and Maintenance Painting
- H. SSPC PA2 Measurement of Dry Paint Thickness with Magnetic Gauges
- I. SSPC SP1 Solvent Cleaning
- J. SSPC SP2 Hand Tool Cleaning
- K. SSPC SP3 Power Tool Cleaning
- L. SSPC SP5/NACE 1 White Metal Blast Cleaning
- M. SSPC SP6/NACE 3 Commercial Blast Cleaning
- N. SSPC SP7 Brush-off Blast Cleaning
- O. SSPC SP10/NACE 2 Near White Blast Cleaning
- P. SSPC SP11 Power Tool Cleaning to Bare Metal
- Q. SSPC SP13/NACE 6 Surface Preparation of Concrete
- R. SSPC SP15 Commercial-Grade Power Tool Cleaning

SSPC Vis1 Pictorial Surface Preparation Standards for Painting Steel Surfaces
T. SSPWC Standard Specifications for Public Works Construction (Greenbook)

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Submit product data sheets per catalog data requirements.	
Application Instructions	Required for each paint and coating per application instruction requirements. Include <ol style="list-style-type: none"> 1. Surface Preparation Requirements. 2. MSDS sheets identifying flammability, toxicity, allergenic properties and any other characteristics requiring field precautions. 3. Safety practices 4. Minimum and maximum recommended dry-film thicknesses per coat for prime, intermediate, and finish coats. 5. Percent solids by volume. 6. Recommended thinners. 7. Statement verifying selected prime coat is recommended by Manufacturer for use with selected intermediate and finish coats. 8. Recommended application, equipment, humidity, and temperature limitations. 9. Curing requirements and instructions. 	
O & M & Cleaning Instructions	Required per operation and maintenance Instruction requirements.	
Certificate of Compliance	<ol style="list-style-type: none"> 1. Submit certification that all coatings conform to applicable local Air Quality Management District rules and regulations for products and application 2. Submit coating system and application certification that coatings comply with specified requirements and are suitable for intended application per certificate of compliance requirements. 	
Material and Color Samples	Required. Submit current Manufacturer's color samples showing full range of available standard colors. Owner will select colors.	
Applicator's Quality Assurance	Submit list of at least 5 completed projects of similar size and complexity. Include product name and location, name of owner, name of contractor, name of engineer, name of coating Manufacturer, approximate area of coatings applied and date of completion	
Inspection Reports	Submit written third-party report from approved testing agency describing inspections made and actions taken to correct nonconforming work. Report nonconforming work not corrected.	
Warranty	Furnish one-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for catalog data, application instructions, O&M instructions, certificates of compliance, and material samples.

1.7 Delivery, Storage and Handling

A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.

B. Labels on all coating system containers shall clearly show

1. Coating or material name
2. Manufacturer
3. Color name and number
4. Batch or lot number

5. Date of manufacture
 6. Storage life
 7. Mixing and thinning instructions
- C. Deliver materials to Project Site in their original, unopened containers bearing label information shown above.
 - D. All paint and coating materials used on job shall be stored in a single place designated by Owner's Representative.
 - E. Manufacturer's instruction and warranty requirements for delivery, storage and handling of painting and coating systems shall be strictly followed. Store materials in clean dry area within temperature range stipulated by Manufacturer.
 - F. Keep containers sealed until ready for use.
 - G. Do not open or use painting and coating system materials until Owner's Representative has inspected containers and has obtained necessary data from information shown on containers and labels.
 - H. Do not use materials beyond Manufacturer's shelf life limits.
 - I. Do not use mixed materials beyond pot life limits.
 - J. Do not apply new coatings to surfaces beyond Manufacturer's specified recoat limits.
 - K. Protect materials from damage or contamination. Keep containers closed when not in use.
 - L. Delivery, storage and handling of shop-primed steel shall adhere to the following procedures and practices:
 1. Upon completing blasting and priming, primer on steel shall be cured sufficiently to minimize damage during handling.
 2. When transporting structural steel, use spacers and other protection to eliminate scuffing of primer during unloading. If wood spacers are used, no splinters or wood particles shall remain in primed surfaces after separation.
 3. To prevent road salts, fuel residue and other contaminants from being deposited on primed surfaces during transit, shop primed steel shall be covered 100%.
 4. Bind loaded steel with padded chains or ribbon binders to minimize damage to paint and coatings during shipment.
 5. Exercise care to prevent abrasion damage during loading, unloading, storage and erection. Sliding of steel across another plate or member will not be permitted except to fit sheets into position during roof fabrication.
 6. Do not store shop-primed steel on ground or on top of other steelwork unless ground or steelwork is covered with approved covering. Steel may be elevated above ground level or other steel members using approved spacers.

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. All materials shall be those of current manufacture and shall meet all applicable regulations for application and intended service. All materials shall meet all applicable Federal, state and local regulations, including Air Quality Management District Regulations. All coats of any particular coating system shall come from same Manufacturer and shall be approved by Manufacturer for the intended service. Should a product specified herein no longer be manufactured or not meet current regulations, Contractor shall substitute a currently manufactured product of at least equal performance meeting all applicable regulations subject to Owner's Representative's approval, at no additional cost.
- B. Materials specified are those that have been evaluated for the specific service. Listed products establish a standard of quality. Standard products of Manufacturers other than those listed will be accepted when it is proved to satisfaction of Owner's Representative they are equal to or better than specified materials in the following properties:
 - 1. Quality
 - 2. Composition
 - 3. Utility
 - 4. Durability
 - 5. Resistance to abrasion and physical damage
 - 6. Life expectancy
 - 7. Ability to recoat in future
 - 8. Solids content by volume
 - 9. Dry film thickness per coat
 - 10. Compatibility with other coatings
 - 11. Suitability for intended service
 - 12. Resistance to chemical attack
 - 13. Temperature limitations in service and during application
 - 14. Type and quality of recommended undercoats and topcoats
 - 15. Ease and convenience of application
 - 16. Ease and convenience of repairing damaged areas

17. Stability of colors

- C. Paints and coatings used on Work shall comply with VOC limits set forth in Section 5.504.4.3 of CALGreen Code.
- D. Products listed were in general use in 2007. In event changes in air quality, water quality or other regulations render a listed product obsolete, Contractor shall substitute an equivalent product shown in Manufacturer's literature as being formulated and appropriate for surface to be coated.
- E. Factory-applied base coatings to a specific product may differ slightly from those listed below where primers are factory-applied by Manufacturers. Such base-coat substitutions for convenience of Contractor are subject to the following stipulations.
 - 1. Surface preparation shall meet or exceed surface preparations specified below.
 - 2. Primer or base coat shall be that recommended and normally used by Manufacturer for condition and exposure of finished installation.
 - 3. Chemical composition of factory-applied base coats shall be similar to chemical composition specified below.
 - 4. In event a different coating system is recommended by Manufacturer to meet performance specifications of other sections, Manufacturer shall notify Contractor in writing and said notice shall be forwarded to Owner's Representative.
 - 5. Contractor shall verify compatibility of adjacent coats with coating Manufacturers.
 - 6. Total DFT shall equal or exceed DFT specified below.
 - 7. Finish coat shall be as stipulated below.
 - 8. In event of paint system failure, Contractor shall repair paint system in failed area to specifications of this section.
- F. Acceptable Manufacturers include the following for industrial and architectural applications:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Industrial Coating System	3M	St Paul, MN
	Ameron Corrosion Control Division	Brea, CA
	Carboline Co.	St Louis, MO
	ICI Devoe - Sinclair - ICI Dulux Paint Div. Glidden Co.	Cleveland, OH
	E I DuPont de Nemours & Co	Wilmington, DE
	Sherwin-Williams Co.	Cleveland, OH
	Tnemec Co Inc.	Kansas City, KS
	Accepted equal	

Acceptable Manufacturers of architectural coatings for concrete, masonry, structural metalwork for normal exposure, wood, drywall and other architectural finishes include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Architectural Coating System	Ameron Corrosion Control Division	Brea, CA
	Carboline Co.	St Louis, MO
	ICI Devoe - Sinclair - ICI Dulux Paint Div. Glidden Co.	Cleveland, OH
	Dunn Edwards Corp.	Los Angeles, CA
	E I DuPont de Nemours & Co	Wilmington, DE
	Frazee Industries, Inc.	San Diego, CA
	Olympic Paints and Stains	Pittsburgh, PA
	Sherwin-Williams Co.	Cleveland, OH
	Tnemec Co Inc.	Kansas City, KS
	Accepted equal	

H. Acceptable Manufacturers for concrete waterproof interior sealant systems include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Concrete Waterproof Interior Sealant	Raven Lining Systems AquataPoxy	Tulsa, OK
	Sherwin-Williams Co.	Cleveland, OH
	Accepted equal	

I. Substitutions will be considered providing the following minimum conditions are met.

1. Request for substitution shall be approved in writing by addendum before date of bid.
2. Proposed coating system dry film thickness shall equal or exceed specified system thickness.
3. Proposed coating system shall employ an equal or greater number of separate coats.
4. Proposed coating system shall employ coatings or paints of same generic type.
5. Requests for substitution shall include full descriptive literature and required for submittal above including generic coating type, non-volatile content by volume and a list of 10 similar projects, all at least three years old where coatings or paints have been applied to similar exposure.
6. Owner's Representative may also require submittal of laboratory data sheets certified by independent testing laboratory satisfactory to Owner's Representative, showing results of complete spectrographic and durability tests on proposed substitute.
7. Owner's Representative shall be sole and final judge of acceptability of substitutions.

J. In addition to requirements stated elsewhere, acceptable manufacturers shall demonstrate a minimum of ten years domestic experience in manufacture of coating systems similar to those furnished.

K. In addition to requirements stated elsewhere, all painting, coating and coating application accessories shall be products of a single manufacturer.

L. Thinners shall comply with Manufacturer's application instructions.

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Surface preparation, prime coatings, and finish coats for various systems are specified herein. Unless otherwise noted, all intermediate and finish coats shall be of slightly contrasting colors. It is the intent that coating alternates specified herein serve as a general guide for type of coating desired.
- C. Painting and coating materials shall be especially adapted for use around surface to be coated in its expected environment. Primer coats shall be used as recommended by Manufacturer for these conditions and shall be applied at rates and thicknesses recommended by Manufacturer.
- D. Materials schedules below list competing products of two manufacturers to establish a general standard of quality required. Other listed manufacturers shall furnish products of equivalent chemistry, thickness and product life where their products are not itemized.
- E. Colors shall be selected by Owner from color samples submitted by Contractor.

2.3 Materials – Painting and Coating of Valves, Pumps, Hydrants, Flow Meters, Pipelines and Pipeline Appurtenances

- A. Prime valve, pump and hydrant exteriors at place of manufacture. Apply intermediate and finish coats to valves in field. Finish coat shall match color of adjacent piping. Coat hand-wheels and floor stands same as valves. Coat exterior of hydrants and buried metal valves at place of manufacture.
- B. Coating systems for non-buried valve, hydrant, flow meter, pipeline and pipeline appurtenance exteriors shall meet the following requirements:

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION	ALTERNATE SPECIFICATION
Valve, Pump, Hydrant, Flow Meter or Pipeline Appurtenance Exterior Coating	Epoxy Urethane	AWWA D102 OCS-6 Total DFT 6-9 mils (If zinc is used for primer, a reduction of 1.5 mils is allowed in total coat thickness)		
Surface Preparation		SSPC-SP6/NACE 3 Commercial blast cleaning		
Base Coat (Apply at Place of Manufacture)	Zinc Primer or Polyamidomine Epoxy	Tnemec series 94-97 TnemeZinc DFT 2.0-3.0 mils Or Tnemec Series L69 Epoxoline DFT 2.0-3.0 mils,	Bar Rust 231V DFT 2.0-3.0 mils	Sherwin Williams Macropoxy 646-100 DFT 2.0-3.0 mils
Intermediate Coat	Polyamidomine Epoxy	Tnemec Series L69 Epoxoline DFT 2.0-3.0 mils,	Bar Rust 231V or Devran 224HS DFT 2.0-3.0 mils	Sherwin Williams Macropoxy 646-100 DFT 2.0-3.0 mils
Finish Coat	Aliphatic or Acrylic Urethane	Tnemec Series 1080 Endura-Shield Series 1080 DFT 2.0-3.0 mils	Devthane 378H Semi Gloss or 379H Gloss DFT 2.0-3.0 mils	Sherwin Williams Hi-Solids Polyurethane 100 (Semigloss or Gloss) DFT 2.0-3.0 mils

- C. Coating systems for buried valve, hydrant, flow meter, pipeline and pipeline appurtenance exteriors shall meet requirements for buried metal specified elsewhere in this section.

- D. Apply interior lining of valves and hydrants 3-inches and larger as follows: Coat interior metal surfaces excluding seating areas and bronze and stainless-steel pieces. Remove all protuberances which may produce pinholes in lining. Round all sharp edges to be coated. Remove any contaminants which may prevent bonding of lining.
- E. Apply interior lining of valves and hydrants 3-inches and larger per AWWA C550 and Section 09 96 56.
- F. Where valves and hydrants 3-inches and larger are specified to receive fusion-bonded epoxy lining, a similar fusion-bonded epoxy coating of thickness specified above may be substituted for liquid epoxy system above provided lining is factory-tested and certified in accordance with Section 09 96 56.

2.4 Metal, Interior and Exterior, Normal Exposure

- A. Paint all exposed steelwork, non-galvanized handrails, exposed pipework, fittings, all mechanical equipment, pumps, motors, doors, door frames and window sash with this coating system.
- B. All metalwork previously given shop prime coat accepted by Owner's Representative shall be touched up as required in field with Tnemec Series 4 Versare Primer or equal.
- C. Coating systems for normally exposed metal shall meet the following requirements:

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION	ALTERNATE SPECIFICATION
Coating for Normal-Exposure Steel	Epoxy Urethane	Total DFT 10-15 mils		
Surface Preparation		SSPC-SP6/NACE 3 Commercial blast cleaning (Where blast cleaning is not possible, provide SSPC SP-15 Commercial-Grade Power Tool cleaning.)		
Base Coat	Rust-inhibitive Polyamide Epoxy	Tnemec Series L69 Epoxy DFT 5.0-6.0 mils,	ICI Devoe Bar-Rust 233V DFT 5.0-6.0 mils	Sherwin Williams Macropoxy 646-100 DFT 5.0-6.0 mils
Intermediate Coat	Polyamide Epoxy	Tnemec Series L69 Epoxy DFT 5.0-6.0 mils,	ICI Devoe Bar-Rust 233V DFT 5.0-6.0 mils	Sherwin Williams Macropoxy 646-100 DFT 5.0-6.0 mils
Finish Coat	Aliphatic Urethane	Tnemec Series 1080 Endura-Shield DFT 2.0-3.0 mils,	Devthane 378H Semi Gloss or 379H Gloss DFT 2.0-3.0 mils	Sherwin Williams Hi-Solids Polyurethane 100 (Semigloss or Gloss) DFT 2.0-3.0 mils

2.5 Metal, Galvanized, Aluminum, Copper, or Brass

- A. Copper, bronze, chromium plate, nickel, stainless steel, aluminum, and factory-finished materials and surfaces shall not be painted except as otherwise specified.
- B. Any nameplates painted over shall be replaced in kind.
- C. Galvanized finish will not be considered a factory finish.

Coat all galvanized metal, aluminum, copper or brass with this coating system where coating is required.

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION	ALTERNATE SPECIFICATION
Coating for Galvanized Metal, Aluminum, Copper or Brass	Epoxy Urethane	Total DFT 4.5-6.5 mils	Total DFT 7-10 mils	Total DFT 4.7-7.3 mils
Surface Preparation		SSPC-SP1 Solvent Cleaning followed by SSPC-SP2 Hand Tool Cleaning Prepare in accordance with ASTM D6386		
Base Coat	Polyamidomine Epoxy or Etch	Thoroughly scarify surface to be coated per Tnemec Technical Memo #98-09 R2 in accordance with ASTM D6386	DevPrep 88 ICI Devoe Bar-Rust 231V or 233V in cold weather DFT 3.0-4.0 mils	Sherwin Williams DTM Wash Primer DFT 0.7-1.3 mils
Intermediate Coat	Polyamidomine Epoxy	Tnemec Series L69 Epoxy DFT 2.0-3.0 mils,	Devran 231V DFT 2.0-3.0 mils	Sherwin Williams Macropoxy 646-100 DFT 2.0-3.0 mils
Finish Coat	Aliphatic or Acrylic Urethane	Tnemec Series 1080 Endura-Shield DFT 2.0-3.0 mils,	Devthane 378H Semi Gloss or 379H Gloss DFT 2.0-3.0 mils	Sherwin Williams Hi-Solids Polyurethane 100 Gloss DFT 2.0-3.0 mils

2.6 Metal, Buried

- A. Coat all buried metal which includes valves, hydrant buries, bolts, nuts, structural steel and fittings with this system.

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION	ALTERNATE SPECIFICATION
Coating for Buried Metal	Polyamidomine Epoxy or Coal Tar Epoxy	Total DFT 12-18 mils	Total DFT 24 mils	Total DFT 16-20 mils
Surface Preparation		SSPC-SP6/NACE 3 Commercial blast cleaning		
Base Coat	Polyamidomine Epoxy or Coal Tar Epoxy	Tnemec Series L69 Epoxy DFT 4.0-6.0 mils	Carboline Bitumastic No. 50 DFT 12 mils	Sherwin Williams Targuard 100 DFT 8.0-10.0 mils
Intermediate Coat	Polyamidomine Epoxy or Coal Tar Epoxy	Tnemec Series L69 Epoxy DFT 4.0-6.0 mils	None	None
Finish Coat	Polyamidomine Epoxy or Coal Tar Epoxy	Tnemec Series L69 Epoxy DFT 4.0-6.0 mils	Carboline Bitumastic No. 50 DFT 12 mils	Sherwin Williams Targuard 100 DFT 8.0-10.0 mils

2.7 Concrete Floors and Walls

- A. Where Contract Documents require concrete surfaces to be painted, paint concrete surfaces with this system.

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION	ALTERNATE SPECIFICATION
Coating for Concrete Floors and Walls	Epoxy		Total DFT 10-12 mils	
Surface Preparation		SSPC SP13/NACE 6 Concrete Surface Preparation Repair concrete where required with Tnemec Series 63-1500 Epoxy Filler/Surfacer or similar product of finish paint manufacturer		

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION	ALTERNATE SPECIFICATION
First Coat (Walls)	Polyamine Epoxy	Tnemec Series 201 Tnemeglaze DFT 5.0-6.0 mils	Devran 224 HS thinned 10% T-10 DFT 5.0-6.0 mils	
First Coat (Floors)	Polyamine Epoxy or Polyamine Novolac Epoxy	Tnemec Series 282 Epoxy with aluminum oxide broadcast into coating to provide non- skid surface DFT 5.0-6.0 mils	Devran 224 HS with aluminum oxide broadcast into coating to provide non-skid surface DFT 5.0-6.0 mils	
Finish Coat	Polyamine Epoxy or Polyamine Novolac Epoxy	Tnemec Series 282 Epoxy DFT 5.0-6.0 mils	Devran 224 HS DFT 5.0-6.0 mils	

2.8 Concrete Floors and Walls – Waterproof Sealant

- A. Where Contract Documents require interior concrete surfaces to be sealed, seal interior concrete surfaces with this system.

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION	ALTERNATE SPECIFICATION
Sealant for Concrete Floors and Walls	Epoxy	ANSI/NSF 61 certified for any use with potable water. Total DFT 10-12 mils		
Surface Preparation		SSPC SP13/NACE 6 Concrete Surface Preparation		
Filler		Fill voids, holes, and pits with Manufacturer-approved filler	Fill voids, holes, and pits with Sherwin Williams Steel Seam FT910	
First Coat	Epoxy		Sherwin Williams Macropoxy 646-100 DFT 5.0-6.0 mils	
Finish Coat	Epoxy	Raven Lining Systems Aquatapoxy DFT 10.0-12.0 mils	Sherwin Williams Macropoxy 646-100 DFT 5.0-6.0 mils	

2.9 Traffic Striping, Pavement Marking, and Curb Marking

- A. Where Contract Documents require marking or striping of pavement, paint asphalt-concrete pavement and Portland cement concrete pavement with this system.

ITEM	MATERIAL	SPECIFICATION
Traffic Line Paint in Arterial Streets	Thermoplastic paint	Total DFT 125 to 188 mils SSPWC Section 210-1.6.2
Traffic Line Paint in Local Streets and Parking Lot Stripes and Markings	Rapid dry paint	SSPWC Section 210-1.6.3 Total WFT per SSPWC Tables 310-5.6.5 (A) and (B)

PART 3 - EXECUTION

3.1 Preparation

- A. Preapplication meeting shall be held one to two weeks before start of coating system application for products covering more than 100 square feet. Meeting shall be attended by Contractor, applicator, Manufacturer's representative and Owner's Representative and shall cover the following topics:

1. Environmental requirements set by Manufacturer for his product
 2. Protection of surfaces not scheduled to be coated
 3. Stormwater pollution prevention requirements
 4. Surface preparation
 5. Application
 6. Disinfection
 7. Repair
 8. Field quality control
 9. Cleaning
 10. Protection of coating systems
 11. Eleven-month inspection
 12. Coordination with other work
- B. Notify Owner's Representative at least 3 days before start of any field surface preparation work.
- C. All surfaces to be coated or painted shall be in proper condition to receive material specified before any coating or painting is done.
- D. Sandblasting shall be done as follows:
1. No more sandblasting or surface preparation than can be coated or painted in a normal working day will be permitted. All sharp edges, burrs, and weld spatter shall be removed. All concrete and masonry surfaces shall cure 30 days prior to coating or painting.
 2. Sandblasting shall be done not more than 8 hours ahead of painting, subject to humidity and weather conditions between time of sandblasting and painting operations. If any rusting or discoloration of sandblasted surfaces occurs before painting, remove such rusting or discoloration by additional sandblasting. Sandblasted surfaces shall not be left overnight before painting.
 3. Protect surrounding areas and surfaces not scheduled to be blasted and/or coated from damage or coloration during surface preparation and coating application. Place drop cloths or apply masking tape where required to prevent spatter, dripping and overspray from contact with floors, surfaces and equipment not scheduled to receive paint or coatings. Take all necessary precautions to protect all adjacent Work and surrounding property and improvements from damage due to painting and coating procedures.
 4. Abrasive blasting nozzles shall be equipped with "deadman" emergency shutoff nozzles. Blast nozzle pressure shall be at least 95 psi and shall be verified using an approved nozzle pressure gauge at each start-up period or as directed by Owner's Representative. Nozzles used during all blast cleaning operations shall be sufficient to ensure timely completion of work on schedule.

5. Field blast cleaning for all surfaces shall be by dry method unless otherwise stated. Contractor shall maintain dust emissions within legal levels and that level which will not create a nuisance.
 6. Particle size of abrasives used in blast cleaning shall produce a 2.0 mil (0.002 inch) surface profile or in accordance with recommendations of Manufacturer of specific paint or coating system to be applied, subject to approval by Owner's Representative.
 7. Abrasives used in blast cleaning shall be new, washed, graded and free of contaminants which would interfere with adhesion of coatings and paints. Do not reuse abrasive unless specifically approved by Owner's Representative.
 8. Blast cleaning from rolling scaffolds shall only be done within confines of interior perimeter of scaffold. Reaching beyond limits of perimeter will be allowed only if blast nozzle is maintained in a position which will produce a profile acceptable to Owner's Representative.
 9. Keep work areas in clean condition. Do not allow blasting materials to accumulate as to constitute a nuisance or hazard to prosecution of Work or operation of existing facilities. Remove spent abrasives and other debris at Contractor's expense. If waste is determined to be hazardous, dispose of waste as required by law.
 10. Blast cleaned and coated/painted surfaces shall be cleaned prior to application of specified paint or coating systems by a combination of blowing with clean dry air, brushing/brooming and/or vacuuming as directed by Owner's Representative. Air hose for blowing shall be at least ½ inch in diameter and shall be equipped with a shut-off device.
 11. Hydroblasting (water blast cleaning) shall be used only when and as directed by Owner's Representative, who will determine pressure to best remove loose, peeling/flaking paint or coating or other detrimental surface contaminants.
 12. Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours. Any cleaned areas not receiving first coat within an eight-hour period shall be recleaned prior to application of first coat.
- E. Prepare steel surfaces in accordance with applicable Manufacturer's instructions and SSPC standards.
- F. Ensure surfaces to receive coatings are dry and free from visible oil, grease, dirt, dust, mill scale, rust, paint oxides, corrosion products and other foreign matter in accordance with specified SSPC standards.
- G. Before application, examine areas and conditions under which coating systems are to be applied. Notify Owner's Representative of areas or conditions which are not acceptable to receive coatings. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.
- H. Arrange with Owner's Representative so that all surface preparation may be inspected and approved prior to application of any coatings.
- I. Surface preparation inspection for metals shall be based on comparison with SSPC-Vis1 "Surface Preparation Standards for Painting Steel Surfaces"

- J. Neutralize all welds with a suitable chemical compatible with specified paint or coating system.
- K. Using a brush, stripe paint critical locations such as welds, corners, edges, roof lap seams, nuts, bolts, ends, rafter flanges and other areas identified by Owner's Representative using specified primer.
- L. Only good, clean brushes and equipment shall be used and all brushes, buckets, and spraying equipment shall be cleaned immediately at end of each painting period.
- M. Where surfaces are joined so closely that proper surface preparation and paint application is not possible, prepare and paint such surfaces prior to assembly or installation.

3.2 Application

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install paint and coating systems at locations shown on Plans and Submittals.
- C. Unless otherwise specified, all ferrous surfaces except for stainless steel or galvanized iron or steel surfaces shall be painted or coated, including top surfaces of steel roof support framing and underside of steel roof plates bearing on roof supports.
- D. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing, mechanical and electrical code requirements
 - 4. SSPC-PA1 "Shop, Field and Maintenance Painting"
- E. Refer variances between above documents and Contract Documents to Owner's Representative.
- F. Mixing shall be done thoroughly using a slow-speed power mixer until all components are thoroughly combined and are of smooth consistency. Use exact proportions specified by Manufacturer. Exercise care to ensure all material is removed from containers during mixing and metering.
- G. Thinning shall only be permitted within limits set by applicable regulatory agencies and as permitted by Manufacturer and approved by Owner's Representative. All thinning shall be done in presence of Owner's Representative.
- H. Use application equipment, tools, pressure settings and techniques in accordance with Manufacturer's application instructions.
- I. Contractor's painting and coating equipment shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from air. Blotter test shall be accomplished at each start-up period and as deemed necessary by Owner's Representative.

Do not apply coatings when environmental conditions are not appropriate or which jeopardize appearance or quality of coating in any way. This includes but is not limited to the following unsatisfactory environmental conditions.

1. When air temperature is below 50°F or above 125°F or is outside limits recommended by Manufacturer for satisfactory application.
 2. When it is expected that air temperature will drop below 40°F or above 125°F within 8 hours after application of coating.
 3. When surface temperature is not at least 5°F (3°C) above dew point or is outside limits recommended by Manufacturer for satisfactory application.
 4. When relative humidity is outside limits recommended by Manufacturer for satisfactory application.
 5. During precipitation including rain, sleet, snow, fog or mist.
 6. When wind velocity is outside limits recommended by Manufacturer for satisfactory application.
 7. In dust or smoke-laden atmospheres.
- K. When above conditions are prevalent, postpone paint or coating application until conditions are favorable. The day's paint or coating application shall be completed in time to permit film sufficient drying and curing time before damage by atmospheric conditions.
- L. Uniformly apply coatings at spreading rate required to achieve specified DFT. Application shall be by airless spray method, except brush and roller application may be required for exterior surfaces if environmental and neighborhood conditions preclude spray application.
- M. Spraying shall be done by cross-lap method of spraying, stroking first in one direction and shortly later, spraying across this section at right angles to first set of passes. Exercise care during spraying to hold nozzle perpendicular and sufficiently close to receiving surface to avoid excessive evaporation of volatile components or loss of material to air or bridging of cracks and crevices.
- N. Drying time between coats stated in Manufacturer's instructions between coats shall be strictly observed.
- O. Apply coatings to be free of film characteristics such as runs or blisters that would adversely affect performance or appearance of coating systems.
- P. Brush coats shall be properly brushed out so as to show minimum of brush marks. When finished and dried, brush strokes shall appear in one direction only and there shall be no curved brush strokes showing.
- Q. Immediately remove spills, oversprays and all coatings that fall on surrounding areas and surfaces not scheduled to receive specified coating.
- R. After completing each coat application, request inspection by Owner's Representative before applying next coat. Work performed in absence of prescribed inspection by Owner's Representative may be required to be removed and replaced with proper inspection and entire cost of removal and replacement, including cost of materials which may be furnished by Owner and used in removed Work shall be borne by Contractor regardless of whether Work removed is found to be defective or not. Work covered up without authority of Owner's

Representative shall upon order of Owner's Representative be uncovered to extent required, and Contractor shall similarly bear entire cost of performing all Work and furnishing all materials necessary for removal of covering and its subsequent replacement as directed and approved by Owner's Representative.

- S. Pinholes and holidays detected during testing shall be marked, repaired in accordance with Manufacturer's printed instructions and retested. No pinholes or other irregularities will be permitted in final coating.
- T. Protect finished surfaces between coats. For subsequent coats, remove dust, dirt, oil, grease and any foreign matter which will affect adhesion or durability of finish by washing with clean rags dipped in a commercial cleaning solvent approved by paint and coating system Manufacturer. Surface shall then be rinsed with clean water and wiped dry with clean rags.
- U. Coats that do not hide undercoat shall be given another coat.
- V. Coats shall be thoroughly dry and cured according to Manufacturer's recommendations before next coat is applied.
- W. Upon completion, remove masking and other temporary coverings and protection of surrounding areas and surfaces.
- X. Additional special provisions for coating systems are as follows:
 - 1. Schedule coating work to avoid excessive dust and airborne contaminants. Protect work from dust and airborne contaminants during coating application and curing.
 - 2. Work is subject to intermittent shutdown if, in opinion of Owner's Representative, cleaning, coating and painting operations are creating a localized condition detrimental to ongoing facility activities, personnel or adjacent property. In event of emergency shutdown by Owner's Representative, Contractor shall immediately correct deficiencies. All additional costs created by shutdown shall be borne by Contractor.
- Y. Following application and testing, protect surfaces of coating systems from damage during construction.

3.3 Field Quality Control

- A. Contractor shall hold a current C-33 Painting and Decorating Contractor's license and have at least five years practical experience and successful history in applying specified products to surfaces of steel standpipes, reservoirs, vessels and elevated tanks for water storage. Upon request, he shall substantiate this requirement by furnishing a list of references.
- B. Employees working on project shall be skilled craftsmen, trained for application of specified coatings and qualified to perform required Work. Work shall be done in a manner comparable with best standards of practice found in that trade. Apply materials evenly so as to be free from sags, runs, crawls, brush marks, wrinkles, skips, holidays or other application defects, blemishes or evidence of poor workmanship. All coats shall be of proper consistency. Cut lines shall be sharply cut to lines.
- C. Before beginning work, prepare 10-foot by 10-foot mockup for each coating system using same materials, tools, equipment and procedures for actual surface preparation and application. Obtain Owner's Representative's approval of mockups. Retain mockups on site to establish standards by which finished coating systems shall be compared.

- D. Repair or replace damaged or colored materials and surfaces not scheduled to be coated.
- E. Touch up or repair damaged coatings shall be acceptable if result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture or color.
- F. Repair in accordance with Manufacturer's instructions coatings that exhibit film characteristics or defects that might adversely affect performance or appearance of coating systems.
- G. Manufacturer's representative shall provide technical assistance and guidance as needed for proper surface preparation and coating system application.
- H. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Mock-up	Compliance with Specifications	Described above	1 each coating system covering more than 1000 sf	Owner	Owner
Surface Preparation	Visual Inspection	SSPC Vis 1, ASTM D2200, NACE Std TM01-70	As directed	Owner	Owner
	Contaminants	Chemical or ultraviolet tests	Owner's option	Owner	Contractor
	Anchor Profile	2 mils or Manufacturer's requirement to be verified by nondestructive instrument such as Keane-Tator Surface Profile Comparator or Testex Press-O Film System	As directed	Owner	Contractor
	Wood Moisture	Moisture content shall be tested using an electronic moisture meter and shall not exceed 15%.	As directed	Contractor	Contractor
Compressor	Verify absence of water and oil	Blotter test	1 each startup	Contractor	Contractor
Atmospheric Conditions	Dewpoint	Sling Psychrometer and US Dept of Commerce Weather Bureau Psychrometric Tables	As directed	Contractor	Contractor
Each Coating System	Compliance with Mockup	Comparison with mockup Contractor to submit written report from approved testing agency on reinspection	Owner's option	Owner	Contractor
Each Coat	Holidays	Nondestructive holiday tester such as Tinker-Razor Model AP or AP-W Contractor to submit written report from approved testing agency on reinspection	Owner's option	Owner	Contractor
	Dry-Film Thickness	SSPC-PA2 Nondestructive magnetic-type thickness gauge such as "Inspector" or "Positest" or when destructive testing is ordered, instrument such as Tooke Gage Contractor to submit written report from approved testing agency on reinspection	Owner's option	Owner	Contractor
	Film Characteristics and Defects	Visual inspection. Contractor to submit written report from approved testing agency on reinspection	As directed	Owner	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Finished Coating System	11-Month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturers printed literature as described below. Repair identified deficiencies.	1 inspection attended by Owner, Contractor, Owner's Representative and Manufacturer's representative	Owner	Contractor

- I. Contractor shall furnish inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of paints and coatings. Contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of thickness gauges. Dry film thickness gauges and holiday detectors shall be available at all times until final acceptance of application. Inspection devices shall be operated by, or in presence of Owner's Representative with location and frequency basis determined by Owner's Representative. Owner's Representative is not precluded from furnish his own inspection devices and rendering his opinion based solely on their tests.
- J. Owner's Representative shall have right to reject all unsatisfactory material or work and to replace it at Contractor's expense if any deficiency is found in quality of installed coating.
- K. Upon completion of work, remove all staging, scaffolding and containers from project site. Clean site to satisfaction of Owner's Representative.
- L. Warranty Inspection shall be conducted during eleventh month following completion of all coating and painting work. Repair all defective work in strict accordance with Contract Documents and to satisfaction of Owner's Representative.
 - 1. Owner will establish inspection date and will notify Contractor at least 30 days in advance. Owner will uncover or otherwise expose surfaces to be inspected. Contractor shall provide at his expense suitable lighting and ventilation for inspection. Contractor shall provide all other necessary inspection equipment to Owner's satisfaction.
 - 2. Entire interior coating system shall be visually inspected. All defective coatings as well as damaged or rusting spots shall be satisfactorily repaired by and at sole expense of Contractor. All repaired areas shall then be tested as specified herein and repair/testing procedure repeated until surface meets specified requirements.
 - 3. Entire exterior paint system shall be visually inspected. All defective, damaged or rusting areas shall be satisfactorily repaired by and at sole expense of Contractor.
 - 4. Warranty Inspection Report will be prepared by Owner's Representative and delivered to Contractor. It will set forth number and type of failures observed, percentage of surface area where failure has occurred, and names of persons making inspection.
 - 5. Repairs shall proceed promptly. Upon completion of inspection and receipt of Inspection Report, Owner will establish a date for Contractor to proceed with remedial Work. Delay on part of Contractor to proceed with remedial work on schedule shall constitute breach of this Contract. In such case, Owner may proceed to have defects remedied as outlined in Contract Documents.



6. Remedial Work shall occur at any location where paint or coating has peeled, bubbled, or cracked and at any location where rusting is evident. All such locations shall be considered failures. Contractor shall make repairs at all points where failures are observed by removing deteriorated coating or paint, cleaning surface and repainting or recoating with same system. If area of failure exceeds 25% of a specific coated or painted surface, entire paint or coating system shall, at Owner's option, be removed and recoated or repainted in accordance with original Contract Documents.
7. Costs of warranty inspection and repair shall be borne by Contractor, who shall include an appropriate amount for testing and repair in his bid. No additional allowance will be paid by Owner for Warranty Inspection and repairs.

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SECTION 09 96 56 EPOXY LININGS AND COATINGS

PART 1 - GENERAL

1.1 Work Included

- A. Requirements for surface preparation, application and testing of fusion-bonded epoxy lining and coating systems for ferrous surfaces of valves, hydrants, flow meters, pumps, pipelines, column pipe, or pipeline appurtenances.
- B. Do not apply fusion-bonded epoxy systems to aluminum, brass, bronze, copper, plastic, rubber, or stainless steel surfaces.
- C. Where Owner deems fusion-bonded epoxy coatings to be impractical, liquid epoxy lining systems may be substituted as described herein.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution

1.3 System Description

- A. Furnish and install complete functional coating system for specified surface in compliance with applicable local air quality management regulations and NSF requirements for use with potable water where applicable. Comply with Manufacturer's application requirements and applicable codes and standards.
- B. The term dry film thickness or DFT shall refer to the thickness of a fully cured coat of paint measured in mils (1/1000 inch)

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Cured lining or coating shall be smooth and glossy with no graininess or roughness. Lining or coating shall have no blisters, cracks, bubbles, under-film voids, mechanical damage, discontinuities or holidays.

Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Valve, Flow Meter, Pump, Pipe, Column Pipe, Fitting, or Pipeline Appurtenance Interior Lining or Coating	Visual Inspection	Pipe or items will be rejected due to any of the following: a. Any sizeable protrusion in lining obviously caused by lining over foreign material. b. Any defect indicating double flow or fold in the lining. c. Any chuck marks or gouges extending to bare metal. d. Any bubble or area which appears to be unbonded to underlying metal surface	Each lined pipe spool or item	Contractor	Contractor
	Holidays	AWWA C213 Section 5.3.3 If less than one holiday per 10 square feet of pipe surface is found, repair per coating Manufacturer's recommendation and retest. If more holidays are found, sandblast, recoat and retest entire pipe spool. Also check weld seam centerlines to verify no porous blisters, craters or pimples lie along peak of weld crown.	Each lined pipe spool or item 16 inches or larger	Contractor	Contractor
		AWWA C213 Section 5.3.3. If number of holidays or pinholes for items 12 inches and smaller is 5 or less per item, repair per coating Manufacturer's recommendation and retest. If more holidays are found, sandblast, recoat and retest entire item.	Each lined valve, hydrant meter, fitting or pipeline appurtenance	Contractor	Contractor
	Lining Thickness	Verify thickness with magnetic-type dry film thickness gauge. Average shall exceed minimum thickness, No individual thickness value shall be more than 2 mils below or 3 mils above specified minimum thickness. Items not meeting these criteria shall be sandblasted, recoated and retested.	Each lined pipe valve or hydrant at three locations per item	Contractor	Contractor

1.5 References

- A. ANSI/NSF 61 Drinking Water System Components – Health Effects
- B. ASTM D1002 Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
- C. ASTM D1044 Resistance of Transparent Plastics to Surface Abrasion
- D. ASTM D2370 Tensile Properties of Organic Coatings
- E. ASTM D2583 Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
- F. ASTM G17 Penetration Resistance of Pipeline Coatings
- G. AWWA C210 Liquid Epoxy Coating Systems for Interior and Exterior of Steel Water Pipelines

AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

- I. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- J. AWWA C620 Spray-Applied In-Place Epoxy Lining of Water Pipelines 3-inch and Larger
- K. California Green Building Standards Code (CALGreen Code)
- L. MSS SP98 Protective Coatings for the Interior of Valves, Hydrants, and Fittings
- M. SSPC PA1 Shop, Field and Maintenance Painting
- N. SSPC PA2 Measurement of Dry Paint Thickness with Magnetic Gauges
- O. SSPC SP5/NACE 1 White Metal Blast Cleaning
- P. SSPC SP10/NACE 2 Near White Blast Cleaning
- Q. SSPC Vis1 Pictorial Surface Preparation Standards for Painting Steel Surfaces

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Submit product data sheets per catalog data requirements.	
Application Instructions	Required for each paint and coating per application instruction requirements. Include <ol style="list-style-type: none"> 1. Surface Preparation Requirements. 2. MSDS sheets identifying flammability, toxicity, allergenic properties and any other characteristics requiring field precautions. 3. Minimum and maximum recommended dry-film thicknesses per coat for prime, intermediate, and finish coats. 4. Percent solids by volume. 5. Statement verifying selected prime coat is recommended by Manufacturer for use with selected intermediate and finish coats. 6. Application and curing requirements and instructions. 	
Certificate of Compliance	<ol style="list-style-type: none"> 1. For work done in California, submit certification that all coatings conform to applicable local Air Quality Management District rules and regulations for products and application 2. Submit coating system and application certification that coatings comply with specified requirements and are suitable for intended application per certificate of compliance requirements. 3. Submit description of repair procedures used if any. 	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for catalog data, application instructions, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. All materials shall be those of current manufacture and shall meet all applicable regulations for the application and intended service. All materials shall meet all applicable Federal, state and local regulations, including Air Quality Management District Regulations. All coats

of any particular coating system shall be of the same Manufacturer and shall be approved by Manufacturer for the intended service. In the event a product specified herein is no longer manufactured or does not meet current regulations, Contractor shall provide a substitute, currently manufactured product of at least equal performance which meets all applicable regulations subject to Owner's Representative's approval, at no additional cost.

- B. Linings and coatings used on Work shall comply with VOC limits set forth in Section 5.504.4.3 of the CALGreen Code.
- C. Factory-applied base coatings to a specific product may differ slightly from those listed below where primers are factory-applied by Manufacturers. Such base-coat substitutions for the convenience of Contractor are subject to the following stipulations.
 1. Surface preparation shall meet or exceed surface preparations specified below.
 2. Primer or base coat shall be that recommended and normally used by Manufacturer for the condition and exposure of the finished installation.
 3. Chemical composition of factory-applied base coats shall be similar to the chemical composition specified below.
 4. In the event a different coating system is recommended by Manufacturer to meet performance specifications of other sections, Manufacturer shall notify Contractor in writing and said notice shall be forwarded to Owner's Representative.
 5. Contractor shall verify compatibility of adjacent coats with coating Manufacturers.
 6. The total DFT shall equal or exceed DFT specified below.
 7. The finish coat shall be as stipulated below.
 8. In event of a paint system failure, Contractor shall repair the paint system in the failed area to the specifications of this section.

D. Acceptable Manufacturers for NSF-61 approved fusion-bonded epoxy include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
NSF-Approved Fusion-Bonded Epoxy Linings and Coatings	3M Scotchkote 6233	Saint Paul, MN
	Northtown Keysite 740	Huntington Beach, CA
	Accepted equal	

E. Acceptable Manufacturers for NSF-61 approved liquid epoxy where permitted include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
NSF-Approved Liquid Epoxy Linings and Coatings	3M Scotchkote 323	Saint Paul, MN
	ICI Devoe - Sinclair - ICI Dulux Paint Div. Glidden Co. Bar Rust 233 series	Cleveland, OH
	Tnemec Pota-Pox L140	Kansas City, KS
	Accepted equal	

2.2 Materials - General

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Interior lining of valves and hydrants 3-inches and larger for use with potable or reclaimed water shall meet the requirements of AWWA C550.

Fusion-bonded epoxy lining systems for valve, hydrant, flow meter, pipeline or pipeline appurtenance interiors shall meet the following requirements.

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION*
Valve, Flow Meter, Pump, Pipe, Column Pipe, Fitting, or Pipeline Appurtenance Interior Lining or Coating	Fusion-Bonded Epoxy	AWWA C213 ANSI/NSF 61 certified for any use with potable water. 100% solids powdered thermosetting epoxy per AWWA C550 Hardness per ASTM D2583: Barcol 17 Hardness on "M" Scale: Rockwell 50 Abrasion Resistance per ASTM D1044 with Tabor CS17 wheel 1000-gram wheel, 1000 cycles: 0.05 gram removed / 5000 cycles 0.115 gram removed Adhesion 3,000 psi (Elcometer) Tensile Strength per ASTM D2370: 7300 psi Penetration per ASTM G17: 0 mil Adhesion Overlap Shear, 1/8-inch steel panel, 0.010 glue line per ASTM D1002: 4300 psi Impact (100 in-lb minimum (Gardner 5/8" diameter tip) Total DFT 12.0 mils Total DFT 5.0-16.0 mils on ring grooves and flange faces	
Surface Preparation		SSPC-SP5/NACE 1 White metal blast cleaning	
Base Coat (Apply at Place of Manufacture)	Polyamide Epoxy	3M Company Epoxy Primer DFT 5.0-6.0 mils,	
Finish Coat (Apply at Place of Manufacture)	Polyamide Epoxy	Scotchkote 134 or 206N	Lilly "Pipe Clad" 1500 Red

D. Liquid epoxy lining systems for valve, hydrant, flow meter, pipeline or pipeline appurtenance interiors shall be used only when Owner deems fusion-bonded epoxy coating to be impractical. Liquid epoxy lining systems for valve, hydrant and appurtenance interiors shall meet the following requirements.

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION	ALTERNATE SPECIFICATION
Valve, Flow Meter, Pump, Pipe, Column Pipe, Fitting, or Pipeline Appurtenance Interior Lining or Coating	Epoxy	ANSI/NSF 61 certified for any use with potable water. Total DFT 12.0 mils		
Surface Preparation		SSPC-SP5/NACE 1 White metal blast cleaning		
Base Coat (Apply at Place of Manufacture)	Polyamide Epoxy	Tnemec Pota-Pox L140 (For nonpotable water use Tnemec Series L69) DFT 4.0-5.0 mils,	3M Company Epoxy Primer DFT 4.0-5.0 mils,	ICI Devco Bar-Rust 233V DFT 5.0-6.0 mils
Intermediate Coat (Apply at Place of Manufacture)	Polyamide Epoxy	Tnemec Pota-Pox L140 (For nonpotable water use Tnemec Series L69) DFT 4.0-5.0 mils,	3M Scotchkote 312 or 314 DFT 4.0-5.0 mils,	ICI Devco Bar-Rust 233V DFT 4.0-5.0 mils,
Finish Coat (Apply at Place of Manufacture)	Polyamide Epoxy	Tnemec Pota-Pox L140 (For nonpotable water use Tnemec Series L69) DFT 4.0-5.0 mils,	3M Scotchkote 312 or 314 DFT 4.0-5.0 mils,	ICI Devco Bar-Rust 233V DFT 4.0-5.0 mils,

*Powdered thermosetting epoxy or two coats of polyamide epoxy may be substituted.

- E. All epoxy lining shall meet current Volatile Organic Compound (VOC) content regulations. Epoxy lining for potable water valves and hydrants shall also be listed by National Sanitation Foundation (NSF) for contact with potable water and shall contain no perchloroethylene, lead, chromium or zinc.
- F. Powdered thermosetting epoxy coating systems for steel architectural surfaces shall meet the following requirements.

ITEM	MATERIAL	SPECIFICATION	ALTERNATE SPECIFICATION*
Architectural Exterior Powder-Epoxy Coating	Powdered Thermosetting Epoxy	ANSI/NSF 61 certified for any use with potable water. 100% solids powdered thermosetting epoxy per AWWA C550 Hardness per ASTM D2583: Barcol 17 Hardness on "M" Scale: Rockwell 50 Abrasion Resistance per ASTM D1044 with Tabor CS17 wheel 1000-gram wheel, 1000 cycles: 0.05 gram removed / 5000 cycles 0.115 gram removed Adhesion 3,000 psi (Elcometer) Tensile Strength per ASTM D2370: 7300 psi Penetration per ASTM G17: 0 mil Adhesion Overlap Shear, 1/8-inch steel panel, 0.010 glue line per ASTM D1002: 4300 psi Impact (100 in-lb minimum (Gardner 5/8" diameter tip) Total DFT 12.0 mils	
Surface Preparation		SSPC-SP5/NACE 1 White metal blast cleaning	
Base Coat (Apply at Place of Manufacture)	Polyamide Epoxy	3M Company Epoxy Primer DFT 5.0-6.0 mils,	
Finish Coat (Apply at Place of Manufacture)	Polyamide Epoxy	Scotchkote 134 or 206N	

- G. Spray-applied epoxy lining of pipelines in place shall be completed in accordance with AWWA C620.

PART 3 - EXECUTION

3.1 Preparation

- A. All surfaces to be coated or painted shall be in proper condition to receive material specified before any coating or painting is done.
- B. Prepare iron or steel surfaces in accordance with applicable Manufacturer's instructions and SSPC standards.
- C. Grind surface irregularities, welds, and weld spatter smooth before applying epoxy. Remove all protuberances including slivers, scales, burrs and gouges which may produce pinholes in the lining. Grind a minimum of 0.020-inch off weld caps on pipe weld seams before beginning surface preparation and heating of pipe. Round all sharp edges to be coated.
- D. Allowable grind area shall not exceed 0.5 square feet per location and maximum grind area shall not exceed 2 square feet per item or piece of equipment. Do not use items, pipes or pieces of equipment not meeting these requirements.

Ensure surfaces to receive coatings are dry and free from visible oil, grease, dirt, dust, mill scale, rust, paint oxides, corrosion products and other foreign matter in accordance with specified SSPC standards.

- F. Preheat pipe, item or piece of equipment prior to blast cleaning to remove surface moisture. Preheat shall ensure surface temperature is at least 5°F above dew point temperature during blast cleaning and inspection.
- G. Sandblast surfaces as specified, protecting beveled pipe ends from abrasive blast cleaning.
- H. After sandblasting, apply 5% (by weight) phosphoric acid solution wash to pipe, item or piece of equipment. Average temperature measured in three different locations shall be between 80°F and 130°F during acid wash procedure. Duration of acid contact with surface shall be as follows:

Temperature	Contact Time
80°F	52 seconds
85°F	45 seconds
90°F	36 seconds
95°F	33 seconds
100°F	28 seconds
105°F	24 seconds
110°F	21 seconds
130°F	10 seconds

- I. After completing acid wash, remove acid with demineralized water having maximum conductivity of 5 micromhos/cm at a minimum nozzle pressure of 2500 psi.

3.2 Application

- A. Refer to Section 01 73 00 for basic execution and application requirements.
- B. Furnish and install fusion-bonded epoxy linings and coatings at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements including minimum and maximum drying time between required coats, except as modified herein
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
- D. Refer variances between the above documents and Contract Documents to Owner's Representative.
- E. Coat interior metal surfaces excluding seating areas and bronze and stainless-steel pieces.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics such as runs or blisters that would adversely affect performance or appearance of coating systems.

Apply lining and coating by electrostatic spray or fluidized bed process. Heat and cure per epoxy Manufacturer's recommendations. Heat source shall not leave residue or contaminant on metal surface. Do not allow surfaces to oxidize or flash rust prior to coating.

- I. Pinholes and holidays detected during testing shall be marked, repaired in accordance with Manufacturer's printed instructions and retested. No pinholes or other irregularities will be permitted in final coating.
- J. Protect finished surfaces between coats. For subsequent coats, remove dust, dirt, oil, grease, and any foreign matter which will affect adhesion or durability of finish by washing with clean rags dipped in commercial cleaning solvent approved by paint and coating system Manufacturer. Surface shall then be rinsed with clean water and wiped dry with clean rags.
- K. Coats shall be thoroughly dry and cured according to Manufacturer's recommendations before next coat is applied.
- L. Upon completion, remove masking and other temporary coverings and protection of surrounding areas and surfaces.
- M. Following application and testing, protect surfaces of coating systems from damage during construction.
- N. Spray-applied epoxy lining of pipelines in place shall be completed in accordance with AWWA C620.

3.3 **Field Quality Control**

- A. Repair or replace damaged or colored materials and surfaces not scheduled to be coated.
- B. Repair in accordance with Manufacturer's instructions coatings that exhibit film characteristics or defects that might adversely affect performance or appearance of coating systems. Wire brush or sandblast damaged areas per SSPC SP10. Lightly abrade or sandblast lining and coating on sides of damaged area before applying liquid repair coating specified above. Patched areas shall overlap parent or base coating at least ½-inch. If damaged area exceeds 20 square inches, remove entire lining and coating and recoat and retest entire item.
- C. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Finished Lining or Coating	Holidays	Nondestructive holiday tester such as Tinker-Razor Model AP or AP-W Contractor to submit written report from approved testing agency on reinspection	Owner's option	Owner	Contractor
	Dry Film Thickness	SSPC-PA2 Nondestructive magnetic-type thickness gauge such as "Inspector" or "Positest." Coated items failing inspection will be subject to rejection.	Owner's option	Owner	Contractor
	Film characteristics and defects	Visual inspection. Contractor to submit written report from approved testing agency on reinspection	As directed	Owner	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Finished Coating System	11-Month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature as described below. Repair identified deficiencies.	1 inspection attended by Owner, Contractor, Owner's Representative and Manufacturer's representative	Owner	Contractor

- D. Contractor shall furnish inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of paints and coatings. Contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of thickness gauges. Dry film thickness gauges and holiday detectors shall be available at all times until final acceptance of application. Inspection devices shall be operated by, or in the presence of Owner's Representative with location and frequency basis determined by Owner's Representative. Owner's Representative is not precluded from furnish his own inspection devices and rendering their opinion based solely on their tests.
- E. Owner's Representative shall have right to reject all unsatisfactory material or work and to replace it at Contractor's expense if any deficiency is found in quality of installed coating.
- F. Upon completion of work, remove all staging, scaffolding and containers from Work site. Clean site to satisfaction of Owner's Representative.
- G. Warranty Inspection shall be conducted between eleventh month following completion of all coating and painting work. Repair all defective work in strict accordance with Contract Documents and to satisfaction of Owner's Representative.
1. Owner will establish inspection date and will notify Contractor at least 30 days in advance. Owner will uncover or otherwise expose surfaces to be inspected. Contractor shall provide at his expense suitable lighting and ventilation for the inspection. Contractor shall provide all other necessary inspection equipment to Owner's satisfaction.
 2. Entire interior coating system shall be visually inspected. All defective coatings as well as damaged or rusting spots shall be satisfactorily repaired by and at sole expense of Contractor. All repaired areas shall then be tested as specified herein and repair/testing procedure repeated until surface meets specified requirements.
 3. Entire exterior paint system shall be visually inspected. All defective, damaged or rusting areas shall be satisfactorily repaired by and at sole expense of Contractor.
 4. Warranty Inspection Report will be prepared by Owner's Representative and delivered to Contractor. It will set forth number and type of failures observed, percentage of surface area where failure has occurred, and names of persons making inspection.
 5. Repairs shall proceed promptly. Upon completion of inspection and receipt of Inspection Report, Owner will establish date for Contractor to proceed with remedial Work. Delay on the part of Contractor to proceed with remedial work on schedule shall constitute breach of this Contract. In such case, Owner may proceed to have defects remedied as outlined in Contract Documents.



6. Remedial Work shall occur at any location where paint or coating has peeled, bubbled, or cracked and at any location where rusting is evident. All such locations shall be considered failures. Contractor shall make repairs at all points where failures are observed by removing deteriorated coating or paint, cleaning surface and repainting or recoating with the same system. If area of failure exceeds 25% of a specific coated or painted surface, entire paint or coating system shall, at Owner's option, be required to be removed and recoated or repainted in accordance with original Contract Documents.
7. Costs of warranty inspection and repair shall be borne by Contractor, who shall include an appropriate amount for testing and repair in their bid. No additional allowance will be paid by Owner for Warranty Inspection and repairs.

END OF SECTION

SECTION 26 42 00 CATHODIC PROTECTION SYSTEM

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of galvanic (passive) cathodic protection equipment including zinc, magnesium, and aluminum anodes, wiring, joint bonding, test stations, reference cells, coupons, and thermite welds.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 64 00: Installation of Owner-Furnished Products
- E. Section 01 65 00: Product Delivery Requirements
- F. Section 01 66 00: Product Storage and Handling Requirements
- G. Section 01 73 00: Execution
- H. Section 03 30 00: Cast-in-Place Concrete
- I. Section 09 90 00: Painting and Coating
- J. Section 31 23 00: Excavation and Fill

1.3 System Description

- A. Furnish and install complete and fully operational cathodic protection system, including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable permits, building codes, and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Contractor shall have at least 5 years' experience in installation of cathodic protection equipment.

1.5 References

- A. ASTM B418 Cast and Wrought Galvanic Zinc Anodes
- B. ASTM B843 Magnesium Alloy Anodes for Cathodic Protection
- C. ASTM C94 Ready-Mixed Concrete
- D. ASTM D1248 Polyethylene Plastics Molding and Extrusion Materials
- E. NACE SP0169 Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- F. NACE SP0286 Electrical Isolation of Cathodically Protected Pipelines
- G. NACE SP0375 Wax Coating Systems for Underground Piping Systems
- H. NACE TM0497 Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
- I. NFPA 70 National Electric Code (NEC)
- J. National Electrical Manufacturers Association (NEMA) Standards
- K. Standard Specifications for Public Works Construction (SSPWC)
- L. Caltrans Test Method 217 Sand equivalence

1.6 Submittals

A. Furnish the following submittals on personnel assigned to project.

SUBMITTAL	DESCRIPTION	
Subcontractor Qualifications	Submit documentary evidence subcontractor has been in business in California for at least 5 years	
	Submit name of proposed onsite foreman along with documentary evidence proposed onsite foreman has worked in such capacity in employ of subcontractor at least 3 years and has completed at least 3 installations of product.	
	Submit documentary evidence of NACE certification of Corrosion Engineer	

B. Furnish the following submittals on Work furnished.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per General Conditions and Special Provisions Shop Drawing requirements.	
Catalog Data	Required per Catalog Data requirements for anodes, rectifiers, junction boxes, wire and cables, test stations, reference cells, coupons, and thermite welds.	
Engineering Calculations	Submit basis of design calculations for cathodic protection equipment furnished	
Installation Instructions	Required per Installation or Application Instruction requirements.	
O & M Instructions	Required per Operation and Maintenance Instruction requirements	
Test Results	Submit written records of tests described in Part 3 below prepared by Corrosion Engineer.	
Warranty	Furnish one-year warranty from date of final acceptance	

C. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions and test record transcripts.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of cathodic protection equipment shall be strictly followed.
- C. Refer to Section 01 64 00 for information regarding Owner-furnished products.

1.8 Unit Prices

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Sacrificial Zinc Anodes	American Smelting and Refining Company (ASARCO)	
	Corrpro Corrosion Div Aegion	Medina, OH
	Farwest Corrosion Control	Gardena, CA
	Magnesium Corporation of America (MagCorp)	Salt Lake City, UT
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Coke Breeze	Asbury (Farwest Corrosion Control)	Gardena, CA
	Loresco	Hattiesburg, MS
	Accepted equal	
Galvanic Anode Backfill	Farwest Corrosion Control	Gardena, CA
	Loresco	Hattiesburg, MS
	Accepted equal	
Anode Caps	Raychem	
	Accepted equal	
Wire and Cable	Farwest Corrosion Control	Gardena, CA
	Kris-Tech Wire Company	Rome, NY
	Accepted equal	
Detectable Metal Warning Tape	Calpico, Inc.	South San Francisco, CA
	Terra Tape Division Reef Industries Sentryline Detectable 620	Houston, TX
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Sacrificial anode cathodic protection systems components shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION				
Deep Well Anodes	Graphite	Rods with minimum dimension of 4-inch diameter by 80 inches long Suitable for use in seawater				
	Conductor Cable	Equipped with continuous, uncut #8 AWG 7 strand copper conductor with kynar/Halar insulation Internally connected conductor cable				
	Anode Cap	Epoxy and heat shrink cap				
Sacrificial Anodes	Zinc Anodes	Conform to ASTM B418, Type II Use pre-packaged zinc alloy (special high grade) ingot: Chemical Composition: <ul style="list-style-type: none"> • Aluminum (max) 0.005% • Cadmium (max) 0.003% • Copper (max) 0.002% • Iron (max) 0.0014% • Lead (max) 0.003% • Zinc – remainder ¼" galvanized steel core Silver solder lead wire connection				
	Dimensions	1"	COPPER PIPE SIZE	COPPER PIPE LENGTH	ZINC ANODE SIZE	ZINC ANODE WEIGHT
			0-45'	1.4"x1.4"x30"	15 lbs	
		45'-90'	2.0"x2.0"x30"	30 lbs		
		90'-120'	2.0"x2.0"x48"	40 lbs		
		120'-180'	2.0"x2.0"x60"	60 lbs		
		>180'	Use multiple anodes	0.33 lbs/ft		
2"		0-22'	1.4"x1.4"x30"	15 lbs		
		22-70'	2.0"x2.0"x48"	40 lbs		
	70-90'	2.0"x2.0"x60"	60 lbs			
	>90'	Use multiple anodes	0.66 lbs/ft			

ITEM	MATERIAL	SPECIFICATION
	Packaging	Package in cotton or permeable cloth bag with galvanic anode backfill material consisting of <ul style="list-style-type: none"> • 75% gypsum • 20% powdered bentonite • 5% anhydrous sodium sulfate 100% of backfill granular material shall pass a 100-mesh screen Pack backfill around anode by mechanical vibration to density which will maintain anode in center of cloth bag surrounded by at least 1" backfill. Packaged weight of anode plus backfill shall be double weight of bare metal anode.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install cathodic protection systems before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Provide traffic control to satisfy requirements of applicable local and state jurisdictions.
- C. Locations of cathodic protection equipment, test stations, devices, outlets and appurtenances are approximate. Exact locations shall be determined by Contractor in field subject to acceptance by Owner's Representative.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install cathodic protection systems at location shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire and electrical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install cathodic protection systems to tolerances recommended by Manufacturer. Unless otherwise shown, install cathodic protection systems true and level using precision instruments.
- F. Coat all exposed surfaces of steel pipe, welds, and conductors.

3.3 Field Quality Control

- A. Field testing shall be performed by "qualified corrosion technician," under supervision of either California-licensed Registered Corrosion Engineer or NACE-Certified Cathodic Protection Specialist.

END OF SECTION

**SECTION 31 05 16
AGGREGATE AND ROCK PRODUCTS FOR EARTHWORK**

PART 1 - GENERAL

1.1 Work Included

- A. Materials and installation of rock, stone, crushed rock, rock dust, gravel and sand.
- B. Materials used for concrete aggregate are specified in Section 03 30 00.
- C. Materials used for cement and concrete for earthwork are specified in Section 31 05 23
- D. Except as modified herein, aggregate and rock products shall conform to Standard Specifications for Public Works Construction (Greenbook) Section 200.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 03 30 00: Cast-in-Place Concrete
- H. Section 31 23 00: Excavation and Fill
- I. Section 31 23 33: Trenching and Backfilling

1.4 Quality Assurance

- A. Rock products shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quality of soft, friable, thin, elongated or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.

- B. Plant testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Crushed Rock	Percentage Wear	ASTM C131 Meet requirements below in Part 2	1 each sieve test	Contractor	Contractor
Caltrans Class 2 Aggregate Base	Sieve Analysis	California Test Method 202 Meet requirements below in Part 2	1 each source for each gradation used	Contractor	Contractor

- C. All percentages referred to herein shall be by weight.

1.5 References

- A. ASTM C127 Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- B. ASTM C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine
- C. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
- D. ASTM D1556 Density and Unit Weight of Soil in Place by SandCone Method

- F. ASTM D4253 Maximum Index Density and Unit Weight of Soils Using Vibratory Table
- F. ASTM D4254 Maximum Index Density and Unit Weight of Soils and Calculation of Relative Density
- G. ASTM D6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- H. California Test Method 202 Sieve Analysis of Fine and Coarse Aggregates
- I. California Test Method 216 Relative Compaction of Untreated and Treated Soils and Aggregates
- J. California Test Method 217 Sand Equivalent
- K. California Test Method 227 Cleanness Value
- L. California Test Method 229 Durability Index
- M. California Test Method 301 Resistance "R" Value of Treated and Untreated Bases, Subbases and Basement Soils by Stabilometer
- N. California Test Method 302 Film Stripping
- O. California Test Method 548 Evaluation of Aggregate for Lean Concrete Base (LCB)
- P. SSPWC Standard Specifications for Public Works Construction (Greenbook) Section 200 "Rock Materials"

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Test Results	Required for all rock products	

- B. Refer to Section 01 33 00 for definition of requirements for catalog data and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Rock products shall be clean, hard, sound, durable, uniform in quality and free of any detrimental quantity of soft, friable, thin, elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance. Unless otherwise specified, products shall meet requirements of Section 200 of Standard Specifications for Public Works Construction (Greenbook) and the following:

ITEM	DESCRIPTION	
Crushed Rock and Rock Materials (See Standard Specifications for Public Works Construction (Greenbook) Table 200-1.2 (B))	Percentage Wear per ASTM C131	Abrasion loss < 15% after 100 revolutions Abrasion loss < 52% after 500 revolutions
	Fractured Faces	At least 50% of particles retained on 3/8" sieve shall have 3 or more fractured faces Less than 5% shall show no fractured faces
	Gravel	Less than 10% of particles passing 3/8" sieve but retained on No 4 sieve shall be gravel
Crushed Aggregate Base (See Standard Specifications for Public Works Construction (Greenbook) Table 200-2.2.3 (A))	R-Value per California Test Method 301	80 minimum
	Sand Equivalent per California Test Method 217	50 minimum
	Percentage Wear per ASTM C131	Abrasion loss < 15% after 100 revolutions Abrasion loss < 52% after 500 revolutions
	Durability Index per California Test Method 229	40 minimum
	Specific Gravity Per ASTM C127	2.58 minimum
Crushed Miscellaneous Base (See Standard Specifications for Public Works Construction (Greenbook) Table 200-2.4.3 (A))	R-Value per California Test Method 301	78 minimum
	Sand Equivalent per California Test Method 217	35 minimum
	Percentage Wear per ASTM C131	Abrasion loss < 15% after 100 revolutions Abrasion loss < 52% after 500 revolutions
	Durability Index per California Test Method 229	40 minimum
	Gravel	Less than 15% of particles passing 3/8" sieve but retained on No 4 sieve shall be gravel
	Brick Per California Test Method 202	Less than 3% brick by weight No brick particles shall be retained on No. 4 sieve
Disintegrated Granite (See Standard Specifications for Public Works Construction (Greenbook) Table 200-2.7.3 (A))	R-Value per California Test Method 301	73 minimum
	Sand Equivalent per California Test Method 217	30 minimum
Gravel	Fractured Faces.	No particles shall have more than one fractured face.
Sand	Composition	Natural or manufactured granular material or combination thereof, free of deleterious amounts of inorganic material, mica, loam, clay and other substances unsuitable for sand's intended purpose.
Aggregate for Portland Cement Concrete	See Section 03 30 00	
Aggregate for Mortar Sand	See Section 04 05 00	

- C. Owner's Representative may waive percentage wear requirements in table above provided durability index requirements shown are met.

Crushed rock and rock materials shall meet the following gradations: (from Standard Specifications for Public Works (Greenbook) Table 200-1.2.(A))

PERCENTAGE PASSING SIEVES BY WEIGHT							
SIEVE SIZE	1" CRUSHED ROCK	3/4" CRUSHED ROCK	1/2" CRUSHED ROCK	3/8" CRUSHED ROCK	1/4" CRUSHED ROCK	3/16" CRUSHED ROCK	ROCK DUST
1 1/2"	100%						
1"	90-100%	100%					
3/4"	30-60%	90-100%	100%				
1/2"	0-20%	30-60%	90-100%	100%			
3/8"		0*20%	20-60%	90-100%			100%
1/4"					100%		
No. 4	0-5%	0-5%	0-15%	30-60%	75-100%	100%	90-100%
No. 8			0-5%	0-10%	0-25%	40-75%	
No. 16					0-5%	0-10%	
No. 30							20-60%
No. 200					0-2%	0-2%	5-20%
ASTM C131 Test Grading	A	B	B	C	D	D	

- E. Where called for on Plans, "Caltrans Class 2 Aggregate Base" shall conform to gradation below. Contractor may choose from either 1 1/2"-Maximum or 3/4"-Maximum grading, but once a grading is selected, it shall not be changed without written authorization from Owner's Representative. If on any day, material furnished meets contract compliance requirements but falls outside of operating range, material placement may continue for remainder of that day, after which substitute material shall be furnished complying with requirements for "Operating Range" to Owner's Representative's satisfaction.

PERCENTAGE PASSING SIEVES BY WEIGHT				
SIEVE SIZE	1 1/2" MAXIMUM CLASS 2 AGGREGATE BASE		3/4" MAXIMUM CLASS 2 AGGREGATE BASE	
	OPERATING RANGE (MOVING AVERAGE)	CONTRACT COMPLIANCE (SINGLE TEST)	OPERATING RANGE (MOVING AVERAGE)	CONTRACT COMPLIANCE (SINGLE TEST)
2"	100%	100%		
1 1/2"	90-100%	87-100%		
1"			100%	100%
3/4"	50-85%	45-90%	90-100%	87-100%
No. 4	25-45%	20-50%	35-60%	30-65%
No. 30	10-25%	6-29%	10-30%	5-35%
No. 200	2-9%	0-12%	2-9%	0-12%

- F. Where called for on Plans, Greenbook Crushed Aggregate Base shall conform to gradation below: (from Standard Specifications for Public Works (Greenbook) Table 200-2.2.2)

PERCENTAGE PASSING SIEVES BY WEIGHT	
SIEVE SIZE	CRUSHED AGGREGATE BASE GRADATION
1 1/2"	100%
3/4"	90-100%
3/8"	50-80%
No. 4	35-55%
No. 30	10-30%
No. 200	2-9%
ASTM C131 Test Grading	B

Where called for on Plans, “Crushed Miscellaneous Base” or “Processed Miscellaneous Base” shall conform to gradation below: (from Standard Specifications for Public Works (Greenbook) Table 200-2.4.2 (A))

PERCENTAGE PASSING SIEVES BY WEIGHT		
SIEVE SIZE	“COARSE” CRUSHED MISCELLANEOUS BASE GRADATION	“FINE” CRUSHED MISCELLANEOUS BASE GRADATION
2”	100%	
1½”	85-100%	100%
¾”	50-85%	85-100%
⅜”		55-75%
No. 4	25-45%	35-60%
No. 30	10-25%	10-30%
No. 200	2-9%	2-9%
ASTM C131 Test Grading	A	B

H. Where called for on Plans, disintegrated granite shall conform to gradation below: (from Standard Specifications for Public Works (Greenbook) Table 200-2.7.2 (A))

PERCENTAGE PASSING SIEVES BY WEIGHT	
SIEVE SIZE	CRUSHED AGGREGATE BASE GRADATION
1½”	100%
1”	90-100%
No. 4	50-100%
No. 30	25-55%
No. 200	5-18%

I. Where called for on Plans, aggregate for “Lean Concrete Base” shall conform to gradation below: (from Standard Specifications for Public Works (Greenbook) Table 200-4.2.2.1 (A))

PERCENTAGE PASSING SIEVES BY WEIGHT				
SIEVE SIZE	1½” MAXIMUM CLASS 2 AGGREGATE BASE		¾” MAXIMUM CLASS 2 AGGREGATE BASE	
	OPERATING RANGE (MOVING AVERAGE)	CONTRACT COMPLIANCE (SINGLE TEST)	OPERATING RANGE (MOVING AVERAGE)	CONTRACT COMPLIANCE (SINGLE TEST)
2”	100%	100%		
1½”	90-100%	87-100%	100%	100%
1”			90-100%	87-100%
¾”	50-85%	45-90%	50-100%	45-100%
⅜”	40-75%	35-80%	40-75%	35-80%
No. 4	25-60%	20-65%	35-60%	30-65%
No. 30	10-30%	6-34%	10-30%	6-34%
No. 200	0-12%	0-15%	0-12%	0-15%

PART 3 - EXECUTION

3.1 Installation

- A. Refer to Section 01 73 00 for execution and installation requirements.
- B. Furnish and install aggregate and rock products at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:

1. Requirements of contract-referenced soils reports and investigations.
 2. Applicable OSHA and Cal OSHA regulations
 3. Other applicable building code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.

3.2 **Field Quality Control**

- A. Owner's Representative will provide continuous inspection of rock products as placed and compacted.
- B. Owner's Representative will observe and test fills and based on laboratory results will determine whether fills have been placed in accordance with Contract Documents.
- C. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Backfill or Soil Prepared in Place	Sampling	ASTM D75	As directed	Owner / Contractor	Contractor
	Sieve Analysis	ASTM C136 or California Test Method 202	As directed	Owner / Contractor	Contractor
	Sand Equivalence	California Test Method 217	As directed	Owner / Contractor	Contractor

- D. Allow sufficient time for testing and evaluation of results before material is needed. Owner's Representative will be sole and final judge of suitability of all materials.
- E. Do not use materials in question pending test results.
- F. Contractor shall remove unsatisfactory material, recompact, adjust moisture or compaction methods, place new material, and perform other operations necessary to meet Contract requirements as directed by Owner's Representative.

END OF SECTION

**SECTION 31 05 50
PROTECTING EXISTING UTILITIES**

PART 1 - GENERAL

1.1 Work Included

- A. Materials and procedures to protect existing underground utilities.
- B. Materials and procedures to connect to existing underground utilities.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 73 00: Execution
- C. Section 02 41 15: Utility Line Removal
- D. Section 33 12 12: Resilient Wedge Gate Valves

1.3 References

- A. ASCE 38 Standard Guidelines for the Collection and Depiction of Existing Subsurface Data
- B. ASTM C143 Slump of Hydraulic Cement Concrete
- C. ASTM C425 Compression Joints for Vitrified Clay Pipe and Fittings
- D. ASTM C700 Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated

1.4 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings for Supporting Pipe and Utilities Crossing Trenches	Required when utilities to be supported exceed 16" diameter or any transverse dimension.	
	Required when requested in writing by Owner's Representative	
Engineering Calculations	Submit for pipe supports for existing utilities greater than 24" in any dimension. If concrete beams are used as supports, calculations shall take into account concrete strength based on days elapsing between placing concrete and trenching beneath concrete beams. Do not use 28-day strength unless concrete will be at least 28 days old when beam is placed in service.	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings and engineering calculations.

1.5 Project Conditions

- A. Design Engineer has attempted to show approximate location of buried utilities on Plans pursuant to Utility Quality Level D (QLD) as defined in ASCE 38. These approximate locations are based on:
 1. Record maps requested and received during design from utilities identified through an inquiry to Underground Service Alert and utilities.
 2. Comments received from Utilities after their review of preliminary plans showing record drawing information.

3. Field reconnaissance and plotting of approximate locations of readily visible surface features including manhole covers, valve covers, utility boxes, marking posts, pavement repair strips, and culvert end sections which might indicate presence of buried utilities.
 4. Design Engineer's professional judgment in correlating record map information to observed surface features
- B. Utility locations on Plans are based solely on the above. Plotted locations may not accurately reflect subsurface conditions.
- C. Prior to excavation, and prior to submittal of cut sheets for pre-engineered pipe, Contractor shall pothole and determine precise locations of all utilities which are:
1. Shown on plans
 2. Identified by Underground Service Alert
 3. Evident from readily visible surface features including manhole covers, valve covers, utility boxes, marking posts, pavement repair strips, and culvert end sections which might indicate presence of buried utilities.
 4. Identified by Contractor by walking alignment using a reliable electronic pipe finder.
- D. Power trench excavating equipment may only be used when and where all the following conditions exist.
1. Contractor has notified Underground Service Alert and all known Utility Owners at least 2 working days before excavating.
 2. Contractor has thoroughly searched entire excavation route using a reliable electronic pipe finder and has pre-marked horizontal locations of conflicts.
 3. Utilities shown on Plans have been potholed in advance of excavation as needed to verify locations.
 4. No pipelines carrying gas, petroleum, explosives, hazardous materials, or other regulated contaminants are believed to be within 5' of area to be excavated.
 5. Owner's Representative is continuously present during excavation.
- E. Pursuant to 49 CFR Part 192, Contractor shall coordinate with operators of high-pressure gas lines who are required by law to have a representative on-site at all times during excavation in the vicinity of their pipelines.
- F. Power equipment specifically designed and manufactured for potholing existing utilities is exempt from the above restrictions.
- G. Hand excavation shall be used
1. In areas where buried gas, petroleum, explosives or hazardous material piping is known to be present
 2. In areas where electrical, fiber optic or communications conduit is known to be present.

3. In first 5' below existing grade where drilling or auguring equipment is used.
- H. Pursuant to Section 4215 of California Government Code,
1. Owner will be responsible *“for timely removal, relocation, or protection of existing main or trunk line utility facilities located on the site”* if such utilities are not identified by Owner in Contract Documents.
 2. Owner will compensate Contractor for documented *“costs of locating, repairing damage not due to the failure of the Contractor to exercise reasonable care, and removing or relocating such utility facilities not indicated in the plans and specifications with reasonable accuracy, and for equipment on the project necessarily idled during such work.”*
 3. *“Contractor shall not be assessed liquidated damages for delay in completion of the project when such delay was caused by the failure of the public agency or the owner of the utility to provide for removal or relocation of such utility facilities.”*
- I. Pursuant to Section 4216 of California Government Code, Owner’s liability shall be limited to reimbursement of costs due to utility facilities either not shown on Contract Documents, or shown on Contract Documents at locations more than 2’ vertically or 5’ horizontally in error from field locations, except where location of said utilities are evident from surface features or staked correctly by Underground Service Alert.
- J. Owner will not indicate presence of existing service laterals or appurtenances when presence of utilities on Project site can be inferred from presence of other visible facilities, such as buildings, meters and junction boxes, on or adjacent to Work site. Owner will identify main or trunk lines in Contract Documents. Contractor shall make their own investigations, including exploratory investigations, to determine or verify locations and type of existing service laterals or appurtenances when their presence can be inferred from presence of other visible facilities.
- K. If Contractor discovers Utility facilities not identified by Owner in Contract Documents, Contractor shall immediately notify Owner and Utility in writing.
- L. Utilities not shown on plans or shown on plans in a position different from field location shall, upon discovery, be immediately brought to attention of Owner's Representative and affected Utility in writing.
- M. Costs, and work to be done by Contractor in locating, removing, relocating, protecting or temporarily maintaining such utility facilities shall be covered by a written change order conforming to provisions herein pertaining to changes in Work. Owner may make changes in alignment and grade of Work to obviate need to remove, relocate, protect or temporarily maintain utility facilities or to reduce costs of Work involved in removing, relocating, protecting or temporarily maintaining such utility facilities. Changes in alignment and grade will be ordered in accordance with provisions pertaining to changes in Work.
- N. Damage to underground utilities, pipelines or other facilities whose existence is shown on Plans or identified by field staking or markings shall be immediately brought to attention of Owner's Representative and affected Utility, and repaired at Contractor's expense. Exact determination of location of these utilities, pipelines or other facilities shall be Contractor's responsibility. Contractor shall be solely and directly responsible for damage, injury, expense, loss, inconvenience, delay, suits, actions or damage that may result from Contractor's failure to verify or locate utilities whose existence is indicated. Costs incurred for protection of these lines or costs incurred due to presence of lines, whether or not they lie within trench prism, shall be borne in full by Contractor.

- O. When it is necessary to remove, relocate, protect or temporarily maintain a utility other than
1. existing mains or trunk-line facilities not originally shown on Plans with sufficient accuracy to allow Work to proceed according to Contract Documents or;
 2. existing service laterals or appurtenances whose presence cannot be inferred from presence of other visible facilities, such as buildings, meters and junction boxes, on or adjacent to Work site;

Contractor shall bear all expenses incidental to Work on utility or damage thereto. Work on utility shall be done in manner satisfactory to Utility Owner. Utility Owner will have option of doing such Work with their own forces, or permitting Work to be done by Contractor.

- P. No representations are made that obligations to remove, relocate, protect or temporarily maintain a utility and to pay cost thereof is not required to be borne by utility. Contractor shall investigate, to find out whether or not said cost is required to be borne by Utility Owner.
- Q. Liquidated damages will not be assessed for damages in delay in completion of Work, when such delay was caused by failure of Owner, Owner's Representative, Design Engineer and Utility Owner to provide for removal or relocation of utility facilities. Right is reserved to governmental agencies and to Utility Owners to enter at any time upon any street, alley, right of way or easement for purpose of making changes in their property made necessary by Work and to maintain and make repairs to their property.

1.6 Unit Prices

- A. Payment for locating, potholing, exposing, and protecting existing utilities will be included in price bid for Work items for which such Work is appurtenant.
- B. Payment for abandoning or removing existing utilities will be included in the price bid for Work items for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Replacement Materials

- A. Unless otherwise shown or specifically authorized in writing by Owner's Representative, reconstruct damaged utilities with new materials of same size, type and quality as that removed.

PART 3 – EXECUTION

3.1 Preparation

- A. Section 4216 of California Government Code states Contractors *“planning to conduct any excavation shall contact the appropriate regional notification center at least two working days but not more than 14 calendar days, prior to commencing excavation.”*
- B. In Southern California, the appropriate regional notification center is Underground Service Alert of Southern California (DigAlert) (1-800-422-4133) or 811.
- C. Contractor shall be responsible for damage done to public or private property shown on Plans or marked or staked in field.

- D. Construction Plans will be provided to Utilities by Owner.
- E. Construction schedule shall be provided to Utilities by Contractor. Coordinate construction schedule with Utility Owner's requirements.
- F. Notify Utility Owner 2 working days in advance of utility crossing construction. Coordinate construction schedule with utility service requirements.
- G. Expose all utilities ahead of pipe and conduit laying operations to allow for adjustment in alignment or grade line, to verify pipe and utility location and depths, types materials, conditions and sizes for ordering proper transition and/or tie-in fittings, and so Owner's Representative may verify that no buried utilities interfere with proposed construction. Identify true location and depth, type, material, condition and size of utilities and service connections. Where potholing or exposure is not done, repair or replacement of damaged utilities and necessary horizontal and vertical realignments shall be paid for entirely by Contractor.
- H. Electrical utilities may maintain energized underground electrical power lines in immediate vicinity of Work. These power lines represent an extreme hazard from electrical shock to construction personnel or equipment coming in contact with them. State law requires parties planning excavations in public right of way to contact Utilities for locations of their underground facilities. Contractors, their employees, and other personnel working near underground power lines must be warned to take adequate protective measures. (See: OSHA Std. 1926-651(A)). Notify electrical Utility to arrange, if possible, to have these lines de-energized when Work reaches their immediate vicinity. Cost of such temporary arrangements shall be borne by Contractor.
- I. Electrical utility companies may maintain energized aerial electrical power lines in immediate vicinity of Work. Do not consider these lines to be insulated. Construction personnel working near these lines are exposed to an extreme hazard from electrical shock. Contractors, their employees and construction personnel working on this project must be warned of the danger and instructed to take adequate protective measures, including maintaining a minimum of 10' clearance between lines and construction equipment and personnel. (See OSHA Std. 1926.550(A)15). As an additional safety precaution, call electrical utility company to arrange, if possible, to have these lines de-energized or relocated when Work reaches their immediate vicinity. Cost of such temporary arrangements shall be borne by Contractor.
- J. It shall not be the responsibility of either Owner or their Representative to verify need for electrical Utility shutdowns, nor to verify shutdowns have taken place.
- K. Before hot-tapping asbestos-cement pipe, the following items shall be on-hand:
 - 1. Hot-tapping equipment of appropriate size
 - 2. Water source and means of application sufficient to maintain continuously wetted cutting area
 - 3. Waste disposal bags
 - 4. OSHA-required safety equipment including, but not limited to disposable coveralls, full-face air-supplied respirators, rubber boots, hard hats, eye protection, and gloves.

3.2 Protection

- A. Protect existing active services and utilities in place against damage from construction.

- B. Maintain existing services and utilities in service. Do not shut down active services or utilities except where previous written authorization has been obtained from Owner's Representative and Utility.
- C. Use pipe and duct supports as needed to protect utilities.
- D. Notify Utilities in writing at least 3 working days before authorized shutdown.
- E. Unauthorized shutdowns shall only be made where necessary, as an emergency measure, to protect property or human life until proper authorization can be obtained.

3.3 Removal and Reconstruction

- A. Utilities relocated or rebuilt for Contractor's convenience, shall be relocated or rebuilt at Contractor's expense. Repair, replacement or relocation of buried utilities shall be completed at Contractor's expense by either Utility's forces, or by a contractor accepted by Utility in writing and properly licensed to perform Work.
- B. Utility relocation or reconstruction shall conform to applicable Standard Details and Specifications. Provide temporary service for disconnected Utility.
- C. Replace damaged or removed utilities in kind, except as otherwise shown or authorized by Owner's Representative. Reconstruct utilities with new material of same size, type and quality as that removed.

3.4 Backfill and Compaction

- A. Backfill and compact under and around utilities so no voids are left.
- B. Before replacing a utility, backfill trench and compact to elevation 1 foot above top of ends of utility. Excavate cross trench of proper width for utility.
- C. Sand-cement slurry may be used as backfill to ease compaction. Sand-cement slurry shall consist of one sack (94 pounds) Portland cement per cubic yard of slurry. Add sufficient moisture for workability without exceeding 6" slump. Submit specific methods and procedures to Owner's Representative prior to construction.

3.5 Abandoned Utility Lines

- A. Remove and dispose of abandoned utilities within trench per Section 02 41 15.

3.6 Connecting to Existing Water Mains

- A. Contact Water Utility Owner 72-hours before connecting to existing mains.
- B. Comply with all Utility requirements for tapping existing lines, including field directives from Utility inspectors.
- C. Wet connections (hot taps) shall be made as follows:
 - 1. Tap existing lines while under pressure.
 - 2. Schedule tapping procedure with Water Utility so as not to interfere with normal operation of existing pipe line.

3. Cut tapped pipe in presence of Water-Utility-designated inspector to full nominal diameter of tapping valve.

D. Wet connections (hot-taps) of asbestos cement pipe shall proceed as follows:

1. Tap existing lines while under pressure.
2. Schedule tapping procedure with Water Utility so as not to interfere with normal operation of existing pipe line.
3. Excavate around asbestos-cement pipe a sufficient distance to assure adequate tool clearance in area to be tapped. Take care to avoid abrading or chipping pipe.
4. Clean and wash pipe surface with water in area to be cut.
5. Attach tapping equipment around asbestos-cement pipe.
6. Apply water to area being cut until tapping is complete.
7. Cut tapped pipe in presence of Water-Utility-designated inspector to full nominal diameter of tapping valve.
8. Tap pipe, keeping entire exposed area of pipe in vicinity of tap wet during operation so no friable asbestos cement dust is created.
9. Detach tapping equipment and move to next location, repeating above procedure.
10. Upon completion of final tap, thoroughly wash tapping equipment with clean water to remove all asbestos-cement debris. Drain wash water into trench bottom. Remove washed tapping equipment from trench.
11. Install other pipe and fittings as needed to complete Work taking care to avoid abrasion or chipping of asbestos-cement pipe.
12. When all pipe Work is complete, thoroughly wash hands, boots, and any small tools with clean water to remove all asbestos-cement debris. Drain wash water to trench bottom.
13. Remove disposable protective clothing, HEPA filters, tapping coupons, and other asbestos-contaminated materials, debris or containers and dispose of them in sealed impermeable bags or other closed impermeable containers.
14. Exit ditch in manner that no asbestos-cement debris will contaminate clothing, boots, tools or other clothing.
15. Backfill trench.

E. Dry connections shall be made as follows:

1. Schedule tapping procedure with Water Utility so as not to interfere with normal operation of existing pipe line.
2. Coordinate with Water Utility to minimize downtime.
3. Arrange for presence of Water Utility inspector.

4. Water Utility shall operate valves to isolate main.
 5. Verify Water Utility pipeline is isolated and relieved of pressure before cutting main.
 6. Cut tapped pipe in presence of Water-Utility-designated inspector to full nominal diameter of tapping valve.
 7. Place 2 ounces of HTH in pipe at each point where existing main is cut.
 8. Swab new pipe and fittings internally with an accepted chlorine solution.
- F. Make perpendicular connections to asbestos-cement pipe by making wet connection (hot tap). Make longitudinal connections to asbestos-cement pipe by removing entire pipe piece or snap-cutting per Section 02 41 15. Replace removed segment with AWWA C900 Class 200 PVC pipe in presence of Water-Utility-designated inspector. Swab new pipe and fittings internally with an accepted chlorine solution.

3.7 **Field Quality Control**

- A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Cement-Sand Slurry Backfill	Slump (6" Maximum)	ASTM C143	1 each batch	Owner	Contractor
Connection to Existing Water Line	Verification of Proper Connection	Make cut in presence of Owner's Representative and present coupon to Owner's Representative Coupon shall match full valve nominal size.	1 each connection	Contractor	Contractor

END OF SECTION

SECTION 31 23 00 EXCAVATION AND FILL

PART 1 - GENERAL

1.1 Work Included

- A. Structural and trenching excavation activities as required to complete Work under wet and dry conditions in whatever material or class of material is encountered, including:
1. Contacting and notifying underground utilities, no less than 48-hours before excavating.
 2. Compliance with State and Federal safety regulations.
 3. Designing, furnishing, placing, and removing all sheeting, shoring and bracing needed to safely support sides of excavations.
 4. Compliance with applicable agencies' permit conditions for work in public or railroad right-of-way, and for work on private property.
 5. Loosening, excavating, removing, loading, and transporting excess soil from excavations.
 6. Stockpiling, exporting and importing material.
 7. Pumping, ditching, draining, and other required measures to remove or exclude water.
 8. Supporting and protecting structures above and below ground.
 9. Maintaining trees which are not permitted to be removed.
 10. Preparing and stabilizing subgrade for pipe, paving and structures.
 11. Backfilling around structures and all backfilling of trenches and pits.
 12. Transporting, depositing, and compacting fill where required.
 13. Rough and fine grading, and preparation of right-of-way.
 14. Soil sterilant application.
 15. Legal disposal of cleared, grubbed and excess excavated materials.
 16. Cleaning up debris, papers and loose rocks.
 17. Restoring fences and other disturbed property.
 18. All other incidental earthwork and supplementary operations needed to complete Work.
- B. Except as modified herein, earthwork shall conform to Standard Specifications for Public Works Construction (Greenbook) Section 300.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements

- Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 01 73 33: Mechanical Identification
- I. Section 03 30 00: Cast-in-Place Concrete
- J. Section 31 05 16: Aggregate and Rock Products for Earthwork
- K. Section 31 10 00: Site Clearing
- L. Section 31 23 19: Dewatering
- M. Section 31 05 50: Protecting Existing Utilities
- N. Section 32 12 16: Asphalt Paving
- O. Section 32 13 13: Concrete Paving

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. ASTM C143 Slump of Hydraulic Cement Concrete
- B. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
- C. ASTM D1556 Density and Unit Weight of Soil in Place by SandCone Method
- D. ASTM D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
- E. ASTM D4253 Maximum Index Density and Unit Weight of Soils Using Vibratory Table
- F. ASTM D4254 Maximum Index Density and Unit Weight of Soils and Calculation of Relative Density
- G. ASTM D6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- H. California Test Method 202 Sieve Analysis of Fine and Coarse Aggregates
- I. California Test Method 216 Relative Compaction of Untreated and Treated Soils and Aggregates
- J. California Test Method 217 Sand Equivalent
- K. SSPWC Standard Specifications for Public Works Construction (Greenbook) Section 300 "Earthwork"
- L. SSPWC Standard Specifications for Public Works Construction (Greenbook) Section 306-1 "Open-Trench Excavations"

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required for soil sterilants per catalog data requirements. Required for pipe identification tape	
Product Samples	Required for pipe identification tape	
Permits	Copies of permits obtained for excavation, grading, etc. required by state and local governing authorities	
Certificate of Compliance	Submit affidavit of compliance with California Construction Safety Order requirements prior to beginning excavation on any trench or excavation. Affidavit shall certify compliance with all shoring, bracing, sloping or other protective system provisions required by California Construction Safety Orders for worker protection from hazard of caving ground during excavation.	

Refer to Section 01 33 00 for definition of requirements for catalog data and certificates of compliance.

1.7 Delivery, Storage and Handling

A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.

1.8 Unit Prices

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

B. In absence of pay items for contaminated soils, Contractor shall be entitled to payment as Extra Work for documented costs incurred by Contractor for removing, segregating, covering, and legally disposing of contaminated soils. Contractor shall not be entitled to payment for imported material to replace contaminated soils.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Soil Sterilant	Elanco "Surflan"	Greenfield, IN
	Bayer Aventis Crop Science (formerly Rhône-Poulenc) "Ronstar G 50 WP"	Leverkusen, NRW, GE
	Rainbow Technology "Weedkiller"	Pelham, AL
	Accepted equal	
Buried Pipe Identification Tape	See Section 33 05 26	

2.2 Materials

A. Refer to Section 01 61 00 for basic requirements for products and materials.

B. Refer to Section 31 05 16 for basic requirements for aggregate and rock products.

C. The following definitions shall apply to soil and backfill:

ITEM	MATERIAL	SPECIFICATION
Granular Material	Sand or Gravel	California Test Method 217 minimum sand equivalence of 30 Not more than 20% of material shall pass through 200-mesh sieve.
Imported Sand	Sand	California Test Method 217 minimum sand equivalence of 30
Pervious Backfill (per Greenbook 300-3.5.2)	Gravel, Crushed Gravel, Crushed Rock, Natural Sands, and/or Manufactured Sands	California Test Method 217 minimum sand equivalence of 60 100% passing ¾" sieve 80-100% passing ⅜" sieve 0-8% passing No 100 sieve 0-3% passing No 200 sieve

ITEM	MATERIAL	SPECIFICATION
Suitable Structural Backfill Material (per Greenbook 300-3.5)	Imported or Excavated Material Meeting Specification	California Test Method 217 minimum sand equivalence of 20 35-100% passing No 4 sieve 20-100% passing No 30 sieve Material free from shale, sod, stones, concrete and clods over 4" diameter, roots, trash, lumber, organic material, ashes and other debris considered unsuitable by Owner. Material shall have no unusual color or sulfide odor. Compact to specified densities.
Suitable Soil Material	Imported or Excavated Material Meeting Specification	Material free from shale, sod, stones, concrete and clods over 4" diameter, roots, trash, lumber, organic material, ashes and other debris considered unsuitable by Owner. Material shall have no unusual color or sulfide odor. Compact to specified densities.
Unclassified Fill	Imported or Excavated Material Meeting Specification	Material free from shale, sod, stones, concrete and clods over 6" diameter, roots, trash, lumber, organic material, ashes and other debris considered unsuitable by Owner. Material shall have no unusual color or sulfide odor. Compact to specified densities.
Cement-Sand Slurry	Cement (94-lb sacks per cubic yard of mix)	1 sack per cubic yard minimum and not less than that required by applicable agency encroachment permits
	Maximum Slump	Maximum 5" per ASTM C143
Native Material	Material obtained from required site excavations When native material is unsuitable for use in backfill, it shall be disposed of off-site and suitable material capable of being compacted to required relative density shall be furnished by Contractor at their expense.	
Import Material	Owner-accepted material obtained from off-site borrow areas.	
Buried Pipe Identification Tape	See Section 33 05 26. See section on appropriate utility pipe or conduit material for required message	
Soil Sterilant	Combination of sodium chlorate and borates	

D. Soil and backfill materials for pipelines and utilities shall be prepared to the following specifications:

ITEM	MATERIAL	SPECIFICATION
Backfill for Over-Excavation Beneath Pipes	Concrete Slurry	1-sack cement-sand slurry mix Maximum 6" slump per ASTM C143
	Suitable Soil Material (where cement-sand slurry not required)	90% compaction per ASTM D1557 or California Test Method 216
Backfill of Tunnels beneath Concrete Flatwork	Sand	90% compaction per ASTM D1557 or California Test Method 216
Pipe Zone Material (Material from 4 to 6 inches below pipe to a plane 12 inches above top of pipe)	Native or Imported Granular Material	90% compaction per ASTM D1557 or California Test Method 216 or California Test Method 217 Minimum sand equivalence of 30 Material shall also be suitable soil material as defined above. Maximum lifts vary with equipment. See below.

ITEM	MATERIAL	SPECIFICATION
Trench Zone Material (Material in Pipe Trench above Pipe Zone and below any Street Zone)	Cement-Sand Slurry	1-sack cement-sand slurry mix
	Suitable Soil Material (where cement-sand slurry not required)	90% compaction per ASTM D1557 or California Test Method 216 Maximum lifts vary with equipment. See below. May contain stones, asphalt pavement or concrete of up to 6-inches in largest dimension so long as such solids are completely surrounded by fines so no voids are present in backfill as placed. No material greater than two inches in any dimension shall be placed within one foot of any pipe, valve, or structure. All backfill within 24-inches of ductile-iron fittings or valves shall be clean, washed sand. Provide buried pipe identification tape in pipe trench 18 inches above pipe
Street Zone Material (Base material in pipe trench below pavement subgrade to depth of 30 inches below finished road surface.	Crushed Aggregate Base Material	95% compaction per ASTM D1557 or California Test Method 216 Conform to Section 200-2.2, crushed aggregate base of SSPWC Contractor may substitute on-site materials conforming to Section 200-2.5, Processed Miscellaneous Base of SSPWC Maximum lifts vary with equipment. See below. Material shall also be suitable soil material as defined above. Stones concrete and clods smaller than specified limit may not exceed 20 percent of backfill volume over any pipe segment. Place in 8-inch maximum lifts.
Surface Zone Material (upper 12" of trench to finish surface in unimproved or landscaped areas)	Topsoil per Section 32 90 00	80% compaction per ASTM D1557 or California Test Method 216 Maximum lifts vary with equipment. See below.

E. Soil and backfill materials for paving shall be prepared to the following specifications:

ITEM	MATERIAL	SPECIFICATION
Backfill for Over-Excavation Beneath Paving	Concrete Slurry	1-sack cement-sand slurry mix Maximum 6-inch slump per ASTM C143
	Suitable Soil Material (where concrete slurry not required)	90% compaction per ASTM D1557 or California Test Method 216
Roadway/Paving Fills > 3' Below Base	Suitable Soil Material	90% compaction per ASTM D1557 or California Test Method 216 Place in 4' maximum lifts
Top 3' of Roadway/Paving Fills Below Base	Suitable Soil Material	90% compaction per ASTM D1557 or California Test Method 216 Place in 8" maximum lifts
Roadway/Paving Base	Crushed Aggregate Base Material	95% compaction per ASTM D1557 or California Test Method 216 Conform to Section 200-2.2, crushed aggregate base of SSPWC Contractor may substitute on-site materials conforming to Section 200-2.5, Processed Miscellaneous Base of SSPWC Maximum lifts vary with equipment. See Section 32 12 16 for asphalt-concrete paving or 32 13 13 for concrete paving

Soil and backfill materials for structures shall be prepared to the following specifications:

ITEM	MATERIAL	SPECIFICATION
Backfill for Over-Excavation Beneath Structures	Concrete	Section 03 30 00 Class A
Backfill of Tunnels Beneath Concrete Flatwork	Sand	90% compaction per ASTM D1557 or California Test Method 216
Structural Bedding Beneath Footings, Slabs and Sand Blanket	Crushed Aggregate Base Material	95% compaction per ASTM D1557 or California Test Method 216 Conform to Section 200-2.2, crushed aggregate base of SSPWC Contractor may substitute on-site materials conforming to Section 200-2.5, Processed Miscellaneous Base of SSPWC If plans are silent regarding thickness, provide 8" layer of aggregate beneath 4" sand layer
Sand Blanket Beneath Slabs	Sand	90% compaction per ASTM D1557 or California Test Method 216 If plans are silent regarding thickness, provide 4" sand layer with 10-mil PVC vapor barrier with sealed laps in center of sand layer.

PART 3 - EXECUTION

3.1 Preparation

- A. Contractor's attention is directed to possible existence of pipe and other underground improvements which may or may not be shown on Plans. Preserve and protect any such improvements whether shown or not. Where necessary to remove and replace or to relocate such improvements to prosecute Work, improvements shall be removed, maintained, and permanently replaced by Contractor at their expense, except as otherwise provided in Contract Documents.
- B. Section 4216 of the California Government Code states Contractors *"planning to conduct any excavation shall contact the appropriate regional notification center at least two working days but not more than 14 calendar days, prior to commencing excavation."*
- C. Preparation for fill shall proceed as follows:
1. Areas to receive fill shall first be cleared and grubbed per Section 31 10 00.
 2. Areas shall then be scarified to provide a bond between existing ground and fill material to be deposited thereon.
 3. When fills are to be placed over existing surface improvements to remain in place cut 4" drainage holes through structure or paving at 5' centers each way, or break or saw-cut pavement in grid pattern of 5' each way with minimum ¼" gap between broken sections.
- D. Control of runoff and groundwater shall comply with the following:
1. Control grading to prevent water running into excavations. Do not obstruct surface drainage. Provide swales, gutters temporary drains or other means of channeling flow without interruption around excavations.
 2. Preserve existing drainage patterns except as otherwise shown. Where construction methods cause temporary obstruction of drainage patterns, provide temporary facilities adequate for expected flows and a means of emergency removal of obstruction.

3. Procure permit from appropriate Regional Water Quality Control Board for all groundwater dewatering operations.
 4. Provide and maintain ample means and devices and promptly remove and properly dispose of all water from any source entering excavation or other parts of Work. Dewatering methods shall ensure preservation of final lines and grades of bottoms of excavations. Said methods may include well points, sump points, suitable rock or gravel placed below required bedding for drainage and pumping purposes, temporary pipelines, and other means that will not be detrimental to proposed construction. Contractor is responsible for obtaining all water discharge permits required.
 5. Dewatering for structures and pipelines shall commence when groundwater is first encountered and shall continue until water can be allowed to rise in accordance with provisions of this section.
 6. Do not place concrete footings or floors in water. Do not allow water to rise over Work until concrete or mortar has set at least 8 hours. Do not allow water to rise unequally against walls for 28 days. Do not allow groundwater to rise around pipe until jointing compound in joints has set hard.
 7. Dispose of water in suitable manner without damage to adjacent property. Do not drain water into Work built or under construction without prior consent of Owner's Representative. Dispose of water according to permits and in such manner as not to be a menace to public health and public or private property.
- E. Obtain written permission from Owner prior to any blasting or use of explosives. Explosives, if used, shall be of such quantity and power and shall be used in such locations as to minimize opening of seams and disturbing of material outside prescribed excavation limits. As excavation approaches its final limits, reduce depths of holes for blasting and quantity of explosives used for each hole so to minimize disturbance of underlying or adjacent material.
- F. Protection of open excavations shall comply with latest revision of rules, orders and regulations of Division of Industrial Safety of State of California. Nothing contained in these Contract Documents shall be construed as relieving Contractor of full responsibility for providing shoring, bracing, sloping or other provisions adequate to guarantee worker protection and safety.
1. Vertical supports including steel H-beams and piles shall be drilled into place, except final 4 feet may be driven.
 2. Where drilling is impracticable because of rocks or running sand, Owner's Representative may accept placing of vertical supports by means other than drilling, provided Contractor assumes sole responsibility to protect existing surface and subsurface improvements in place.
 3. If sheeting is used for trench support, no sheeting shall remain in trench upon project completion except where removal of portions of said sheeting is impracticable in opinion of Owner's Representative.
- G. No material shall cause undue interference with public travel. Provide free access to all fire hydrants, water valves, meters, and private drives, or other property or facilities that may have routine or emergency use.
- H. Do not deposit backfill against new concrete structures until concrete has developed specified 28-day compressive strength.

3.2 Installation

- A. Refer to Sections 01 73 00 and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install excavation and fill at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Requirements of contract-referenced soils reports and investigations.
 - 2. Manufacturer's installation and warranty requirements
 - 3. Applicable OSHA and Cal OSHA regulations
 - 4. California Building Code Chapter 18 "Soils and Foundations."
 - 5. Standard Specifications for Public Works Construction (Greenbook) Section 300 "Earthwork"
 - 6. Standard Specifications for Public Works Construction (Greenbook) Section 306-1 "Open Trench Excavations"
 - 7. Other applicable building code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Earthwork within public rights-of-way controlled by a state, county or city, or earthwork within railroad rights-of-way shall be in accordance with requirements and provisions of permits issued by those agencies for construction within their respective rights-of-way. Such permit requirements and provisions which are more restrictive than those specified herein, shall take precedence and supersede provisions of Contract Documents.
- F. Should contaminated soil be encountered, Contractor shall perform the following activities:
 - 1. Promptly notify Owner's Representative contaminated or potentially contaminated soil has been encountered so Owner may identify party legally responsible for disposal of contaminated soil and properly direct Contractor how to proceed.
 - 2. Conduct work in contaminated areas in accordance with applicable OSHA and Cal OSHA regulations.
 - 3. Segregate and cover contaminated soils prior to removal from site.
 - 4. Dispose of contaminated soils as directed by Owner and as required by law.
- G. Should excavation be carried below lines and grades shown, refill excavated space to proper elevation with material as specified in Part 2 above for correction of faulty grades after overexcavation.

Site grading and general excavation shall proceed as follows:

1. Stripping: Strip all vegetation such as roots, brush, heavy sods, heavy growth or grass, and all decayed vegetable matter, rubbish, and other unsuitable materials within area of Work prior to starting excavation or embankment. Trees and other natural growths outside actual lines of construction operations shall not be destroyed and such measures as are necessary shall be taken by Contractor, at their own expense, for protection thereof.
2. Excavation: After stripping, excavation of whatever substances are encountered within grading limits of Work shall be carried to lines and grades shown. All suitable excavated material shall be used to meet embankment requirements of Work. Material in excess or not suitable for embankment shall be disposed of as specified herein.
3. Embankment: After stripping, areas to receive embankment or fill shall be benched, if sloping, and scarified to a depth of 6-inches, then compacted as specified.
4. If ground is in loose, uncompacted condition after stripping, it shall be compacted as specified. Do not deposit unsuitable material in fill areas where compaction is required.
5. Unless special material is required, material for embankments or roadway fills may consist of excavated material from structures or a mixture of excavated materials and materials borrowed off-site. Leaves, grass, roots, stumps, sludge, and other organic matter shall not be deposited in any embankment or fill. Off-site sources of fill must be designated and are subject to evaluation and approval by Owner's Representative.
6. Do not place material beyond sloping lines of embankment unless so ordered by Owner's Representative. Material allowed to be placed beyond embankment lines shown shall be compacted as required above unless otherwise authorized by Owner's Representative.
7. Compact material for embankments or roadway fills by rolling with power rollers weighing at least ten tons, with sheepsfoot rollers, with vibrating rollers, or with pneumatic tire rollers, as appropriate for soil type being compacted, and as required to accomplish Work. As each layer is deposited, apply water in sufficient amounts to ensure optimum moisture to secure compaction specified. If excess moisture is encountered in fill, manipulate each layer so as to dry out excess moisture. Water shall be uniformly incorporated with fill material in amount sufficient to ensure required density after compaction.
8. Use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but traffic of such equipment shall be distributed over fill in such manner as to use compaction afforded thereby as an addition to compaction by rollers.
9. Excavate and fill to lines and grades shown with maximum slope not exceeding that shown.
10. Plan haul routes to avoid passing heavy off-highway equipment over pipelines with less than 4-feet of cover. Where crossings must be made, provide concrete encasement or accepted bridging.

11. Finish: All areas covered by Work, including excavated and filled sections and transition areas, shall be uniformly graded to elevations shown. Finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. Round edges of spoil and borrow areas to blend into natural contours. Degree of finish ordinarily obtainable from a blade grader will be satisfactory for open areas, but hand grading and raking will be required around structures and walkways. Finished surface shall be not more than 0.1-foot above or below established grade and sloped to prevent ponding.

I. Structural excavation shall proceed as follows:

1. Excavation of all material of whatever nature necessary for construction of structures and foundations shall be carried out to lines and grades shown, and as required to provide working clearance and safe construction slopes and to emplace shoring, sheeting, bracing, and other Work required.
2. Except when concrete is authorized to be placed directly against excavated surfaces, establish clear space at sides of excavation to facilitate form construction and removal and provide for excavation protective support system.
3. Where concrete is to be placed on original ground without subgrade preparation, do not use machinery using teeth nearer than 3-inches from any finished subgrade. Remove last 3-inches without disturbing subgrade.
4. Do not place backfill until structure footings or other portions of structure or facility have been inspected by Owner's Representative and accepted for backfilling.
5. Place backfill in horizontal layers, moistened and tamped, rolled or otherwise compacted.
6. Water settling will not be permitted. Place backfill so no additional unbalanced loading occurs during placing.
7. Take care when backfilling to obtain adequate compaction beneath pipes and to avoid injury or displacement of such pipes.

J. Pervious material shall be placed as follows:

1. Place pervious material in layers following specifications for structural backfill.
2. Pervious material at any location shall come from the same plant and conform to the same grading.
3. Where pervious material would be exposed to erosion, cover with 12 layer of topsoil or other earthy material accepted by Owner's Representative.

K. Backfill over pipe shall proceed as follows:

1. After pipe has been properly laid, exterior joints grouted and inspected, begin backfilling operations using material as specified above.
2. Contractor will be held responsible for any displacements of pipes or other structures, any damage to them or any instability caused by improper depositing of backfill material or improper use or handling of tools or equipment.

3. Backfill pipe located in public traveled right-of-way at end of each day's operations in accordance with applicable permit requirements. Remove spoil piles from traffic lanes by end of working day.
4. Mechanical densification or compaction of backfill shall use rolling, vibrating or impact means, or a combination thereof. Method or methods used shall result in obtaining compaction of backfill in various specified zones and within maximum lifts specified. Densification or compaction method or methods used shall not damage pipe, adjacent ground, existing improvements, or improvements installed as part of Work.
5. Place material for mechanically compacted backfill in lifts which, prior to compaction, shall not exceed depths specified for various types of equipment.
 - a. Hand directed mechanical tampers - maximum lift depth of 6-inches in pipe zone, 8 inches elsewhere.
 - b. Impact, free-fall, or "stomping" equipment - maximum lift depth of 3-feet. Not appropriate over rigid or cement-mortar lined pipe or PVC.
 - c. Vibratory equipment with smooth contact surface - maximum lift depth of 2-feet.
 - d. Rolling equipment, including, vibratory interrupted surface equipment - maximum depth of 1-foot.
6. Contractor is advised water settling in pipe zone triggers a requirement under AWWA C651 paragraph 5.1.2 to perform bacteriologic testing at 200-foot intervals instead of 1200-foot intervals. Should Contractor elect to use water settling for potable water pipelines, Contractor shall perform additional disinfection required under AWWA C651 at no additional cost to Owner.
7. Water settling may be used in pipe zone and trench zone in lieu of mechanical compaction, only where material being backfilled is sufficiently sandy and permeable so specified compaction is achieved. Densification by saturation shall be accomplished by inserting a pipe, through which water is being supplied under pressure, to bottom of lift of material to be consolidated, and applying to each square yard or lesser surface area in this manner sufficient water to completely saturate overlying backfill and cause obvious settlement. Where water settling is used, exercise care to prevent pipe from floating. Do not use water settling in street zone.
8. Contractor may use densification by saturation only when it has been determined it will not result in damage to adjacent ground, existing improvements or improvements installed for Work, and that it is appropriate to obtain specified compaction. Some encroachment permits limit methods of densification or compaction. In addition, use of densification by saturation is subject to all the following requirements.
 - a. Apply water in manner, quantity and rate sufficient to saturate thickness of lift being densified.
 - b. Vibrating compacting equipment may be necessary to supplement water saturation process where required densities cannot be attained by saturation alone.
 - c. Lift thickness of backfill shall not exceed that which can be readily densified by saturation procedure. In no case shall undensified lift exceed 5-feet.

- d. Character of material excavated from trench may be generally, or in zones, unsuitable or densification with water. In this case, Contractor may, at no additional cost to Owner, import suitable material for saturation, or densify excavated material by mechanical compaction. If water does not readily drain from trench, it shall be removed by sump pump.
9. Control of Trench Backfill by Zones: Whether mechanical compaction or densification by water saturation is employed, backfill shall be constructed by zones, and compaction requirement for each zone followed unless otherwise specified.
- L. Backfill in pipe zone shall occur as follows:
1. Hand-place backfill simultaneously on each side of pipe for full trench width, moistened as required to achieve specified compaction.
 2. In placing and compacting backfill, give particular attention to underside of pipe and fittings to provide firm support along full pipe length.
 3. Place locating tape 6 to 12 inches above top of pipe or at location shown on Owner's standard drawings.
 4. Take care in backfilling to avoid damage to pipe coating, locating tape and any conduits that may be installed in pipe zone. Complete pipe zone compaction before covering it with trench zone material.
- M. Backfill in trench zone shall use either mechanical compaction or water settling, depending on nature of material. Complete trench zone compaction before covering it with street zone material.
- N. Backfill in street zone shall occur as follows:
1. Backfill in traveled ways and public streets shall be in accordance with right-of-way agreement, encroachment permit or applicable regulations of agency having jurisdiction over traveled way. In absence of such provisions, compact soil by accepted hand-, pneumatic or mechanical-type tampers.
 2. Water consolidation will not be permitted.
 3. Construct pavement section in accordance with Contract Documents.

3.3 Field Quality Control

- A. Owner's Representative will provide continuous inspection of fill and will field test fill and earth backfill as placed and compacted, and inspect excavations and subgrade before concrete is placed and provide periodic inspection of open excavations, embankments, and other cuts or vertical surfaces of earth.
- B. Owner's Representative will observe and test fills and based on laboratory results will determine whether fills have been placed in accordance with Contract Documents.
- C. Owner's Representative may require deepening of footings and order such deepening based on uncovered soil conditions.

Whenever excavated material is not suitable for backfill, Contractor shall at their expense arrange for and furnish suitable imported backfill material which is capable of attaining specified relative density. Contractor shall also arrange for removal and off-site disposal of unsuitable excavated material at their own expense.

- E. Special inspection and field testing required by Chapter 17 of CBC (Table 1704.7) for controlled fill shall be completed by an ICBO-certified special inspector selected by Owner and shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Subgrade Beneath Controlled Fill	Preparation of Site Beneath Fill	CBC Section 1704.7 and Soils Report	Periodic per CBC Table 1704.7	Owner	Contractor to reimburse Owner for costs of first deputy inspector if re-inspection is required
Controlled Fill	Classification and Testing of Controlled Fill Materials				
	Materials, Densities and Lift Thicknesses		Continuous per CBC Table 1704.7		

- F. Special inspection and field testing required by Chapter 17 of CBC (Table 1704.7) for subgrade beneath structures, footings and foundations shall be completed by an ICBO-certified special inspector selected by Owner and shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Subgrade Beneath Structures and Footings	Material and Bearing Capacity Verification	CBC Section 1704.7 and Soils Report	Periodic per CBC Table 1704.7	Owner	Contractor to reimburse Owner for costs of first deputy inspector if re-inspection is required
	Excavation Depth and Material Verification				

- G. For testing purposes, percentages shall be determined by weight.
- H. Make all necessary excavations for compaction and other soils tests as directed by Owner's Representative.
- F. "Relative compaction" is ratio, expressed as percentage, of in-place dry density to laboratory maximum dry density.
- G. Compaction shall be deemed to comply with Contract Documents when no more than one test of any 3 consecutive tests falls below specified relative compaction. Failing test shall be no more than 3 percentage points below specified compaction. Contractor shall pay costs of any retesting of Work not conforming to Contract Documents.
- I. Allow sufficient time for testing and evaluation of results before material is needed. Owner's Representative will be sole and final judge of suitability of all materials.
- J. Do not use materials in question pending test results.

Contractor shall remove unsatisfactory material, recompact, adjust moisture or compaction methods, place new material, and perform other operations necessary to meet Contract requirements as directed by Owner's Representative whose decisions and directions will be considered final on these matters.

- L. Owner's Representative will not provide and is not being paid to provide directions or submittal review regarding Contractor's excavation safety procedures. Any questions or concerns of Owner's Representative will be referred to CAL/OSHA whose decisions or directions shall be considered final.

3.9 Adjusting and Cleaning

- A. Make necessary arrangements for and remove and dispose of all surplus excavated material off-site, unless otherwise provided for in Contract Documents. All costs for disposal of surplus waste material shall be borne by Contractor.
- B. Dispose of all surplus material not required for backfill or fill. Disposal shall occur outside limits of public rights-of-way and/or easements. Disposal shall comply with applicable ordinances and regulations of governmental agencies having jurisdiction and shall be done at no cost or liability to Owner.
- C. Do not deposit excavated material on private property unless written permission from property owner is secured by Contractor. Before Owner will accept Work as being completed, Contractor shall file written release signed by all property owners with whom they have entered into agreements for disposal of surplus excavated material absolving Owner from any liability connected therewith.
- D. Do not deposit excess material in water courses or other locations where disposed material will interfere with natural drainage.
- E. After backfill is completed, dress site smooth and leave site in neat and presentable condition, free of all cleared vegetation, rubbish and other construction wastes. Haul away and legally dispose of surplus rock or other excavated material which cannot be used for backfill. Areas next to structures where blade-type equipment cannot reach shall be hand raked.

END OF SECTION

**SECTION 33 05 16
PRECAST CONCRETE UTILITY STRUCTURES**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of precast concrete vaults.
- B. Precast concrete manholes are covered in Section 33 39 13.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 03 20 00: Concrete Reinforcing
- I. Section 03 30 00: Cast-in-Place Concrete
- J. Section 07 72 33: Roof and Floor Hatches
- K. Section 31 23 00: Excavation and Fill
- L. Section 33 39 13: Precast Concrete Manholes

1.3 System Description

- A. Furnish and install complete precast concrete vault including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
- B. Precast concrete vault dimensions shown on Plans are interior dimensions.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Concrete Vault	Concrete Strength	ASTM C31	Submit certified test record on request	Contractor	Contractor

1.5 References

- A. ASCE 7 Building Code Requirements for Minimum Design Loads in Buildings and Other Structures
- B. ASTM A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- C. ASTM C31 Making and Curing Concrete Test Specimens in the Field

- ASTM C150 Portland Cement
- E. ASTM C913 Precast Concrete Water and Wastewater Structures
- F. ASTM D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
- G. California Building Code (CBC)
- H. CRSI Manual of Standard Practice

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per structural shop drawing requirements	.
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements	
Engineering Calculations	Required for rebar for vaults over 10' deep or with lateral footing loads per engineering calculations requirements sealed by licensed California Civil Engineer. Required to justify designs less than Class 700 specified.	
	Required for concrete mix design per engineering calculations requirements sealed by licensed California Civil Engineer.	
Test Record Transcripts	Submit for factory tests per test record transcript requirements	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, engineering calculations, and test record transcripts.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of precast concrete vaults shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Meter Boxes	Armorcast	
	Accepted Equal	
Utility Vaults	Brooks Products	Ontario, CA
	Eisel Enterprises, Inc.	Placentia, CA
	Jensen Precast	Sparks, NV
	J & R Concrete Products	Perris, CA
	Olson Precast Company	Rialto, CA
	Rockway Precast	North Las Vegas, NV
	Utility Vault Division Oldcastle Precast	Fontana, CA
Accepted Equal		

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Precast concrete vaults shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Vault	Portland Cement Concrete	See Section 03 30 00 Fly ash not permitted
Steel Reinforcing	Steel	See Section 03 20 00
Hatches, Lids, Frames	Metals	See Section 07 72 33
Joint Sealant	Grout	See Section 03 60 00
	Mortar	One part Portland cement to two parts well-graded sand passing No. 8 sieve per Section 03 30 00.
	Plastic Sealing Compound	See Section 07 92 00

- C. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Pre-Cast Concrete Vault Sections	Design Surcharge and Lateral Earth Pressure	AASHTO H-20 Loading
	Minimum 28-day Compressive Strength f_c	4000 psi
	Steel Reinforcing Yield Strength f_y	60 ksi
Rectangular Box Wall Design	Wall Design	Class 700, or submit sealed engineering calculations justifying a lesser design.
	Roof Design	Design for H-20
	Dimensions	per ASTM C913 Table X1.1
	Reinforcement	per ASTM C913 Table X1.2

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install precast concrete vaults before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Refer to Section 31 23 00 for open trench requirements.
- C. Furnish and install precast concrete vaults at locations shown on Plans and submittals.
- D. The following installation standards shall be followed:
1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. Applicable building code requirements

Refer variances between above documents and Contract Documents to Owner's Representative.

- F. Install precast concrete vaults to tolerances recommended by Manufacturer. Unless otherwise shown, install precast concrete vaults true, plumb, and level using precision gauges and levels.

3.3 **Field Quality Control**

- A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Precast Concrete Vaults	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed Literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

SECTION 33 05 24 UTILITY PIPE JACKING

PART 1 - GENERAL

1.1. Work Included

- A. Materials and installation of jacked steel casing and carrier pipe using horizontal boring-and-jacking methods.

1.2. Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 09 90 00: Painting and Coating
- H. Section 31 23 00: Excavation and Fill
- I. Section 33 08 11: Pressure Testing and Flushing of Water Utilities

1.3. System Description

- A. Furnish and install complete casing pipe and carrier pipe to limits shown on Plans including appurtenant connections in conformance with Manufacturer's installation requirements and compliance with applicable construction and safety codes and standards.
- B. Limits of boring and jacking shown on Plans may be increased by Contractor for Contractor's convenience. However, Owner's acceptance to increase limits of boring and jacking must first be obtained.
- C. Where Owner accepts increase in jacking limits, payment will be based on original jacking limits.
- D. Method and equipment used in jacking operation shall be optional with Contractor; however, proposed method must be first reviewed and accepted by Owner. Method and equipment chosen shall use methods taking due regard for worker safety, adjacent structures and improvements, utilities, and public. Owner's acceptance shall in no way relieve Contractor from responsibility for damages of any nature which might result from method used or responsibility to comply with Contract Documents.

1.4. Quality Assurance

- A. Bore-and-jack operations shall be performed by qualified contractor with at least 5 years experience in work of similar nature.
- B. Only workmen experienced in operation of jacking steel casing shall be used on Work.
- C. All welding shall be performed by qualified welders, welding operators, and tackers who have had prior experience with type of material used. Welders shall be qualified under provisions of ANSI/AWS D1.1 by independent local, approved testing agency not more than 12 months prior to commencing Work on casing. Machines and electrodes similar to those used in Work shall be used in qualifications tests. Contractor shall bear full expense of qualifying welders.

- D. All welding procedures used to fabricate steel casings shall be pre-qualified under provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or special welds for pipe cylinders, casing joint welds, reinforcing plates, and grout coupling connections.
- E. Install casing subject to acceptance by of agencies having jurisdiction over area containing bore-and-jack operations. Work shall conform to requirements of encroachment permits and property use permits issued by agencies having jurisdiction.
- F. Contractor is solely responsible for jobsite safety. Contractor shall perform Work in manner to maximize safety, avoid exposure of workers, and control dust, fumes, vapors, gases, or other atmospheric impurities in accordance with OSHA, Federal, State, and local requirements.
- G. Comply with all permit requirements and with “Tunnel Safety Orders” of Division of Industrial Safety of State of California as outlined in Title 8 of California Administrative Code.

1.5. References

- A. Title 8, California Administrative Code, “Tunnel Safety Orders”
- B. AWWA C210 Liquid Epoxy Coatings for Interior and Exterior of Steel Water Pipelines
- C. AWS Standard Qualification Procedure for Manual Welding Operators
- D. ASTM American Society for Testing and Materials
- E. AWWA C604 Installation of Steel Water Pipe 4” and Larger
- F. AWWA M11 Steel Water Pipe: A Guide for Design and Installation
- G. AWWA M23 PVC Pipe – Design and Installation

1.6. Submittals

- A. Furnish the following submittals:

SUBMITTAL	DESCRIPTION	
Division of Mining and Safety Permit	Submit copy of permit and gas classification	
Catalog Data	Required per Catalog Data requirements.	
	Required for steel casing pipe, grout couplings, grout, casing insulators, casing end seals, and carrier pipe.	
Experience	Documentation of qualifications and experience of boring-and-jacking subcontractor including name and telephone number of references for 3 projects. Provide name of site safety representative and person responsible for gas testing with evidence of CAL/OSHA certification for each, respectively.	
Installation Methods	Submit description of methods, procedures, and equipment to be used to install casing pipe. Show methods proposed for temporary ventilation and for checking line and grade of casing. Indicate location of muck disposal sites. Show locations and dimensions of all jacking and receiving pits with procedures and methods proposed to install carrier pipe, including blocking details and spacing of blocking points. Provide calculations for anticipated jacking loads and details for thrust block. Use 2.0 safety factor to design thrust block.	
Schedule	Submit casing installation schedules that address excavation, casing and carrier pipe installation, and backfill operations.	
Fabrication Drawings	Material list and casing details including diameter, thickness, physical and chemical properties, and class of steel casing pipe. Provide fabrication drawings and certificates of compliance from casing supplier.	
Welding Procedures	Welding procedures under provisions of ANSI/AWS D1.1.	

SUBMITTAL	DESCRIPTION	
Dewatering	Groundwater control methods, SWPPP BMP, drawings, details, calculations, and supporting information.	
Warranty	Furnish one-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for catalog data,

1.7. Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Transportation shall be by competent haulers and accomplished in a manner that will avoid damage to pipe, its lining, or coating.
- C. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of steel pipe shall be strictly followed.
- D. Handle pipe and special fittings carefully. Use blocking and holddowns during shipment to prevent movement or shifting.

1.8. Unit Prices

- A. Payment for Work in this section shall be included as part of lump sum or unit-price bid amount for which such Work is appurtenant, including all Work and materials specified herein and as may be required to install and complete this portion of Work.
- B. Where bid items are provided for payment per lineal foot of bore-and-jack installed casing and carrier pipe, measurement shall be made horizontally over pipe centerline between jacking limits as indicated on Plans.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Casing Insulators - Metallic	Pipeline Seal and Insulator, Inc. (PSI)	Houston, TX
	Smith Blair “800” Series	Texarkana, AR
	T Christy Enterprises (714) 507-3300	Anaheim, CA
	Accepted equal	
Casing Insulators – Non-Metallic	Pipeline Seal and Insulator, Inc. (PSI) “Ranger”	Houston, TX
	T Christy Enterprises (714) 507-3300	Anaheim, CA
	Accepted equal	
Casing End Seals Rubber	Pipeline Seal and Insulator, Inc. (PSI) Model S	Houston, TX
	T Christy Enterprises (714) 507-3300	Anaheim, CA
	Accepted equal	
Casing End Seals Heat Shrinkable	T Christy Enterprises (714) 507-3300	Anaheim, CA
	Accepted equal	

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Steel casings shall be welded steel pipe no less than minimum diameter and thickness shown on Plans or specified herein.
- C. Each end of steel casing shall be factory beveled to accommodate field welding.
- D. Only new steel casing pipe shall be used for jacking operations. Any section of steel casing showing signs of failure shall be removed and replaced with new section adequate to sustain loads imposed upon it.
- E. Design of steel casing, as shown on Plans, is based on superimposed loads and not necessarily on loads that may be placed upon it due to jacking operations. Contractor may increase casing diameter or wall thickness for method of Work, loadings involved, and site conditions, at no additional cost to Owner subject to review and additional requirements of Owner's Representative. Any increases in casing diameter shall not interfere with existing utilities.
- F. Steel casing pipe shall have the following minimum diameters unless otherwise shown on Plans:

NOMINAL PIPE SIZE	MINIMUM STEEL CASING ID
4"	8"
6"	10"
8"	14"
10"	16"
12"	18"
14"	24"
15"	24"
16"	28"
18"	30"
20"	32"
21"	32"
24"	36"
27"	38"
30"	44"
33"	46"
36"	48"
42"	54"
48"	60"

- G. Recommended casing diameters are based on AWWA M23.
- H. Casings 36" in diameter and larger shall have grout couplings sufficient in number and spacing for contact grouting annular void outside casing due to overcutting.
- I. Steel casing pipe shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Steel Casing Pipe	Steel	AWWA C200 Circumferential stress in steel shall not exceed 16,500 psi at design pressure.
	Steel Sheet or Plate	ASTM A53 Grade B or ASTM A570 Grade 33 or Grade 36
	Size	As shown on plans.
	Wall Thickness	As shown on plans
	Steel Cylinder Welds	Full penetration welds, straight or spiral seam.

- J. Carrier pipe to be jacked into casing shall be as shown on Plans. Design of carrier pipe is based on internal design pressure and normal trench conditions. Any increase in carrier pipe strength required to withstand jacking operation shall be Contractor's responsibility.
- K. Casing end seal shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Casing End Seal	Butadiene Rubber Sheet	1/4" thick
	Heat-shrinkable sleeve	Minimum 2500 psi tensile strength Use thixotropic adhesive sealant
Bands and Hardware	Stainless Steel	SAE Type 316

- L. Metallic casing spacers (casing insulators or pipe skids) shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Casing Spacer Band	Stainless Steel	SAE Type 304 14-gauge minimum 8" minimum width with 2 runners on top and 2 on bottom for carrier pipe <14" diameter / 12" minimum width with 2 runners on top and 4 on bottom for carrier pipe 14" diameter and greater Center-restrained, position type
	PVC-Coated Mild Steel	14-gauge minimum Fusion bonded PVC Coating 8" minimum width with 2 runners on top and 2 on bottom for carrier pipe <14" diameter / 12" minimum width with 2 runners on top and 4 on bottom for carrier pipe 14" diameter and greater Center-restrained, position type
Liner	PVC	0.090" thick
Risers	Stainless Steel	SAE Type 304 10-gauge minimum Welded to band
	PVC-Coated Mild Steel	10-gauge minimum Welded to band
Anti-Friction Runners	Polyethylene, Polypropylene or Glass-Reinforced Polymer	Heavy-duty, 2" minimum width at ends
Studs, Nuts and Washers	Stainless Steel	5/16" SAE Type 304

- M. Non-metallic casing spacers (casing insulators or pipe skids) shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Casing Spacer Band and Risers	Polypropylene	Center-restrained, position type

- N. Casing insulators shall be of such dimensions to center carrier pipe within casing and prevent it from flotation.
- O. Provide at least 1" but no more than 2" clearance between top runner and soffit of casing.

2.3 Mixes

- A. Lean grout shall consist of one part portland cement, 4 parts sand and sufficient water to produce workable mixture.

PART 3 - EXECUTION

3.1 Preparation

- A. Pothole existing utility crossings before boring to verify no conflicts will interfere with boring operations.
- B. Notify Owner's Representative at least 3 days in advance of start of boring operations.
- C. Boring and jacking shall not begin until the following conditions have been met:

CONDITION	DESCRIPTION
Submittals	Submittals made and reviewed
Pre-Construction Surveys	Surveys completed, including installation of settlement points and their initial survey.
Shaft Excavation and Support	Shaft excavation and support has been completed in accordance with specifications and applicable safety rules.
Groundwater Control	Groundwater control for breaking out of jacking pit has been established.
Pre-Construction Safety Conference	Conduct pre-construction safety conference per CAL/OSHA requirements. Inform Owner of time and place of conference at least 7 days in advance.
Safety	Contractor's site safety representative shall prepare code of safe practices and emergency plan in accordance with CAL/OSHA requirements. Provide Owner with copy of each document prior to beginning tunnel excavation. Hold safety meetings and provide safety instruction for new employees as required by CAL/OSHA.
Equipment and Materials	Furnish at jobsite all necessary equipment, power, water, and utilities for excavation, pipe jacking, bentonite mixing and pumping, removal and disposal of spoil, grouting, and other associated work consistent with Contractor's methods of construction. Jacking equipment and methods shall be compatible with anticipated geologic conditions identified in geotechnical reports described in Special Provisions. Provide suitable jacking frame and thrust block to carry out Work.

- D. No gasoline-powered equipment shall be permitted in jacking and receiving pits. Diesel-, electric-, and pneumatic-powered equipment will be acceptable, subject to applicable local, state, and federal regulations.

3.2 Installation

- A. Refer to Section 01 73 00, AWWA C604, and AWWA M11 for basic execution and installation requirements.
- B. Fit steel jacking head to head section of casing so it extends around entire outer surface of steel casing and projects at least 18 inches beyond leading end of casing. Jacking head shall not be more than 1/2" greater in diameter than outside diameter of casing surface (i.e. 1/4" radial overcut). Securely anchor head to prevent any wobble or alignment variation during boring and jacking operation.
- C. Provide jacks of adequate capacity to push casing through soil as required to complete bore-and-jack operation. Provide suitable jacking frame and thrust block to carry out Work.
- D. Set casing to be jacked on guide rails, properly braced to support casing, and direct it in proper line and grade. Line up jacking assembly in direction and grade of tunnel. Weld or connect casing joints completely prior to jacking.

Perform excavation entirely within jacking head and not in advance of head to minimize voids outside casing. Coordinate advance of casing and boring rate to avoid over-excavation. Maintain soil plug inside jacking head and steel casing as required to minimize loss of ground. At no time shall boring excavation progress ahead of jacking head casing (i.e. no unsupported tunneling or free bore is allowed). Restrict excavation of material to minimum clearance necessary to prevent binding to avoid loss of ground and consequent settlement or possible damage to overlying pavement, utilities, or structures. Pressure grout all voids.

- F. Excavated materials shall be removed from casing as boring-and-jacking operation progresses. No accumulation of excavated materials within casing shall be permitted. Dispose of all excavated materials from casing in accordance with Contract Documents and applicable laws.
- G. All welded joints shall be single-welded butt joints. Welds shall be full circumference and full strength. No voids in welds shall be allowed, and joints shall not allow water to leak into casing pipe.
- H. Jacking and receiving pits shall be constructed in accordance with the following:
 - 1. Jacking and receiving pits shall be located as shown on Plans, or if not shown on Plans, as determined by Contractor in accordance with Contractor's tunnel work plan. Design size and location of jacking pits as necessary so as to maintain vehicle traffic access around pits.
 - 2. Jacking and receiving pits shall be tight sheeted and braced in such manner as to provide safe working conditions and to protect any adjacent facilities or structures in accordance with all CAL/OSHA safety requirements. Sheeting shall be adequate to withstand added loads and vibrations due to traffic. Shoring systems for jacking and receiving pits shall be designed by a California-licensed professional engineer with signed and sealed drawings submitted for review in accordance with Contract submittal procedures.
 - 3. Heavy guide timber, structural steel, or concrete cradles of sufficient length shall be provided to assure accurate control of boring alignment. Provide adequate working space within excavation to permit insertion of lengths of installed casing. Anchor or brace timbers and structural steel sections to maintain orientation of jacks in line casing axis casing. Construct thrust block, consisting of timber, concrete, or structural steel framework between jacks and casing end to provide uniform end bearing over casing perimeter and to distribute jacking pressure evenly.
 - 4. Excavated hole ahead of casing shall not be more than 0.10-foot greater than outside limits of jacking head. Sluicing or jetting with water ahead of casing will not be permitted. When material begins to cave in from outside these limits, face of excavation shall not extend beyond end of casing greater than 1½-feet, unless permitted by Owner. Areas resulting from caving or excavation outside above limits shall be backfilled with sand or grout by Owner-accepted method which will fill voids.
 - 5. After jacking equipment and excavated materials from boring and jacking operations have been removed from jacking and receiving pits, prepare bottom of pits as a pipe trench foundation. Backfill excavations, compact backfill materials, and restore jacking and receiving pit sites in accordance with Section 31 23 00.
- I. Immediately after completion of jacking operation, inject lean grout through grout couplings in such manner as to completely fill all voids outside casing pipe resulting from jacking operation. Lean grout shall consist of 1 part Portland cement, 4 parts sand, and sufficient

water to produce workable mixture. Control grout pressure to avoid deformation of casing and avoid movement of surrounding ground. Sand for lean grout shall be of such fineness that 100% will pass No. 8 sieve and not less than 35% will pass No. 50 sieve. After completion of grouting, close grout couplings with malleable iron or cast-iron threaded plugs.

- J. Install carrier pipe as shown on Plans in accordance with specified tolerances. Contractor shall be solely responsible for installation methods and procedures, which shall be in accordance with pipe Manufacturer's recommendations. If bell and spigot carrier pipe is specified, Contractor shall employ appropriate methods to assure pipe joints are not "over-belled".
- K. Remove all loose soil from casing. Install casing insulators to support carrier pipe and prevent movement or damage to carrier pipe during installation. Each section of carrier pipe shall be supported by at least 3 casing insulators with one casing insulator approximately 1 foot from each end of carrier pipe and one casing insulator in longitudinal center of carrier pipe.
- L. When warning tape is used on mainline or when carrier pipe to be jacked is reclaimed water line without purple color coding and stenciled warning, attach warning tape to carrier pipe prior to strapping on casing insulators (pipe skids).
- M. Annular space between casing and carrier pipe shall be left void unless otherwise specified on Plans. Both ends of casing between casing and carrier pipe must be sealed water-tight around exterior casing and carrier pipe.

3.3 Field Quality Control

- A. Driving ends of steel casing shall be properly protected using jacking head and steel casing and shall be jacked true to grade and alignment shown on Plans with allowable maximum deviation in grade of 0.25 feet per 100 feet of jacked steel casing and with an allowable maximum deviation in alignment of 0.50 feet per 100 feet of jacked steel casing.
- B. Control application of jacking pressure and excavation of materials ahead of casing as it advances to prevent casing from becoming earthbound or from deviating from required line and grade. Remove augers and other obstructions, and check line and grade using surveying methods from inside casing, or other methods approved by Owner, at least every 60 feet or every third casing section, whichever is less, unless permitted otherwise in writing by Owner. Verify line and grade of casing at least 2 times during progress of each bore and jack operation.
- C. Hydrostatic testing of carrier pipe shall be completed in accordance with pipe testing requirements of Section 33 08 11. Sufficiently block and brace carrier pipe to protect pipe during hydrostatic testing.

3.4 Cleaning

- A. Thoroughly clean casing of soil, trash, construction materials, and debris prior to jacking carrier pipe into place.

3.5 Protection

- A. Contractor shall be responsible for preventing settlement or heave of overlying roadways, improvements, and all other damage due to boring and jacking operations.

Where casing is installed by bore-and-jack methods, surface settlement monitoring stations shall be established. Each monitoring station shall include one point on pipe centerline and 2 points offset 15 feet to left and right of pipe centerline.

- C. In unimproved areas, where required on Plans, monitoring stations shall be located every 100 feet along pipe centerline. If total length of bore-and-jack is less than 200 feet, place monitoring station at longitudinal center of bore-and-jack alignment. Bore-and-jack runs in unimproved areas less than 100 feet in length do not require a monitoring station at longitudinal center of bore-and-jack alignment, unless otherwise shown on Plans.
- D. In paved areas, and at railroad crossings, bridges and drainage channels and other structures, monitoring stations shall be located every 25 feet along pipe centerline unless otherwise indicated on Plans.
- E. One monitoring station at each end of casing shall serve as "Subsurface Settlement Monument" and be installed on casing centerline about 25 feet from each end of casing segment between jacking and receiving pits. Two Subsurface Settlement Monuments shall be installed on each casing.
- F. Contractor shall have California-licensed Land Surveyor survey each settlement monitoring station and Subsurface Settlement Monument at least once per day during bore-and-jack operation, and shall monitor each settlement monitoring station and Subsurface Settlement Monument one month following completion of bore-and-jack operation. Contractor shall report survey results, accurate to within accepted surveying standards, to Owner the same day that they are recorded. Contractor shall immediately report to Owner any indication of settlement or heave. Results shall be presented in graphic format showing total cumulative vertical movement per day, with time in 1-day increments plotted on horizontal axis. Results shall be accurate to 0.01 foot and shall be plotted on vertical axis to nearest 0.01 foot.
- G. Contractor shall be fully responsible for correcting all pavement settlement and any other damage that occurs as a result of installation of casing.
- H. Conduct all operations so trucks and other vehicles do not create dust nuisance in streets and adjacent properties. Promptly remove and dispose of any muck or slurry spillage at approved disposal sites complying with state regulations. Perform Work so as not to disturb roadways, adjacent structures, landscaped areas outside of limits of construction or easement, or utilities. Any damage shall be immediately repaired to satisfaction of Owner, agency, property owner or utility having jurisdiction, at no additional cost to Owner.

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**SECTION 33 05 26
UTILITY IDENTIFICATION**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of buried utility identification systems including signs, markers, flags, and trace wires.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution

1.3 System Description

- A. Furnish and install complete utility identification products including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. California Fire Code (CFC)
- B. California Mechanical Code (CMC)
- C. California Plumbing Code (CPC)

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation or application instruction requirements.	
Material Samples	Required	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for catalog data, installation instructions, and material samples.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.



Manufacturer's instruction and warranty requirements for delivery, storage and handling of utility identification products shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Identification Tape	Calpico, Inc.	South San Francisco, CA
	Terra Tape Division Reef Industries	Houston, TX
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Utility identification products shall identify the following:

FLUID
Groundwater
Potable Water
Recycled Water
Wastewater

PART 3 - EXECUTION

3.1 Preparation

- A. Examine areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of Work.

3.2 Installation

- A. Refer to Section 01 73 00 and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install utility identification products at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. Other applicable fire, plumbing, mechanical and electrical code requirements
- D. Refer variances between the above documents and Contract Documents to Owner's Representative.
- E. Install utility identification products to tolerances recommended by manufacturer.

3.3 Field Quality Control

A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Utility Identification Products	Installation	Visual inspection of finished installation	1 inspection	Owner	Owner

END OF SECTION

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SECTION 33 05 31 PIPING JOINT MATERIALS

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of piping joint materials including bolts, nuts, washers, flange gaskets, and preparation for pipe welding.
- B. Bolts and nuts for flanges, grooved or shouldered couplings, sleeve type couplings and flange coupling adaptors and harnesses shall use materials specified herein.
- C. Where dissimilar metals are in contact, flange insulating kits and threaded insulating bushings are required and included in Section 33 05 32.
- D. Joint materials for bell and spigot joints and adhesive or solvent-weld joints are covered in applicable sections for pipe material being joined.
- E. For pipelines buried in soils containing organic solvents or petroleum products use gaskets and elastomers compatible with soil chemistry.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 33 05 32: Flange Insulating Kits and Threaded Insulating Bushings
- H. Section 33 05 33: Couplings, Tie Rods, Flange Connectors, and Unions

1.3 System Description

- A. Furnish and install bolts, nuts, washers and flange gaskets where required, including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable codes and standards.

1.4 References

- A. ASME/ANSI B1.1 Unified Screw Threads
- B. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- C. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
- D. ASME/ANSI B16.21 Non Metallic Flat Gaskets for Pipe Flanges
- E. ASME/ANSI B16.42 Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300
- F. ASME/ANSI B16.47 Large Diameter Steel Flanges NPS 26 through NPS 60
- G. ASME/ANSI B18.2.1 Square and Hex Bolts and Screws (Inch Series)
- H. ASME/ANSI B18.2.2 Square and Hex Nuts (Inch Series)
- I. ASME/ANSI B1.20.1 National Pipe Thread Taper
- J. ASME B31.3 Process Piping
- K. ASTM A193 Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

- ASTM A194 Carbon and Alloy Steel Nuts for High Pressure and High Temperature Service
- M. ASTM A307 Carbon Steel Bolts and Studs, 60,000-psi Tensile Strength
- N. ASTM A563 Carbon and Alloy Steel Nuts
- O. ASTM B98 Copper-Silicon Alloy Rod, Bar and Shapes
- P. ASTM F467 Nonferrous Nuts for General Use
- Q. ASTM F468 Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
- R. ASTM F593 Stainless Steel Bolts, Hex Cap Screws, and Studs
- S. ASTM F594 Stainless Steel Nuts
- T. AWWA C111 Rubber Gasket Joints for Ductile Iron Pressure Pipe
- U. AWWA C115/ANSI A21.15 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- V. AWWA C207 Steel Pipe Flanges
- W. AWWA C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines.
- X. AWWA C217 Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Pipelines

1.5 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	

- B. Refer to Section 01 33 00 for definition of requirements for catalog data.

1.6 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of bolts, nuts, washers and flange gaskets shall be strictly followed.

1.7 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 – PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Anti-Seize Compound for Stainless Steel Bolts and Nuts	Bostik Never Seez	
	Christy’s Antiseize	Anaheim, CA
	Husk-It Husky Lube O-Seal	
	Loctite	
	Permatex	
	Ramco Antiseize	Huntington Beach, CA
	Ramco TRX-Synlube	Huntington Beach, CA
	Accepted Equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Bolts and Nuts	Industrial Threaded Products, Inc.	Brea, CA
	Ocean State Stainless, Inc.	Huntington Beach, CA
	Pacific Coast Bolt	Santa Fe Springs, CA
	Tripac Fasteners	Corona, CA
	Western Pacific Products	Corona, CA
	Accepted Equal	
Buried Bolt Coatings	3M Company (EC 244)	Saint Paul, MN
	Protecto-Wrap	Denver, CO
	Carboline Bitumastic No. 50	Saint Louis, MO
	Engard Coatings 858	Los Angeles, CA
	Tnemec Co. (46-465 H.B. Tnemecol)	Kansas City, KS
	Accepted Equal	
NSF 61-Listed Flange Gaskets	Bluegard Div. Garlock, Inc. Style 98206	Palmyra, NY
	PSI (Pipeline Seal and Insulator, Inc.) "Linebacker 61"	Houston, TX
	U.S. Pipe and Foundry "Flange-Tyte"	Birmingham, AL
	Accepted equal	
Flange Gaskets – Cloth-Inserted	Bluegard Div. Garlock, / Inc. Style 5000	Palmyra, NY
	Buffalo Rubber Matting LLC	Buffalo, NY
	John Crane (Cranite)	Cerritos, CA
	Johns Manville 60	
	Richard Klinger C4400	Sidney, OH
	Tripac Style 5000	Corona, CA
	Western Pacific Products	Corona, CA
	Accepted equal	
Flange Gaskets – Neoprene	Bluegard Div. Garlock, Inc. Style 2000	Palmyra, NY
	Buffalo Rubber Matting LLC	Buffalo, NY
	John Crane (Cranite)	Cerritos, CA
	Johns Manville 60	
	Richard Klinger C4400	Sidney, OH
	Tripac Style 2000	Corona, CA
	Western Pacific Products	Corona, CA
	Accepted equal	
Flange Gaskets – Low-Torque for Use with Plastic Flanges	Proco Series 9013	Stockton, CA
	Accepted equal	

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Unless otherwise specified, bolts, nuts and washers for pipe assembly below ground shall meet the following requirements.

ITEM	MATERIAL	SPECIFICATION
Bolts for Underground Ferrous Installations (Buried or in Underground Structures)	SAE Type 316 Stainless Steel	ASTM A193 B8M T-316 Heavy hexagon series ANSI B1.1 Class 2A fit ¼-inch to ½-inch shall project through tightened nut Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – “B8M”
Nuts for Underground Ferrous Installations (Buried or in Underground Structures)	SAE Type 316 Stainless Steel	ASTM A194 8M-T316 Heavy hexagon series ANSI B1.1 Class 2B fit ¼-inch to ½-inch shall project through tightened nut Nickel-phosphate undercoating Threading per ANSI/ASME B18.2.2
Mechanical Joint T-Head Bolts	“Cor-Ten” Steel	Minimum 45-ksi yield strength T-head dimensions per AWWA C111 ANSI B1.1 Class 2A fit Coarse thread series
Mechanical Joint T-Head Mating Nuts	“Cor-Ten” Steel	ANSI B1.1 Class 2B fit Heavy hexagon series
Coating for New Bolts and Nuts	Nickel-phosphate Undercoating Blue Teflon or Xylan Fluoropolymer Coating	
Coating for Existing Bolts and Nuts	Antiseize Lubricant / Oil and Graphite	
Washers	Washer material shall be same as each bolt.	Provide washer for each nut.
Coating for Buried Nuts and Bolts	Accepted Manufacturer’s coating listed above	2 coats minimum 15 mils per coat

- C. Unless otherwise specified, bolts, nuts and washers for pipe assembly above ground shall meet the following requirements.

ITEM	MATERIAL	SPECIFICATION
Bolts for Above-Ground Ferrous Installations	Zinc-Plated Carbon Steel	ASTM A307 Grade B Heavy hexagon series ANSI B1.1 Class 2A fit Class 3A fit may be used for holes tapped for studs. ¼-inch to ½-inch shall project through tightened nut. Threads may be either cut or cold-formed Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – “A307B”
	SAE Type 316 Stainless Steel	ASTM A193 B8M-316 Heavy hexagon series ANSI B1.1 Class 2A fit Class 3A fit may be used for holes tapped for studs. ¼-inch to ½-inch shall project through tightened nut. Threads may be either cut or cold-formed Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – “B8M”

ITEM	MATERIAL	SPECIFICATION
Nuts for Above-Ground Ferrous Installations	Zinc-Plated Carbon Steel	ASTM A563 Heavy hexagon series ANSI B1.1 Class 2B fit Nickel-phosphate undercoating Blue Teflon or Xylan fluoropolymer coating Threading per ANSI/ASME B18.2.2
	SAE Type 316 Stainless Steel	ASTM A194, Grade 1, 2 or 2H Heavy hexagon series ANSI B1.1 Class 2B fit Nickel-phosphate undercoating Blue Teflon or Xylan fluoropolymer coating Threading per ANSI/ASME B18.2.2
Hollow Metal Fire Hydrant Bolts	Carbon Steel	ASTM A307 Grade A Heavy hexagon series ANSI B1.1 Class 2A fit 5/8-inch bolt with 11/32" hole drilled 2 3/8" deep into shank and 100% silicon-filled to prevent internal corrosion 1/4-inch to 1/2-inch shall project through tightened nut. Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – "A 307 A"
Fire Hydrant Bolt Mating Nuts	Carbon Steel	ASTM A563 Heavy hexagon series ANSI B1.1 Class 2B fit Threading per ANSI/ASME B18.2.1
Bolts on Adjoining Bronze Flanges Above Ground	Low-Silicon Bronze Grade C65100 or Grade C63000	ASTM B98 or ASTM F468 Finished hexagon series ANSI B1.1 Class 2A fit 1/4-inch to 1/2-inch shall project through tightened nut Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – "651," "SB," or unmarked
Nuts on Adjoining Bronze Flanges Above Ground	Low-Silicon Bronze Grade C65100 or Grade C63000 to match bolt material	ASTM B98 or ASTM F467 Finished hexagon series ANSI B1.1 Class 2B fit 1/4-inch to 1/2-inch shall project through tightened nut Nickel-phosphate undercoating Blue Teflon or Xylan fluoropolymer coating Threading per ANSI/ASME B18.2.2
Bolts on Bronze Flanges mating with Plastic Flanges Above Ground	Low-Silicon Bronze Grade C65100 or Grade C63000	ASTM B98 or ASTM F468 Finished hexagon series ANSI B1.1 Class 2A fit 1/4-inch to 1/2-inch shall project through tightened nut Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – "651," "SB," or unmarked
Nuts on Bronze Flanges Mating with Plastic Flanges Above Ground	Low-Silicon Bronze Grade C65100 or Grade C63000 to match bolt material	ASTM B98 or ASTM F467 Finished hexagon series ANSI B1.1 Class 2B fit 1/4-inch to 1/2-inch shall project through tightened nut Nickel-phosphate undercoating Blue Teflon or Xylan fluoropolymer coating Threading per ANSI/ASME B18.2.2
Bolts on Bronze Flanges mating with Ferrous Flanges Above Ground	SAE Type 316 Stainless Steel	ASTM A193 B8M-316 Heavy hexagon series ANSI B1.1 Class 2A fit 1/4-inch to 1/2-inch shall project through tightened nut Nickel-phosphate undercoating Blue Teflon or Xylan fluoropolymer coating Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – "B8M"

ITEM	MATERIAL	SPECIFICATION
Nuts on Bronze Flanges Mating with Ferrous Flanges Above Ground	SAE Type 316 Stainless Steel	ASTM A194 8M T-316 Heavy hexagon series ANSI B1.1 Class 2B fit ¼-inch to ½-inch shall project through tightened nut Nickel-phosphate undercoating Blue Teflon or Xylan fluoropolymer coating Threading per ANSI/ASME B18.2.2
Coating for New Bolts and Nuts	Nickel-phosphate Undercoating Blue Teflon or Xylan Fluoropolymer Coating	
Coating for Existing Bolts and Nuts	Antiseize Lubricant / Oil and Graphite	
Washers	Washer material shall be same as each nut.	Provide washer for each nut.

- D. Unless otherwise specified, bolts, nuts and washers for pipe assembly above ground in corrosive, high-chloride or saltwater environments shall meet the following requirements.

ITEM	MATERIAL	SPECIFICATION
Bolts for Above-Ground Ferrous Installations	SAE Type 316 Stainless Steel	ASTM A193 B8M T-316 Heavy hexagon series ANSI B1.1 Class 2A fit Class 3A fit may be used for holes tapped for studs. Nickel-phosphate undercoating Blue Teflon or Xylan fluoropolymer coating ¼-inch to ½-inch shall project through tightened nut. Threads may be either cut or cold-formed Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – “B8M”
Nuts for Above-Ground Ferrous Installations	SAE Type 316 Stainless Steel	ASTM A194, 8M T-316 Heavy hexagon series ANSI B1.1 Class 2B fit Nickel-phosphate undercoating Blue Teflon or Xylan fluoropolymer coating Threading per ANSI/ASME B18.2.2
Coating for New Bolts, Nuts, and Washers	Nickel-phosphate Undercoating Blue Teflon or Xylan Fluoropolymer Coating	
Coating for Existing Bolts and Nuts	Antiseize Lubricant / Oil and Graphite	
Washers	Washer material shall be same as each nut.	Provide washer for each nut.

- E. Unless otherwise specified, flange gaskets shall meet the following requirements.

ITEM	MATERIAL	SPECIFICATION	
Flange Gaskets on Metallic Flanges	Standards	ANSI B16.21 Meet NSF 61 for potable water applications	
	Material	SBR Styrene Butadiene Rubber Non-asbestos	
	Alternate Material	EPDM (ethylene propylene)	
		FKM (Viton or FLUOREL) fluorocarbon	
		NBR Nitrile (acrylonitrile butadiene)	
		Neoprene (polychloroprene)	
		PTFE (Teflon or GoreTex)	
SBR-Fiber Non-Asbestos Composite			

ITEM	MATERIAL	SPECIFICATION
	Material for Hydrocarbon Applications and Contaminated Soils	FPM (Viton or FLUOREL) fluorocarbon
	Thickness	NBR Nitrile (acrylonitrile butadiene)
	Working Pressure Rating	1/8-inch minimum (SBR) or other materials
	Style	1/16-inch minimum (PTFE - Teflon)
	Flange Gaskets on PVC, CPVC, and Fiberglass Flanges	350 psi at 180°F
		Full-face type with pre-punched boltholes where both flanges are flat face. Ring flange gaskets extending to inner edge of bolts may be used where raised-face flange is present. Steel flange shall be flat face where adjoining flange is steel.
		Full-faced, 1/8"-thick Elastomer, Shore "A" of 70 Durometer Non-creeping PTFE with insert filler Teflon ring or Teflon envelope Suitable for pressures to 150 psi Suitable for temperatures to 120°F Suitable and chemically compatible with conveyed fluid.

PART 3 - EXECUTION

3.1 Preparation

- A. Clean and wire brush flange faces of pipe, valves and pipeline equipment before joining to adjacent flanges. Clean flange bolts and nuts by wire brushing. Lubricate threads with oil and graphite. Tighten nuts uniformly and progressively.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install bolts, nuts, washers and flange gaskets at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing, and mechanical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Do not force fit or spring pipe, conduit or equipment into place. Corrective measures for cases of poor alignment shall be approved in advance by Owner's Representative.
- F. Deflections at joints shall not exceed 80% of Manufacturers' published tolerance limits.
- G. Mitered piping joints are not permitted.

Pipe bends shall conform to ASME B31.3 and be free from wrinkles, creases or corrugations.

- I. Water pipe bends shall use approved AWWA fittings, except steel water pipe fittings in vaults or above grade may match API dimensions subject to Owner's approval.
- J. Cut pipe threads with sharp dies and made up with approved thread sealing compound. Threads to be seal welded shall be made up dry. Do not use Teflon sealers.
- K. Epoxy coated pipe, valves and fittings shall be fabricated and installed without cutting, notching or welding.
- L. Threaded pipe joints shall be cleaned by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves.
- M. Assemble flanges as follows:
 1. Clean flange surfaces to mate with gasket, removing loose dirt, scale and detritus.
 2. Repair pits, corrosion, dents or scratches which may make sealing impossible.
 3. Inspect gasket to verify gasket is of proper material and style, free of defects or damage.
 4. Inspect flange bolts and studs for proper material, size, threading and length.
 5. Clean and lubricate bolt threads and nut contact surfaces using lubricant chemically compatible with all materials involved.
 6. Center gasket on flange.
 7. With gasket in place, align mating flange bolt holes. Make sure mating flange faces are flush against gasket prior to bolt-up.
 8. Insert bolts, nuts and washers. Tighten by hand until snug.
 9. Before tightening bolts beyond hand-tight, operate adjacent valves through full range of motion to ensure clear unobstructed operation of discs and other internal parts.
 10. Tighten bolts in sequence by 5-lb. increments following a 180° opposing sequence.
 11. Since gaskets relax after seating, retighten 24 hours after installation and pressure testing to compensate for any relaxation.
 12. Flange bolt torques shall be as recommended by valve or pipe manufacturer:

Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pipeline Joint	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
Materials	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

B. If flanges leak under pressure testing, loosen or remove nuts and bolts, replace flange gasket, reinstall or retighten bolts and nuts and retest joints. Joints shall be watertight.

END OF SECTION

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**SECTION 33 05 32
FLANGE INSULATING KITS AND THREADED INSULATING BUSHINGS**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of flange insulating kits and threaded insulating bushings.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 33 05 31: Pipeline Joint Materials

1.3 System Description

- A. Dissimilar metals, when used in conjunction with each other shall have suitable insulation provided between adjoining surfaces to eliminate direct contact and resultant current.
- B. Furnish and install threaded insulating bushings where dissimilar threaded piping materials come into contact.
- C. Furnish and install flange insulating kit and insulation at locations where flanges of dissimilar metals mate, including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable codes and standards.
- D. Insulating kits or bushings are not required in the following cases:
 - 1. Where connecting any pipe material to plastic, fiberglass, clay or concrete pipe.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

N/A

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation or application instruction requirements.	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for catalog data, and installation instructions.

Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of flange insulating kits shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Flange Insulation Kit Products	APS Advance Products & Systems, Inc	Scott, LA
	Calpico, Inc.	South San Francisco, CA
	Central Plastics Company	
	Corpro Corrosion Div Control Products Company	
	Farwest Corrosion Control	Gardena, CA
	PSI (Pipeline Seal and Insulator, Inc.)	Houston, TX
	Accepted equal	
Insulating Reducing Bushings	Christy's	Anaheim, CA
	Accepted equal	
Insulating Gaskets	Johns Manville "No. 71 Dielectric Sheet Packing"	
	Linebacker "Type E"	
	Raybestos-Manhattan "No. 73"	
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Flange insulating kits shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Flange Bolts and Nuts	Various steels	See Section 33 05 31.
Insulating Gaskets	Dielectric Phenolic	500 V/mil dielectric strength 25 ksi compressive strength
Gasket Seal Element	Nitrile	
Insulating Sleeves	Mylar	4000 V/mil dielectric strength <0.8% water absorption
Insulating Washers for Bolts	Phenolic	500 V/mil dielectric strength 33 ksi compressive strength <1.6% water absorption
Steel Washers over Insulating Washers	Stainless Steel	SAE Type 316

The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Application	Fluid in Pipe	Potable Water
	Fluid Temperature	33°F to 100°F
	Flange insulating kits, sleeves, and gaskets shall be compatible with the above fluids	
Insulating Gaskets	Gaskets	Full faced with bolt holes
	Thickness	1/8" minimum
	Drilling	Match adjacent flanges
Flange Isolation Kits Buried	Type	One-piece-sleeve and washer (2 steel washers + 1 one-piece isolating sleeve)
Insulating Washers for Buried Bolts	Dimensions	1/8" minimum thickness ID of washer shall fit over isolating sleeve
Steel Washers over Insulating Washers	Thickness	1/8" minimum thickness Steel and isolating washer shall have same ID and OD

- D. If insulating flange kit is not compatible with tapping valve, provide additional flanged spool or prefabricated insulating joint.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install flange insulating kits before submitting shop drawings or ordering.
- B. Clean faces of flange pairs of all dirt, rust, laitance, grease or fouling materials which would interfere with a watertight joint and insulating properties of flange kit.
- C. Use alignment pins to properly align flange and gasket.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install flange insulating kits at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. Applicable plumbing, mechanical and electrical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install flange insulating kits according to Manufacturer's installation and warranty requirements. Tighten bolts according to Manufacturer's recommended sequence.
- F. Center bolt insulation sleeves within insulation washers so that insulating sleeve is not compressed or cracked.



Install flange insulating kits to tolerances recommended by Manufacturer. Unless otherwise shown, install flange insulating kits true and level using precision gauges and levels.

H. Install cathodic protection bonding test station at each buried flange insulation. Install 2 test wires on each side of buried insulator as shown.

3.3 **Field Quality Control**

A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Flange Insulating Kits	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Insulation	Ohmmeter test to demonstrate insulation is functional	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

SECTION 33 05 33
COUPLINGS, TIE RODS, FLANGE CONNECTORS, AND UNIONS

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of couplings, tie rods, flange connectors, unions, and appurtenant joint and coating systems.
- B. Grooved and shouldered (Victaulic) style couplings are covered in Section 33 05 34.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 33 05 31: Pipeline Joint Materials

1.3 System Description

- A. Furnish and install complete functional coupling, joint or joint-restraint system including appurtenant structural, and mechanical mountings, thrust restraints, or connections and coatings required for compliance with Manufacturer's installation requirements, and compliance with AWWA and other applicable standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of California Health and Safety Code.
- C. Before ordering materials to fit outside diameters of existing pipe of uncertain dimensions, including but not limited to cast iron pipe, pipe over 16 inches diameter, and pipe over 50 years old, the following procedures shall be followed:
 - 1. Excavate pipe to be joined at location coupling or restraint will be installed.
 - 2. Field measure pipe circumference at that location.
 - 3. Without removing pipe from service, measure outside diameters along x-axis and y-axis.
 - 4. Verify roundness of existing pipe is within Manufacturer's tolerances.
 - 5. If existing pipe roundness is outside coupling or restraint Manufacturer's tolerances, it may be necessary to cut pipe being joined and trace outside diameter template on sheet of butcher paper mounted to plywood board to allow custom fittings to be fabricated to match field pipe geometry.

D. Factory testing shall include:

ITEM	TEST FOR	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Fusion-Bonded Epoxy Linings	Holidays and Lining Thickness	1 each item	Contractor	Contractor

1.5 References

- A. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
- B. ASME/ANSI B16.39 Malleable Iron Threaded Pipe Unions
- C. ASSE 1079 Dielectric Pipe Unions
- D. ASTM A193 Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
- E. ASTM A283 Low and Intermediate Tensile Strength Carbon Steel Plates
- F. ASTM A536 Ductile Iron Castings
- G. ASTM B61 Steam or Valve Bronze Castings (Do not use for potable water wetted surfaces)
- H. ASTM B62 Composition Bronze or Ounce Metal Castings (Do not use for potable water wetted surfaces)
- I. ASTM C1173 Flexible Transition Couplings for Underground Piping Systems
- J. AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems
- K. AWWA C207 Steel Pipe Flanges for Waterworks Service – Sizes 4-inch through 144-inch
- L. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- M. AWWA C219 Bolted Sleeve Type Couplings for Plain End Pipe
- N. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- O. ASTM D2464 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings
- P. AWWA M11 Steel Pipe, A Guide for Design and Installation
- Q. MSS SP123 Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube
- R. NSF/ANSI 61 Drinking Water System Components – Health Effects
- S. NSF/ANSI 372 Drinking Water System Components – Lead Content

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses on items 4-inches and larger	
Installation Instructions	Required per installation instruction requirements.	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for catalog data, and installation instructions,

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of couplings, and tie rods shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers for bolted sleeve type couplings include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Couplings – Steel Bolted Sleeve Type, for Identical Pipe Materials on each side	Ford Meter Box Co Inc. (FC3) or (FC4)	Pell City, AL
	Romac Industries (400)	Bothell, WA
	Accepted Equal	
Couplings – Steel Bolted Transition Sleeve Type, for Different Pipe Materials on each side	Ford Meter Box Co Inc. (FC5)	Pell City, AL
	Romac Industries (TC400)	Bothell, WA
	Accepted Equal	
Couplings – Steel Bolted Reducing Sleeve Type, for Identical Pipe Materials of Different Diameters on Each Side	Ford Meter Box Co Inc. (FC6)	Pell City, AL
	Romac Industries (RC400)	Bothell, WA
	Accepted Equal	
Couplings – Cast Bolted Sleeve Type System, for Identical or Different Pipe Materials on Each Side	Ford Meter Box Co Inc. (FC1) or (FC2A)	Pell City, AL
	JCM Industries, Inc. (Style 210), (Style 211), or (Style 212)	Nash, TX
	Romac Industries (501) or (XR501)	Bothell, WA
Couplings – Steel Bolted Sleeve Type, Restrained for Identical Pipe Materials on each side	Accepted Equal	
	Romac Industries (400RG)	Bothell, WA
	Smith Blair, Inc. (Style 473)	Texarkana, TX
Couplings – Steel Bolted Sleeve Type, Restrained for Identical Pipe Materials of Different Diameters on Each Side	Accepted Equal	
	Smith Blair, Inc. (Style 476)	Texarkana, TX
Couplings – Cast Bolted Sleeve Extended Range Type for Identical or Different Pipe Materials on Each Side	Accepted Equal	
	Romac Industries (Macro)	Bothell, WA
	Smith Blair, Inc. (Style 461) (Quantum)	Texarkana, TX
Couplings – Cast Bolted Sleeve Extended Range Type for Identical or Different Pipe Materials on Each Side	Accepted Equal	

B. Acceptable Manufacturers for flanged coupling adaptors include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Couplings, Flanged Coupling Adaptor for Ductile Iron Pipe	Ford Meter Box Co Inc. (FFCA)	Pell City, AL
	JCM Industries, Inc. (Style 301)	Nash, TX
	Romac Industries (FCA 501)	Bothell, WA
	Smith Blair, Inc. (Style 912)	Texarkana, TX
	Accepted Equal	
Couplings, Flanged Coupling Adaptor for Asbestos Cement Pipe	Ford Meter Box Co Inc. (FFCA-1)	Pell City, AL
	JCM Industries, Inc. (Style 303)	Nash, TX
	Romac Industries (CGFA 501)	Bothell, WA
	Smith Blair, Inc. (Style 916)	Texarkana, TX
	Accepted Equal	
Couplings, Flanged Coupling Adaptor (Restrained)	Ford Meter Box Company (Restrained Flange Adaptor with UFR 1400) 3"-24"	Wabash, IN
	JCM Industries, Inc. (Style 301 Restrained)	Nash, TX
	Romac Industries (RFCA)	Bothell, WA
	Accepted Equal	

Acceptable Manufacturers for external harness-style systems include following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
External Joint Restraint Systems – Restraint Lug and Eyebolt	Romac Industries Duc Lug & 90° Eye-Bolt	Bothell WA
	Accepted Equal	
External Joint Restraint Systems – Restraint Plate and Tie Rod	Smith Blair, Inc. (Style 907)	Texarkana, TX
	Accepted Equal	

D. Acceptable Manufacturers for other coupling products, include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Couplings – C900 PVC High Deflection	Certainfeed (High Deflection (HD) Class 200	Valley Forge, PA
	Accepted Equal	

2.2 Materials

A. Refer to Section 01 61 00 for basic requirements for products and materials.

B. Bolted sleeve type couplings shall comply with AWWA C219 and be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Sleeve	Steel	ASTM A283 Grade C or carbon steel with minimum 30-ksi yield
	Stainless Steel	SAE Type 316
Coupling and Harness Bolts	Stainless Steel	See Section 33 05 31.
Gasket		AWWA C111
Sleeve Lining (couplings 3 inches and larger)	Fusion-Bonded Epoxy	See Section 09 96 56. AWWA C550 12 mil minimum DFT Meet NSF 61 for potable water applications
Exterior Finish Coat	Fusion-Bonded Epoxy	See Section 09 96 56.
Polyethylene Encasement for Buried Couplings and Appurtenances	Polyethylene Sheet	AWWA C105 2 layers, 8 mils each

C. Flanged coupling adaptors shall comply with AWWA C219 and be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Flanges Working Pressures 0-250 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
	Stainless Steel	AWWA C207 Class D, or ANSI /ASME 16.5 Class 150 Raised or plain faced ASME/ANSI B16.47 Class 150 Raised or plain faced for valves 26-inch and larger
Flanges Sizes 6-60" Working Pressures 250-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 300 Raised or plain faced
	Stainless Steel	AWWA C207 Class F, or ANSI /ASME 16.5 Class 300 Raised or plain faced ASME/ANSI B16.47 Class 150 Raised or plain faced for flanges 26-inch and larger
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Sleeve	Steel	ASTM A283 Grade C or carbon steel with minimum 30-ksi yield
	Stainless Steel	SAE Type 316

ITEM	MATERIAL	SPECIFICATION
Coupling and Harness Bolts	Stainless Steel	See Section 33 05 31.
Gasket		AWWA C111
Lining (couplings 3 inches and larger)	Fusion-Bonded Epoxy	See Section 09 96 56 AWWA C550 12 mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas and bronze or stainless steel parts.
Exterior Finish Coat	Fusion-Bonded Epoxy	See Section 09 96 56.
Polyethylene Encasement for Buried Couplings and Appurtenances	Polyethylene Sheet	AWWA C105 2 layers, 8 mils each

- D. Coupling restraint systems for bolted-sleeve-type couplings or flanged coupling adaptors installed on ductile iron or PVC pipe shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Follower Gland	Ductile Iron	ASTM A536 65-45-12
Wedges	Ductile Iron	Single tooth, heat-treated for ductile iron applications
Actuating Bolts	Ductile Iron	ASTM A536 65-45-18
Breakaway Nuts	Carbon Steel	
	Cast Iron	
Tie Rods - Steel	Carbon Steel	ASTM A193 Grade B7 threaded rods. Do not use all-thread
	Galvanized Coating	ASTM A123 - 3.4 mil thickness - 2.00 ounce/ft ²
Tie Rods – Stainless Steel	Stainless Steel	SAEI Type 316
Coating for New Bolts and Nuts	Nickel-phosphate Undercoating Blue Teflon or Xylan Fluoropolymer Coating	See Section 33 05 31.
Coating for Existing Bolts and Nuts	Antiseize Lubricant	See Section 33 05 31.
Lubrication for Above-Ground or Vault-Enclosed Steel Tie-Rod or Bolt Threads	Oil and Graphite, Blue Fluoropolymer Coating or Accepted Valve Manufacturer's Anti-seize Coating	See Section 33 05 31.
Gland Exterior Finish Coat	Fusion-Bonded Epoxy	See Section 09 96 56.
Coating on Buried Bolts and Nuts	Mastic	See Section 33 11 19.
Polyethylene Encasement for Buried Couplings and Appurtenances	Polyethylene Sheet	AWWA C105 2 layers, 8 mils each

- E. Coupling restraint systems for bolted-sleeve-type couplings or flanged coupling adaptors installed on steel pipe shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Follower Gland	Ductile Iron	ASTM A536 65-45-12
Wedges	Ductile Iron	Single tooth, heat-treated for ductile iron applications
Harness Lug	Carbon Steel	
Tie Rods - Steel	Stainless Steel	SAEI Type 316
Tie Rods – Stainless Steel	Stainless Steel	SAEI Type 316

ITEM	MATERIAL	SPECIFICATION
Lubrication for Above-Ground Tie Rods and Bolt Threads	Oil and Graphite, Blue Fluoropolymer Coating or Accepted Valve Manufacturer's Anti-seize Coating	See Section 33 05 31.
Coating on Buried Bolts and Nuts	Mastic	See Section 33 11 19.
Polyethylene Encasement for Buried Couplings and Appurtenances	Polyethylene Sheet	AWWA C105 2 layers, 8 mils each

- F. Flanges shall conform to AWWA C207 requirements and shall mate with adjacent valves or fittings.
- G. Internal bore of couplings and joints shall be as close to that of pipe system as is commercially available.
- H. All coupling products referenced in this section shall be painted and coated, interior and exterior in accordance with Section 09 90 00 or 09 96 56 as applicable.
- I. Small piping coupling materials are covered in Section 22 10 00.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install products before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. On buried couplings and assemblies, lubricate all threaded parts including bolts and compression collars before assembling couplings and joints.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install couplings, tie rods, flange connectors and unions at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing and mechanical code requirements
 - 4. AWWA M11 Steel Pipe, A Guide for Design and Installation
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Couplings, tie rods, flange connectors, and unions shall be furnished and installed by Contractor at location shown on Plans and Submittals.

F. Bolting shall be completed as follows:

1. Wire brush and clean flange before joining flange.
2. Lubricate bolt threads with graphite and oil.
3. Boltheads and nuts shall rest squarely against metal. Draw boltheads and nuts tight against Work using suitable wrench not less than 15 inches long or torque wrench set to provide similar torque. Tap boltheads with hammer while nut is being tightened. After being tightened, nuts shall be locked.
4. Bolts shall extend entirely through nut projecting at least ¼ inch but not more than ¾-inch beyond outside face of nut.

G. Unless otherwise shown, encase all buried couplings and appurtenances with two layers of polyethylene wrap.

3.3 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Couplings, Tie Rods, Flange Connectors, and Unions	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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**SECTION 33 05 34
GROOVED AND SHOULDERED (VICTAULIC-STYLE) COUPLINGS**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of grooved and shouldered couplings and appurtenant coating systems.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 09 90 00: Painting and Coating
- H. Section 09 96 56: Epoxy Linings and Coatings
- I. Section 22 10 00: Plumbing Piping
- J. Section 33 05 31: Pipeline Joint Materials
- K. Section 33 05 33: Couplings, Tie Rods, Flange Connectors, and Unions

1.3 System Description

- A. Furnish and install complete functional thrust-restraining coupling system including appurtenant coatings required for compliance with Manufacturer's installation requirements, and compliance with AWWA and other applicable standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Fusion Bonded Epoxy Linings	Holidays and Lining Thickness	See Section 09 96 56	1 each item	Contractor	Contractor

1.5 References

- A. ASTM A47 Ferritic Malleable Iron Castings
- B. ASTM A183 Carbon Steel Track Bolts and Nuts
- C. ASTM A193 Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
- D. ASTM A283 Low and Intermediate Tensile Strength Carbon Steel Plates
- E. ASTM A449 Hex Cap Bolts, Screws, and Studs
- F. ASTM A536 Ductile Iron Castings
- G. ASTM D2000 Classification System for Rubber Products in Automotive Applications
- H. AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems
- I. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

AWWA C606 Grooved and Shouldered Joints

- K. AWWA M11 Steel Pipe, A Guide for Design and Installation
- L. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses on items 4-inches and larger	
Installation Instructions	Required per installation instruction requirements.	
Warranty	Furnish one-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for catalog data, and installation instructions,

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of couplings, and tie rods shall be strictly followed.

1.8 Unit Prices

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers for grooved couplings for steel pipe include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Couplings – Flexible Grooved Type for Steel Pipe 4 inches through 24 inches	Piedmont Pacific Corporation.	Oakland, CA
	Shurjoint Piping Products	Las Vegas, NV
	Star Pipe Products, Inc.	Easton, PA
	Victaulic Company of America, Inc. (Style 77)	Easton, PA
	Accepted Equal	
Couplings – Roll-Grooved Type for Steel Pipe 28 inches through 42 inches smaller	Piedmont Pacific Corporation.	Oakland, CA
	Shurjoint Piping Products	Las Vegas, NV
	Star Pipe Products, Inc.	Easton, PA
	Victaulic Company of America, Inc. (Style 770)	Easton, PA
	Accepted Equal	
Polyethylene Encasement for Buried Couplings and Appurtenances	Christy’s “AWWA Polywrap”	Anaheim, CA
	Dupont Alathon	Wilmington, DE
	Northtown Company	Huntington Beach, CA
	Trumbull Industries, Inc.	Youngstown, OH
	Accepted Equal	

Acceptable Manufacturers for shouldered couplings for steel pipe include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Couplings – Shouldered Type for Steel Pipe 4 inches through 60 inches	Piedmont Pacific Corporation.	Oakland, CA
	Shurjoint Piping Products	Las Vegas, NV
	Star Pipe Products, Inc.	Easton, PA
	Victaulic Company of America, Inc. (Style 44 with Vic-Ring)	Easton, PA
	Accepted Equal	
Polyethylene Encasement for Buried Couplings and Appurtenances	Christy's "AWWA Polywrap"	Anaheim, CA
	Dupont Alathon	Wilmington, DE
	Northtown Company	Huntington Beach, CA
	Trumbull Industries, Inc.	Youngstown, OH
	Accepted Equal	

C. Acceptable Manufacturers for couplings for ductile iron pipe include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Couplings – Grooved Type for Ductile Iron Pipe 3-in through 36-inch	Piedmont Pacific Corporation.	Oakland, CA
	Shurjoint Piping Products	Las Vegas, NV
	Star Pipe Products, Inc.	Easton, PA
	Victaulic Company of America, Inc. (Style 31)	Easton, PA
	Accepted Equal	
Polyethylene Encasement for Buried Couplings and Appurtenances	Christy's "AWWA Polywrap"	Anaheim, CA
	Dupont Alathon	Wilmington, DE
	Northtown Company	Huntington Beach, CA
	Trumbull Industries, Inc.	Youngstown, OH
	Accepted Equal	

2.2 Materials

A. Refer to Section 01 61 00 for basic requirements for products and materials.

B. Products shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Coupling Housings (Match adjacent pipe material)	Ductile Iron	ASTM A536 grade 65-45-12
	Steel	
Lining (couplings 3 inches and larger)	Fusion-Bonded Epoxy	See Section 09 96 56 AWWA C550 12 mil minimum DFT Meet NSF 61 for potable water applications
Gaskets	Rubber	As recommended by Manufacturer for fluid conveyed AWWA C606 and ASTM D2000 Meet NSF 61 for potable water applications
Bolts and Nuts (Use same material as flange bolts)	Carbon Steel	ASTM A183 or ASTM A449
	SAE Type 316 Stainless Steel	
Exterior Finish Coat	Epoxy Urethane	See Section 09 90 00
Polyethylene Encasement for Buried Couplings and Appurtenances	Polyethylene Sheet	AWWA C105 2 layers, 8 mils each

C. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION
Couplings – Grooved and Shouldered Type on Steel Pipe 4-inch through 24-inch diameter	Minimum wall thickness and other dimensions of roll-grooved steel pipe shall be as shown in AWWA C606 Table 5 Shouldered ends shall be per AWWA C606 Type C or D with dimensions per AWWA C606 Table 6.

ITEM	DESCRIPTION
Couplings – Grooved and Shouldered Type on Steel Pipe 30-inch through 64-inch diameter	Pipe ends shall be shouldered per AWWA C606 Type C or D
Couplings – Grooved and Shouldered Type on DIP Pipe 4-inch through 24-inch diameter	Minimum wall thickness of radius-grooved grooved DIP shall be Class 53. Pipe walls for flexible-joint couplings shall be radius-grooved to dimensions shown in AWWA C606 Table 2. Pipe walls for rigid-joint couplings shall be radius-grooved to dimensions shown in AWWA C606 Table 3. Cut grooving will not be accepted.
Coating on Buried Bolts and Nuts	See Section 15085

- D. Internal bore of couplings and joints shall be as close to that of pipe system as is commercially available.
- E. All coupling products referenced in this section shall be painted and coated, interior and exterior in accordance with Sections 09 90 00 and 09 96 56.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install products before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. On buried couplings and assemblies, lubricate all threaded parts including bolts and compression collars before assembling couplings and joints.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install couplings at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer’s installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing and mechanical code requirements
- D. Refer variances between above documents and Contract Documents to Owner’s Representative.
- E. Couplings shall be furnished and installed by the Contractor at the location shown on the Plans and Submittals.

Bolting shall be completed as follows:

1. Lubricate bolt threads with graphite and oil.
2. Boltheads and nuts shall rest squarely against metal. Draw boltheads and nuts tight against Work using suitable wrench not less than 15 inches long or torque wrench set to provide similar torque. Tap boltheads with thammer while nut is being tightened. After being tightened, nuts shall be locked.
3. Bolts shall extend entirely through nut projecting at least ¼ inch but not more than ¾-inch beyond outside face of nut.

G. Unless otherwise shown, encase all buried couplings and appurtenances with two layers of polyethylene wrap.

3.3 Field Quality Control

A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Couplings	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

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**SECTION 33 05 37
WALL PIPES, SEEP RINGS AND PENETRATIONS**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of steel and cast iron wall pipes, sleeves, wall collars, seepage rings and penetrations.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 03 30 00: Cast-in-Place Concrete
- H. Section 09 90 00: Painting and Coating
- I. Section 33 05 31: Pipeline Joint Materials

1.3 System Description

- A. Furnish and install pipe penetration sleeves, wall pipes, seep rings and rubber hydrostatic annular sealing devices for pipe and conduit penetrations including appurtenant structural, and/or mechanical mountings required for compliance with Manufacturer's installation requirements and compliance with applicable codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Fabricated Steel Wall Sleeve or Penetration and Collar Assembly	Pressure Test	Demonstrate water-tight seal between collar and sleeve. Test at 20 psig for 4 hours.	One each size fabricated wall sleeve	Contractor	Contractor

1.5 References

- A. API 5L
- B. API 5LX
- C. ASME/ANSI B31.3 Process Piping
- D. ASME/ANSI B36.10 Carbon, Alloy and Stainless Steel Pipes
- E. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- F. ASTM A105 Forgings, Carbon Steel for Piping Components
- G. ASTM A135 Electric-Resistance-Welded Steel Pipe

ASTM A139 Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)

- I. ASTM A181 Forgings, Carbon Steel for General-Purpose Piping
- J. ASTM A182 Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings and Valves and Parts for High-Temperature Service
- K. ASTM F593 Stainless Steel Bolts, Hex Cap Screws, and Studs
- L. AWS B3.0 Welding Procedure and Performance Qualification

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per structural shop drawing requirements. Show dimensions and wall thickness. Show proposed coatings including material and thickness. Where flanged-end wall penetrations are used, show flange size and appropriate ANSI or AWWA flange dimensional standard. Where grooved-end wall penetrations are used, show appropriate AWWA C606 grooved-end dimensional standard	.
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements for rubber annular hydrostatic sealing devices.	
Foundry or Test Record Transcripts	Submit results of leakage test for cast-iron sleeves having shrink-fit steel collars or collar halves bottomed in groove and steel sleeves having welded steel collars per foundry or test record transcript requirements.	
Warranty	Furnish one-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, and installation instructions,

1.7 Delivery, Storage and Handling

A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.

B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of wall pipes, seep rings and penetrations shall be strictly followed.

1.8 Unit Prices

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
PVC Pipe Penetration Sleeve with Weep Ring	Calpico, Inc.	South San Francisco, CA
	Pipeline Seal and Insulator, Inc. (PSI) "Century Line" (Type S-316)	Houston, TX
	Proco Products Pen-Seal	Stockton, CA
	Accepted equal	
PVC Wall Sleeve with Weep Ring	Pipeline Seal and Insulator, Inc. (PSI) "WS" Steel Wall Sleeve	Houston, TX
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Steel Wall Sleeve with Weep Ring	Trumbull Industries	Youngstown, OH
	Accepted equal	
Polyethylene Foam Filler for Pipe Penetrations	Dow Chemical Company "Ethaform"	Midland, MI
	Hercules Inc Plastic Products Group Industrial Systems Department (Minicel backer rod)	Middletown, DE
	Pipeline Seal and Insulator, Inc. (PSI) "Cell-Cast"	Houston, TX
	Accepted equal	
Rubber Annular Hydrostatic Sealing Devices	Calpico, Inc. "Pipe Linx"	South San Francisco, CA
	CCI Pipeline Systems "Wrap-it Link" (Type WL-SS)	Breaux Bridge, LA
	Pipeline Seal and Insulator, Inc. (PSI) "Link Seal" (Type S-316)	Houston, TX
	Proco Products Pen-Seal	Stockton, CA
	Trumbull Industries	Youngstown, OH
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Wall pipes, seep rings, and penetrations shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Fabricated Steel Wall Sleeves Containing Pipe	Steel Pipe	ASTM A53 Type E or S Grade B or ASTM A135 Grade B or ASTM A139 Grade B or API 5L or 5LX Standard Weight Thickness per ANSI B36.10
Fabricated PVC Wall Sleeves Containing Pipe	PVC	Schedule 40 minimum
Fabricated Steel Wall Sleeves Connecting to Steel Pipe	Steel Pipe	Material and thickness to match connecting pipe. Provide ends as shown for connection to adjacent steel pipe
Wall Collar on Steel Wall Sleeve	Steel	ASTM A105, A181 or A182
Polyethylene Foam Filler for Pipe Penetrations	Extruded closed-cell polyethylene foam rod or disc	Rod or disc shall be ½-inch larger in diameter than annular space.
Painting and Coating of Steel Wall Sleeve	Epoxy	See Section 09 90 00.

- C. Rubber annular hydrostatic sealing devices shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Pressure Plate	Carbon Steel or Glass Reinforced Plastic Composite	
Bolts and Nuts for Links	Stainless Steel	ASTM F593 Type 316 Rod shall be ½-inch larger in diameter than annular space.
Sealing Element	EPDM Synthetic Rubber (Ethylene-Propylene Diene Monomer) for Water, Wastewater or Treatment Chemical Applications	Black
Painting and Coating		See Section 09 90 00.

The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION
Fabricated Steel Wall Pipes	Provide for all penetrations of new concrete walls, footings, floors or roofs
Rubber Annular Hydrostatic Sealing Devices	Modular mechanical type, using interlocking synthetic rubber links shaped to continuously fill annular space between pipe sleeve and passing pipe. Assemble links to form continuous rubber belt around pipe, with pressure plate under each bolthead and nut. Minimum seating width 4 inches.
Wall Sleeve for Rubber Annular Hydrostatic Sealing Device	Use fabricated steel wall sleeves when containing rubber annular hydrostatic sealing devices through which piping passes. Size of sleeve needed to accommodate passing pipe shall be per recommendation of rubber annular seal Manufacturer
Seepage Ring or Wall Flange	Provide seepage ring or wall flange on wall pipes and sleeves passing through concrete walls and slabs which are to be watertight. Wall flanges shall be steel wall collar welded to steel sleeve or penetration. Cut welded wall collars from steel ring of size shown. Attach collar to steel wall pipe or sleeve with full circle fillet welds. Welding procedures shall be in accordance with ANSI B31.3, Chapter V.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install wall pipes, seep rings and penetrations before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install wall pipes, seep rings and penetrations at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing, mechanical and electrical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Wall pipes, seep rings and penetrations shall be furnished and installed by Contractor at location shown on Plans and Submittals.
- F. Install wall pipes, seep rings and penetrations to tolerances recommended by Manufacturer. Unless otherwise shown, install wall pipes, seep rings and penetrations true and level using precision gauges and levels.
- G. Provide wall pipe or floor pipe and seals at the following locations:
 - 1. Where explicitly shown on Plans.

2. Where pipes penetrate concrete walls or slabs below ground or finish floor.
 3. Where pipes penetrate concrete walls or slabs containing water on one or both sides.
 4. Provide floor sleeve wherever plastic pipe, steel or stainless steel pipe 3-inches and smaller or copper tubing passes through floor or slab. Provide rubber annular sealing device in annular space between sleeve and passing pipe or tubing.
 5. Provide wall sleeves wherever plastic pipe, steel or stainless-steel pipe 3 inches and smaller, or copper tubing passes through a wall. Provide one rubber annular seal when wall is 8 inches thick or less. Provide two rubber annular seals (one at each end of sleeve) when wall thickness exceeds 8 inches. Pack annular space with polyethylene foam filler and fill ends of penetration with 2 inches of elastomeric sealant on both sides of structure.
 6. Where sleeves are installed in which water or soil is on one or both sides of channel or wall, provide two rubber annular seals (one at each end of sleeve).
 7. Where pipes pass through walls or slabs and no sleeves or wall or floor pipe with seep ring is provided, pack annular space with polyethylene foam filler and fill ends of penetration with 2 inches of elastomeric sealant on both sides of structure.
- H. In existing concrete walls and slabs, core drill holes 2 inches larger in diameter than diameter of wall flange or collar. Align wall sleeve and collar assembly with connecting or passing piping. Pack void space between sleeve and concrete with grout.
- I. In new concrete walls and slabs, install wall pipes in walls before placing concrete. Do not allow any portion of sleeve to touch reinforcing steel. Align wall sleeve and collar assembly with connecting or passing piping.
- J. Install wall pipes having flanged end connections as follows:
1. Check alignment before grouting in place or pouring concrete. Realign if sleeve is not properly aligned.
 2. Install flanged end wall sleeves or penetrations with bolt holes of end flanges straddling horizontal and vertical centerlines of sleeve.
 3. Lubricate flange bolts with oil and graphite prior to installation.
- K. Welder qualifications shall be in accordance with AWS B3.0.
- L. Install rubber annular hydrostatic sealing devices in accordance with Manufacturer's instructions.

Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Wall Pipes, Seep Rings and Penetrations	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
		Test hydraulic structure for leakage with wall penetrations in place	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

**SECTION 33 05 39
MANUAL VALVE OPERATORS**

PART 1 - GENERAL

1.1 Work Included

- A. This section includes materials, testing, and installation of manual valve operators.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 09 90 00: Painting and Coating

1.3 System Description

- A. Furnish and install complete operating manual valve operator including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building, plumbing, and electrical codes and standards.

1.4 Submittals

- A. Include submittals for manual valve operators in submittals for valves to which they are attached.

1.5 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of manual valve operators shall be strictly followed.

1.6 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant thereto.

PART 2 - PRODUCTS

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Adjustable Chainwheels	Trumbull Industries	Youngstown, OH
	Accepted Equal	
Floorstands	Rodney Hunt Co.	Orange, MA
	Trumbull Industries	Youngstown, OH
	Accepted Equal	
Valve Boxes and Covers	Eisel Enterprises, Inc.	Placentia, CA
	Accepted Equal	

2.1 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials. Also refer to sections covering valves to which manual operators are attached.
- B. All valves shall be installed complete with any operating handwheels, levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation. Valves shall open by turning counterclockwise.
- C. Gear actuators shall be enclosed, oil-lubricated, with seals on shafts to prevent entry of dirt and water into actuator. Provide stop limiting devices in actuators in open and closed positions. Where possible, actuators shall be self-locking to prevent disc or plug from creeping.
- D. Where operating torque requirements for valve actuators are not stipulated by AWWA standards, valves shall open with maximum pull of 80 pounds on handwheel, lever, chainwheel or crank and maximum torque input of 150 ft-lbs when differential pressure across valve is equal to rated pressure class of valve.
- E. Design actuator components to withstand, without damage, a pull of 200 pounds on handwheel, lever, chainwheel or crank and maximum torque input of 300 foot-pounds when operating against stops.
- F. Unless otherwise specified, valve boxes shall be traffic rated and constructed of the following materials.

ITEM	MATERIAL	SPECIFICATION
Adjustable Chainwheels	Stainless Steel	SAE Type 316
Floorstands	Stainless Steel	SAE Type 316
Valve Boxes	Cast Iron	ASTM A126 Class B Two-piece sliding type
Valve Box Covers	Cast Iron	ASTM A126 Class B Solid skirt 20-lb minimum weight
Extension Pipes	Cast Iron	ASTM A126 Class B

2.2 Equipment

- A. Valves shall close drip tight at rated pressures.
- B. Valve operators shall be satisfactory for applications involving valve operation after long periods of inactivity.
- C. Unless otherwise shown, install valves in horizontal runs of pipe having centerline elevations no higher than 4-foot 6-inches above floor with operating stems vertical. Install buried or submerged operators with nut no more than 4 feet below grade.

Unless otherwise specified all valves shall be furnished with actuators meeting the following minimum requirements.

ITEM	DESCRIPTION	
Buried Valves and Valves within Manholes or Pipe Trenches	Provide 2-inch AWWA actuator nut.	
	Provide valve can and cover as shown above (except in manholes)	
	Provide extension stem on valves where centerline of valve is more than 4 feet below grade. Extension stem shall bring nut to within 6 inches of surface. Pin stem extensions to valve operating nut. Extension stem diameters shall be as follows:	
	Valve size	Minimum extension stem diameter
	3-inch, 4-inch	7/8-inch
	6-inch	1 inch
8-inch	1 1/8-inch	
10-inch - 12-inch	1 1/4-inch	
14-inch	1 3/8-inch	
16-inch - 18-inch	1 1/2-inch	
20-inch - 36-inch	1 3/4-inch	
42-inch - 54-inch	2 inch	
	Provide watertight shaft seals, watertight valve and actuator cover gaskets, and totally enclosed actuator designed for buried service.	
	Provide position indicator designed to fit standard 5-1/4-inch valve box. Indicator shall show valve position and direction and number of turns required to fully open or close valve.	
Submerged Valves	Provide 2-inch AWWA actuator nut.	
	Provide extension stem on valves where centerline of valve is more than 4 feet below high water surface. Extension stem shall bring nut to within 6 inches of water surface. Extension stem size shall be as shown for buried valves.	
	Provide watertight shaft seals, watertight valve and actuator cover gaskets, and totally enclosed actuator designed for submerged service.	
Manually Operated Valves 6-inches and Smaller	Provide hand or lever actuator or handwheel with position indicator.	
Manually Operated Valves 8-inches and Larger	Provide handwheel with position indicator.	
Manually Operated Valves less than 4'6" above Floor or Finish Surface	Install valves with valve stems vertical.	
Manually Operated Valves 4'6" to 6'-9" or More above Floor or Finish Surface	Install valves with valve stems horizontal.	
Manually Operated Valves 6'-9" or More above Floor or Finish Surface	Provide chainwheel and guide actuators with position indicator or provide vertical valve stem and horizontal handwheel 6'6" above finish floor elevation.	
Manually Operated Valves on Vertical Pipe near Walls	Install valves with valve stems horizontal and handwheel on side of valve opposite wall.	
Actuators on Manual Butterfly, Ball and Plug Valves 8-inches through 20-inches	Enclosed worm and gear or enclosed traveling nut type gear actuators with position indicator.	
Actuators on Manual Butterfly, Ball and Plug valves 24-inches and Larger	Enclosed worm and gear type gear actuators with position indicator.	
Actuators on All Motorized Butterfly, Ball and Plug valves	Enclosed worm and gear type gear actuators with position indicator.	
Floor Stands and Extension Stems	Cast iron base nonrising stem indicating type floor stand with handwheel turning counterclockwise to open valve	
	316 stainless steel extension stems, couplings, and stem guide brackets spaced such that L/R does not exceed 150	
	Type 316 stainless steel anchor bolts	
Chainwheels and Guides	Galvanized or cadmium plated or aluminum extending to within 4 feet of operating floor	
	Type 316 stainless steel anchor bolts	
	Chains shall be galvanized steel, type 316 stainless steel or cadmium plated steel	

- E. Furnish special tools, wrenches and appliances needed to adjust, operate, maintain or repair valve operators supplied.

PART 3 - EXECUTION

3.1 Preparation

- A. Install valves and equipment so as to be easy to operate and service. Where geometry of manufactured valves and equipment and field conditions make it difficult or impossible for an average worker to operate or service an installed valve or piece of equipment, notify Owner's Representative of conflict before installing valve or item of equipment.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install valve operators on valves at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Other applicable building, fire, plumbing, mechanical and electrical code requirements
- D. Install operators and extensions to tolerances recommended by Manufacturer. Unless otherwise shown, install manual valve operators true, plumb, and level using precision gauges and levels.

3.3 Adjusting and Lubricating

- A. Valve box cover elevations are not shown on Plans. Determine and set cover elevations in field so finished rim elevations are flush with finished pavement where directed by Owner's Representative.

END OF SECTION

SECTION 33 08 11
PRESSURE TESTING AND FLUSHING OF WATER UTILITIES

PART 1 - GENERAL

1.1 Work Included

- A. Field pressure testing and flushing of all potable water mains / recycled water mains / force mains intended for conveyance of potable water, recycled water, and wastewater under pressure.
- B. Test all pipelines for water-tightness by subjecting each section to Hydrostatic Pressure and Leakage Tests in accordance with applicable requirements of AWWA C600 or C605, except as modified herein.
- C. Plan construction activities to allow and facilitate testing, flushing of all sections of applicable pipelines.
- D. Obtain all permits required to complete Work specified herein.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 75 00: Starting and Adjusting
- H. Section 33 13 00: Disinfecting of Water Utility Distribution

1.3 System Description

- A. Pressure test pipe to AWWA and Contract Document standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances
- B. AWWA C604 Installation of Buried Steel Water Pipe—4-inch and Larger
- C. AWWA C605 Underground Installation of PVC Pipe
- D. National Pollutant Discharge Elimination System Permit (NPDES) – Central Coast Regional Water Quality Control Board (CCWQCB) – General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters.
- E. National Pollutant Discharge Elimination System Permit (NPDES) – Colorado River Regional Water Quality Control Board (CRRWQCB) – General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters.

National Pollutant Discharge Elimination System Permit (NPDES) – Los Angeles Regional Water Quality Control Board (LARWQCB) – General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties, Los Angeles Region Order No. 97-047, NPDES Permit No. CAG674001 or most recent order or amendment.

- G. National Pollutant Discharge Elimination System Permit (NPDES) – Santa Ana Regional Water Quality Control Board (SARWQCB) – General Waste Discharge Requirements for Discharges to Surface Waters that Pose an Insignificant Threat to Water Quality, Santa Ana Region Order No. R8-2003-0061, NPDES Permit No. CAG998001 or most recent order or amendment.
- H. National Pollutant Discharge Elimination System Permit (NPDES) – San Diego Regional Water Quality Control Board (SDRWQCB) – General Permit for Discharges of Hydrostatic Test Water and Potable Water to Surface Waters and Storm Drains or Other Conveyance Systems, San Diego Region Order No. R9-2002-0020 or most recent order or amendment.
- I. Standard Methods for Examination of Water and Wastewater

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Testing Plan	On Owner's request, submit detailed plan showing how Contractor intends to test and flush pipeline and dechlorinate discharge from flushing operation.	
Written Permission to Discharge into Sewer	Required from owner of any sanitary sewer prior to discharge of flushing water into sewer. Submittal shall include any special requirements for treatment of flushing water prior to sewer discharge, estimate of expected maximum discharge rate of flushing flow and analysis of sewer's capacity.	
Written Permission to Discharge into Storm Drain	Required from owner of any storm drain prior to discharge of flushing water into storm drain. Submittal shall include any special requirements for treatment of flushing water prior to storm drain discharge, estimate of expected maximum discharge rate of flushing flow and analysis of storm drain's capacity.	

B. Refer to Section 01 33 00 for definition of requirements for reports and certificates of compliance.

1.7 Delivery, Storage and Handling

A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.

1.8 Unit Prices

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for items to which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Materials

A. Furnish all labor, water, and equipment necessary to complete pressure testing and flushing process.

3.1 Preparation

- A. Apply test pressures at approved outlet or fitting located within elevation of 5-feet of lowest point of each pipe section to be tested. Provide and later securely plug such fittings. Where air valves or other suitable outlets are unavailable, provide approved taps and fittings for air release, and securely plug these later.
- B. Flush all mains and services with potable water (or water as otherwise approved by Owner and regulatory agencies) after completion of construction. Provide sufficient number of suitable outlets at end(s) of line(s) being flushed in addition to those shown on Plans to permit flushing of main with water at velocity of at least 2.5-feet per second over its entire length. Outlets provided shall meet requirements for fittings specified for type of main constructed. Velocity through outlets and fittings shall not exceed 25 fps during flushing. Construct drainage facilities such that water lines cannot be contaminated through flushing outlets.
- C. Provide sufficient hoses, fittings and equipment to direct flushing water to established point of discharge such as gutter and storm drain inlet or natural drainage channel to prevent damage to public or private property and to prevent creating a public hazard. If flushing water must be discharged into traffic lanes, set up traffic control in accordance with requirements of agency having jurisdiction over public right-of-way. Schedule flushing in or adjacent to public streets during periods of reduced traffic volume.
- D. Contractor shall be solely responsible for providing source of water for flushing and methods for discharge of test water, including all associated costs and permits.

3.2 Field Quality Control

A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pipe	4-hour Hydrostatic Pressure Test	AWWA C600 or C605 as amplified below	All pipe sections	Contractor (Owner's Representative will observe and record results)	Contractor (Owner's Representative will observe and record results)
	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner

A. Allowable leakage shall be as follows:

1. No ductile iron or PVC pipe installation will be accepted if leakage exceeds that determined by the following formula (taken from AWWA C600 or AWWA C605):

$$L = \frac{(SD\sqrt{P})}{148,000}$$

in which L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of pipe, in inches

P = average observed test pressure of pipe being tested, as shown, in pounds per square inch gauge, based on elevation of lowest point in line or section under test and corrected to elevation of test gauge.

2. No gasketed steel pipe installation will be accepted if leakage exceeds that determined by the following formula (taken from AWWA C604):

$$L=10 \text{ gallons per inch-diameter per mile of pipe per 24 hours}$$

3. When testing against closed valves, an allowance of 0.0078 gallons per hour per inch of nominal valve size may be added to that computed using formulas above to account for leakage around seals.

B. For PVC, ductile iron, or gasketed steel pipe, allowable leakage is tabulated below.

ALLOWABLE LEAKAGE IN PVC OR DUCTILE IRON PIPE (GALLONS PER HOUR PER 1000 FT OF PIPE)					ALLOWABLE LEAKAGE IN GASKETED STEEL PIPE (GALLONS PER HOUR PER 1000 FT OF PIPE)	ADDITIONAL ALLOWABLE LEAKAGE THROUGH SEALS OF CLOSED VALVES (GALLONS PER VALVE)
PIPE DIAMETER	TEST PRESSURE					
	150 psi	200 psi	250 psi	300 psi	All Pressures	All Pressures
3-inch	0.25	0.29	0.32	0.35	0.24	0.02
4-inch	0.33	0.38	0.43	0.47	0.32	0.03
6-inch	0.50	0.57	0.64	0.70	0.47	0.05
8-inch	0.66	0.76	0.85	0.94	0.63	0.06
10-inch	0.83	0.96	1.07	1.17	0.79	0.08
12-inch	0.99	1.15	1.28	1.40	0.95	0.09
14-inch	1.16	1.34	1.50	1.64	1.10	0.11
16-inch	1.32	1.53	1.71	1.87	1.26	0.12
18-inch	1.49	1.72	1.92	2.11	1.42	0.14
20-inch	1.66	1.91	2.14	2.34	1.58	0.16
24-inch	1.99	2.29	2.56	2.81	1.89	0.19
30-inch	2.48	2.87	3.21	3.51	2.37	0.23
36-inch	2.98	3.44	3.85	4.21	2.84	0.28
42-inch	3.48	4.01	4.49	4.92	3.31	0.33
48-inch	3.97	4.59	5.13	5.62	3.79	0.37
54-inch	4.47	5.16	5.77	6.32	4.26	0.42
60-inch	4.97	5.73	6.41	7.02	4.73	0.47
64-inch	5.30	6.12	6.84	7.49	5.05	0.50

C. For welded steel pipe, no leakage will be permitted.

D. For polyethylene pipe, no leakage will be permitted.

E. Four-hour hydrostatic pressure test shall proceed as follows:

1. After all pipe, appurtenances and permanent thrust blocks have been installed and backfilled sufficiently and temporary plugs, caps, thrust blocks and shoring have been installed for required restraint, they shall be subjected to a hydrostatic pressure test.
2. Test pressure shall be 50 psi in excess of working pressure shown for class of pipe unless test pressure is shown elsewhere in Contract Documents.

3. Conduct pressure tests or retests subsequent to any trench backfill compactive effort that might be performed with heavy duty compacting equipment having overall weight in excess of 100 pounds.
 4. Some equipment such as butterfly valves may have maximum working water pressure less than test pressure. Contractor shall apply a minimum back pressure on these closed devices equal to difference between test pressure and rated pressure of device.
 5. Complete and pass test prior to connecting any new line with existing pipe and mains. Test shall further be conducted with valves open, and open ends of pipes, valves, and fittings suitably closed. Operate and check valves prior to test period. No leakage shall be allowed when testing across any valves.
 6. Maximum length of pipe to be included in any one test shall not exceed 2,500-feet or distance between valves, whichever is greater. Provide suitable test bulkheads, blocking, and fittings to permit such sectionalizing.
 7. Fill line slowly and maintain at operating pressure for at least 24 hours prior to testing to satisfy any system water absorption. While filling and immediately prior to testing, expel all air from pipeline.
 8. Pump pressure in pipeline to specified test pressure following 24-hour soak period. When test pressure has been reached, discontinue pumping until line pressure has dropped 10-psi, at which time line pressure shall again be pumped up to test pressure. Repeat procedure until 4 hours have elapsed from time test pressure was first applied. At end of this period, pump pressure up to test pressure for last time.
 9. Leakage shall be computed as total quantity of water pumped into pipeline during test period, including water added to reach specified test pressure for final time. Leakage shall not exceed rate specified for type of pipe tested.
 10. Allowable leakage is based on AWWA formulas specific to pipe materials tested. These formulas appear in respective AWWA publications for each type of pressure pipe.
 11. Repeat testing until leakage does not exceed specified leakage rate. Repair all visible leaks regardless of amount of leakage.
 12. Complete tests in presence of Owner's Representative. Owner's Representative will record results.
- F. Flushing water may be discharged to sanitary sewer system rather than discharging to storm drain, provided Contractor obtains and submits to Owner a copy of written permission to discharge from sanitary sewer owner including supplementary information described above under Submittals. Schedule discharges to sewers during off-peak periods as recommended by sewer owner.

END OF SECTION

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**SECTION 33 08 31
LEAKAGE AND INFILTRATION TESTING OF GRAVITY SEWER LINES**

PART 1 - GENERAL

1.1 Work Included

- A. Materials and labor for field leakage and infiltration testing of all gravity sanitary sewers intended for conveyance of wastewater under gravity flow. Furnish all labor, materials, tools, and equipment necessary to provide and complete field pressure testing and infiltration testing as specified.
- B. Plan construction activities to allow and facilitate testing of all sections of gravity sanitary sewers.
- C. Leakage tests shall be made on completed pipelines as follows:

PIPE	TEST REQUIREMENT
Gravity Sanitary Sewers 24" diameter or less where difference in elevation between inverts of adjacent manholes <10 feet	Water infiltration test or water exfiltration test as directed by Owner's Representative
Gravity Sanitary Sewers 24" diameter or less where difference in elevation between inverts of adjacent manholes >10 feet	Air test or water infiltration test as directed by Owner's Representative
Gravity Sanitary Sewers >24" diameter	Air test or water infiltration test as directed by Owner's Representative
Gravity Sanitary Sewers in service with no bypass available	CCTV inspection. See Section 33 01 31
Pressure Sanitary Sewers (Force Mains)	See Section 33 08 11
Recycled Water Pipelines	See Section 33 08 11
Water Pipelines	See Section 33 08 11

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 75 00: Starting and Adjusting

1.3 System Description

- A. Complete leakage testing and infiltration testing of gravity sewers in compliance with these specifications.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. ASTM F1417 Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION
Testing Plan	On Owner's request, submit detailed plan showing how Contractor intends to pressure test sewer.

1.7 Unit Prices

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Materials

A. Furnish all labor, materials, and equipment necessary to complete pressure testing of gravity sewers. Deliver equipment to project site in good working order and ready for use.

PART 3 - EXECUTION

3.1 Preparation

- A. Test each section of sewer between two successive manholes or structures for leakage or, at option of Owner's Representative, test for infiltration, or both. Test for leakage on all sections of sewer. Infiltration test shall also be made where groundwater is encountered.
- B. Even though a section may have previously passed leakage or infiltration tests, should compacting equipment weighing over 1000 pounds be used on backfill subsequent to tests or should any operations of Contractor or others may have damaged or affected required water-tight integrity of pipe, structure, and appurtenances. test each sewer section subsequent to last backfill compacting operation in connection therewith, wherein,

3.2 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pipe	Leakage	ASTM F1417 or as shown below	1 test per pipe	Contractor	Contractor
	Infiltration	ASTM F1417 or as shown below	1 test per pipe as requested by Owner	Contractor	Contractor
Manholes or Wet Wells	Leakage or Infiltration	Shall not exceed 0.1 gallons per hour per vertical foot for manholes and wet wells	1 test per manhole or wet well	Contractor	Contractor

B. Perform leakage and infiltration tests after placement and compaction of backfill, installation of utilities, and prior to mandrel test and placing of permanent paving. Correct all deficiencies found during leakage and infiltration test at no additional cost to Owner.

Complete tests in presence of Owner's Representative. Owner's Representative will record results.

- F. Conduct infiltration testing as follows for sewer segments located in natural groundwater table:
1. If groundwater is encountered in construction of section of sewer between structures, close end of sewer at upper structure sufficiently to prevent entrance of water.
 2. Discontinue pumping of groundwater for at least 3 days, and then test section for infiltration.
 3. Where any infiltration exceeding amounts allowed below is discovered before completion and acceptance of sewer, immediately uncover sewer and perform all Work necessary to reduce infiltration to within specified amount at no expense to Owner. Contractor shall stop any individual leaks that may be observed, even if those leaks are in a quantity less than specified limits for acceptance.
 4. Where sewer is not located in natural groundwater table, exfiltration tests or low-pressure air tests shall be used to indicate sewer tightness.
- G. Conduct exfiltration (leakage) testing as follows for sewer segments located above natural groundwater table:
1. Plug sewer at lower end of section to be tested with stopper.
 2. Plug highest end of sewer to be tested with stopper. Stopper plug shall have suitable air vent to allow trapped air removal.
 3. Fill pipe and manhole with water to elevation 4 feet above sewer invert at upper manhole. If groundwater is present, fill pipe and manhole to a point 4 feet above average adjacent groundwater level.
 4. Check system for leaks in hoses, plugs, calibrated containers, etc. while filling through positive shutoff valve.
 5. After filling sewer, allow one hour for absorption of water.
 6. Refill sewer to test elevation.
 7. Close input valve and begin test.
 8. Record elapsed time to empty container of water and calibrate loss rate in gallons per hour.
 9. Where any exfiltration or infiltration exceeding amounts allowed below is discovered before completion and acceptance of sewer, immediately uncover sewer and perform all Work necessary to reduce exfiltration to within specified amount at no expense to Owner. Repair pipe joints or, if necessary, remove and reinstall pipe at Contractor's expense. Sewer will not be accepted until exfiltration and/or infiltration rate, as determined by test, is less than allowable leakage.

Allowable exfiltration or infiltration shall not exceed 50 gallons per inch of internal diameter per mile per day, which equates to the following:

PIPE DIAMETER (Inches)	ALLOWABLE EXFILTRATION OR INFILTRATION (Gal/hr/100-ft)
6"	0.24 gal/hr/100'
8"	0.32 gal/hr/100'
10"	0.39 gal/hr/100'
12"	0.47 gal/hr/100'
15"	0.59 gal/hr/100'
18"	0.71 gal/hr/100'
21"	0.83 gal/hr/100'
24"	0.95 gal/hr/100'
27"	1.07 gal/hr/100'
30"	1.18 gal/hr/100'
33"	1.30 gal/hr/100'
36"	1.42 gal/hr/100'
39"	1.54 gal/hr/100'
42"	1.66 gal/hr/100'
48"	1.89 gal/hr/100'

H. Air testing shall only be done where Owner's Representative determines exfiltration or infiltration testing is impractical. Where directed by Owner's Representative, air testing shall proceed as follows:

1. Conduct air leakage test on all gravity sewers not tested by infiltration or exfiltration testing. Test each section of sewer between two successive manholes or structures.
2. Clean and wet line to be tested.
3. Plug all pipe outlets with suitable test plugs and securely brace each plug.
4. Compressor used to add air to pipe shall have blowoff valve set at 5 psig to ensure internal pipe pressure cannot exceed 5 psig.
5. Constantly monitor pressure in pipeline using gage and hose arrangement separate from hose used to fill sewer with air.
6. Add air slowly to portion of pipe installation under test until internal air pressure reaches 3.0 psig.
7. After 3.0-psig internal pressure is reached, maintain air pressure between 2.5 psig and 3.5 psig for at least 2 minutes to allow air temperature to reach equilibrium with pipe wall temperature. Add only enough air to maintain pressure.
8. Check exposed pipe and plugs for leakage by coating with soap solution. If any failures are observed, bleed off air and make necessary repairs.
9. After 2-minute period, disconnect air supply.
10. When pressure decreases to 2.5 psig, start timing with stopwatch or sweep-second-hand watch.
11. Determine time lapse required for air pressure to drop to 1.5 psig gage pressure.
12. If pressure drop from 2.5 psig to 1.5 psig occurs in less time than values tabulated below, pipe shall be overhauled and, if necessary, replaced and reinstalled until joints and pipe pass air test.

13. Use Greenbook tables in Section 306-1.4.4 to determine minimum time lapse required for air pressure to drop from 2.5 psig to 1.5 psig. With 6" laterals or house connections these values are as follows:

PIPE DIAMETER (Inches)	TIME IN SECONDS FOR PRESSURE DROP FROM 2.5 PSIG TO 1.5 PSIG					
	SEWER LENGTH (ft)	HOUSE CONNECTION LENGTH				
		0'	100'	200'	300'	400'
8"	0'	0	40	80	100	100
	50'	40	70	110	110	110
	100'	70	110	120	110	110
	150'	110	120	120	120	110
	200'	140	130	120	120	120
	300'	140	130	120	120	120
	400'	140	130	130	120	120
10"	50'	50	90	120	120	110
	100'	110	140	130	130	120
	200'	170	150	140	140	130
	300'	170	160	150	140	140
	400'	170	160	150	150	140
12"	50'	80	120	140	130	120
	100'	160	170	150	140	140
	200'	200	180	170	160	150
	300'	200	190	180	170	160
	400'	200	190	180	180	170
15"	50'	120	160	160	150	140
	100'	250	210	190	170	160
	200'	260	230	210	200	190
	300'	260	240	220	210	200
	400'	260	240	230	220	210
18"	50'	180	220	190	170	160
	100'	310	260	220	200	190
	200'	310	280	260	240	220
	300'	310	290	270	260	240
	400'	310	290	280	270	260
21"	50'	240	260	220	200	180
	100'	360	300	260	240	200
	200'	360	330	300	280	260
	300'	360	330	320	300	290
	400'	360	340	330	310	300
24"	50'	320	310	260	220	200
	100'	410	350	310	280	260
	200'	410	370	350	320	310
	300'	410	380	360	350	330
	400'	410	390	370	360	350
27"	50'	400	350	290	260	230
	100'	460	390	350	320	290
	200'	460	420	390	370	350
	300'	460	430	410	390	380
	400'	460	440	420	410	390
30"	50'	480	490	330	290	260
	100'	510	440	390	360	330
	200'	510	470	440	420	390
	300'	510	480	460	440	420
	400'	510	490	470	460	440
33"	50'	560	440	370	320	290
	100'	560	490	440	400	370
	200'	560	520	490	460	440
	300'	560	530	510	490	470
	400'	560	540	520	510	490

36"	50'	610	480	410	360	320
	100'	610	540	480	440	410
	200'	610	570	540	510	480
	300'	610	590	560	540	520
	400'	610	590	570	560	540
39"	50'	660	530	450	390	350
	100'	660	590	530	480	450
	200'	660	620	590	560	530
	300'	660	640	610	590	570
	400'	660	640	620	610	590
42"	50'	710	580	490	430	390
	100'	710	640	580	530	490
	200'	710	670	640	610	580
	300'	710	690	660	640	620
	400'	710	690	670	650	640

END OF SECTION

SECTION 33 11 11 DUCTILE-IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 Work Included

- A. Materials and installation of Ductile-Iron Pipe (DIP) and fittings.
- B. Do not use ductile iron pipe and fittings under any of the following circumstances:
 - 1. For buried pipelines exposed to seawater.
 - 2. For buried pipelines within 200 feet of electrified railways.

1.2 Related Work Described Elsewhere

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 33: Mechanical Identification
- H. Section 03 30 00: Cast-in-Place Concrete
- I. Section 09 90 00: Painting and Coating
- J. Section 09 96 56: Epoxy Linings and Coatings
- K. Section 31 05 50: Protecting Existing Utilities
- L. Section 31 23 00: Excavation and Fill
- M. Section 33 05 31: Pipeline Joint Materials
- N. Section 33 05 32: Flange Insulating Kits
- O. Section 33 05 38: Hangers and Supports
- P. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- Q. Section 33 11 19: Mastic and Tape-Wrap Systems for Metal Pipe
- R. Section 33 13 00: Disinfecting of Water Utility Distribution

1.3 System Description

- A. Furnish and install ductile-iron pressure pipe as shown on Plans including appurtenant fittings and connections in conformance with Manufacturer's installation requirements and in compliance with applicable construction safety codes and standards.

1.4 Quality Assurance

- A. Manufacturer of pipe and fittings shall employ manufacturing methods and material formulations in use for at least 5 years.
- B. Owner or Owner's Representative shall be entitled to inspect pipes and witness manufacturing process.

Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY		
Fusion-Bonded Epoxy Lining	Visual Inspection	See Section 09 96 56.	See Section 09 96 56.	Contractor	Contractor		
	Holidays			Contractor	Contractor		
	Lining Thickness			Contractor	Contractor		
Ceramic Epoxy Lining	Visual Inspection	Pipe will be rejected due to any of following: a. Sharp protuberances or significant sags, dimples, or curtains b. Protrusion in lining clearly caused by lining over foreign material. c. Any defect indicating double flow or fold in lining. d. Chuck marks or gouges extending to bare metal. e. Any bubble or area which appears to be unbonded to underlying metal surface	Each lined pipe spool or fitting	Contractor	Contractor		
	Holidays	Test at 100V per mil				Contractor	Contractor
	Lining Thickness	Owner's Representative will designate locations for spot measurements using Type 1 magnetic thickness gage taken at points of equilateral triangle 3" on a side: Triangles shall be located at both ends, in middle, and at midpoints of each half of pipe, plus 5 randomly-selected points. (1) No single spot measurement shall be less than 75% of specified minimum thickness. (2) Average of 3 spot measurements from any single triangle shall not be less than 80% of specified minimum thickness. 3) Average of all spot measurements on pipe shall exceed specified minimum thickness.				Contractor	Contractor

D. Repair holidays and knife-test areas in polyurethane linings as follows:

1. Repair holidays and cut ends by solvent cleaning, roughening with coarse sand paper, and applying brushable 2-component material recommended by Manufacturer for such purposes.
2. Overlap acceptable coating and lining at least one inch in all directions. Mix repair material and apply in accordance with Manufacturer's recommendation.

E. Repair holidays and knife-test areas in polyethylene linings as follows:

1. Expose bare metal surface with power grinder at least one inch in all directions from holidays and knife test areas, and abrade polyethylene surface for 2" around exposed area. Remove all dust.

2. Mix and apply coal tar epoxy according to Manufacturer's instructions, working it into abraded surfaces thoroughly. Allow epoxy to cure.
3. Abrade epoxy surface with sandpaper and remove dust.
4. Apply second coat of epoxy and allow to cure.

1.5 References

- A. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 250 and 800
- B. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- C. ASTM A377 Index of Specifications for Ductile Iron Pressure Pipe
- D. ASTM A536 Ductile Iron Castings
- E. ASTM A624 Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
- F. ASTM A716 Ductile Iron Culvert Pipe
- G. ASTM A746 Ductile Iron Gravity Sewer Pipe
- H. ASTM D16 Terminology of Paint, Varnish, Lacquer and Related Products
- I. ASTM D471 Test Method for Rubber Property – Effect of Liquids
- J. ASTM D1248 Polyethylene Plastics Extrusion Materials For Wire and Cable
- K. ASTM D2240 Rubber Property - Durometer Hardness
- L. ASTM D4060 Abrasion Resistance of Organic Coatings by the Taber Abraser
- M. ASTM D4561 Pull-Off Strength of Coatings Using Portable Adhesion Testers
- N. ASTM G14 Resistance of Pipeline Coatings (Falling Weight Test)
- O. AWWA C104/ANSI A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- P. AWWA C105/ANSI A21.5 Polyethylene Encasement for Ductile-Iron Pipe Systems
- Q. AWWA C110/ANSI A21.10 Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water
- R. AWWA C111/ANSI A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- S. AWWA C115/ANSI A21.15 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- T. AWWA C116/ANSI A21.16 Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
- U. AWWA C150/ANSI A21.50 Thickness Design of Ductile Iron Pipe
- V. AWWA C151/ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
- W. AWWA C153/ANSI A21.53 Ductile-Iron Compact Fittings, 3 In. through 64 In., for Water Service
- X. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances
- Y. AWWA Manual M41 Ductile-Iron Pipe and Fittings
- Z. SSPC SP1 Solvent Cleaning
- AA. SSPC SP6/NACE 3 Commercial Blast Cleaning
- BB. SSPC SP10/NACE 2 Near White Blast Cleaning

1.6 Submittals

- A. Furnish the following submittals:

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
	Required for pipe, couplings, fittings, protective coatings, and gaskets.	
Installation Instructions	Use AWWA C600 for pipe installation	
	Submit supplementary information as needed to cover proprietary methods of joint restraint.	

SUBMITTAL	DESCRIPTION	
Line Drawings	Line drawings.	
	Materials list.	
	Layout schedule.	
	Order of installation.	
	Length and location of each pipe section and fitting.	
	Dimensional checks.	
	Station and elevation of pipe invert at all changes in grade.	
	Data on curves and bends for both horizontal and vertical alignment.	
Certificate of Compliance	Deliver with pipe an affidavit from Manufacturer certifying compliance with requirements of AWWA standards and Contract Documents	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for catalog data, installation instructions, and certificates of compliance.

1.7 **Delivery, Storage and Handling**

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Pack, ship, handle, and store pipe in accordance with Manufacturer's instructions and AWWA C600 and AWWA M41 Chapter 11.
- C. Transportation shall be by competent haulers and accomplished in a manner that will avoid damage to pipe, lining, or coating.
- D. Before release of chains, cables and strapping around pipe being delivered, check loads to ensure all chock blocks are secure on both ends of support timbers. If not, provide suitable wedges or chocks to prevent pipe from rolling when other restraints are removed.
- E. Unload pipe by mechanical means, such as crane or backhoe, or by nylon slings and skids, as recommended by Manufacturer. In using skids, prevent pipes from striking other pipe. Do not drop pipe from trucks.
- F. Store pipe and fittings in accordance with Manufacturer's recommendations to prevent damage and contamination.
- G. Carefully handle pipe to prevent damage to lining and coating. Attach cable, rope, or other devices used for lowering fittings into trench around exterior of fitting for handling. Do not attach cable, rope, or other device through fitting's interior for handling.

1.8 **Unit Prices**

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant, including all Work and materials specified herein and as may be required to install and complete this portion of Work.
- B. Payment by linear foot shall be for each diameter and for each pipe strength designation measured horizontally over pipe centerline.

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Ductile-Iron Pipe	American Cast Iron Pipe Company (ACIPCO)	Birmingham, AL
	Atlantic States Cast Iron Pipe Company	Phillipsburg, NJ
	Clow Water Systems Company	Coshocton, OH
	Griffin Pipe Products	Council Bluffs, IA
	Pacific States Cast Iron Pipe Co Div. McWane, Inc.	Provo, UT
	U.S. Pipe and Foundry	Birmingham, AL
	Accepted equal	
Ductile-Iron Pipe Fittings	American Cast Iron Pipe Company (ACIPCO)	Birmingham, AL
	Clow Water Systems Company	Coshocton, OH
	Griffin Pipe Products	Council Bluffs, IA
	Star Pipe Products	Columbus, OH
	Tyler Union Div. McWane, Inc.	Tyler, TX
	U.S. Pipe and Foundry	Birmingham, AL
	Accepted equal	
Push-on Joints	American Cast Iron Pipe Company (ACIPCO) "Fastite"	Birmingham, AL
	Atlantic States Cast Iron Pipe Company	Phillipsburg, NJ
	Clow Water Systems Company	Coshocton, OH
	Griffin Pipe Products "Fastite or Tyton"	Council Bluffs, IA
	Pacific States Cast Iron Pipe Co Div. McWane, Inc.	Provo, UT
	U.S. Pipe and Foundry "Tyton"	Birmingham, AL
	Accepted equal	
Restrained Joints	American Cast Iron Pipe Company (ACIPCO) "Flex-Ring"	Birmingham, AL
	Atlantic States Cast Iron Pipe Company	Phillipsburg, NJ
	Clow Water Systems Company "Super-Lock"	Coshocton, OH
	Griffin Pipe Products "Snap-Lok"	Council Bluffs, IA
	Pacific States Cast Iron Pipe Co Div. McWane, Inc. "Thrust Lock"	Provo, UT
	U.S. Pipe and Foundry "TR-Flex"	Birmingham, AL
	Accepted equal	
Restrained Joints – Locking Gasket Type	American Cast Iron Pipe Company (ACIPCO) "Fast-Grip"	Birmingham, AL
	Griffin Pipe Products "Talon"	Council Bluffs, IA
	Pacific States Cast Iron Pipe Co Div. McWane, Inc. "Sure-Stop"	Provo, UT
	U.S. Pipe and Foundry "Field-Lok"	Birmingham, AL
	Accepted equal	
Ball and Socket Joints	American Cast Iron Pipe Company (ACIPCO) "Flex-Lok"	Birmingham, AL
	Atlantic States Cast Iron Pipe Company	Phillipsburg, NJ
	Clow Water Systems Company	Coshocton, OH
	Pacific States Cast Iron Pipe Co Div. McWane, Inc.	Provo, UT
	U.S. Pipe and Foundry "Usiflex"	Birmingham, AL
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Restrained Joint High Deflection Coupling	U.S. Pipe and Foundry "XTRA-Flex"	Birmingham, AL
	Accepted equal	
Tee-Head Bolts and Hex Nuts on Mechanical Joints	NSS Industries Corten	
	Accepted equal	
Shop Coat on Buried Pipe	Koppers 11-S Primer	Pittsburgh, PA
	Accepted equal	
Field Coatings on Buried Pipe	Koppers Bituplastic No 33	Pittsburgh, PA
	Accepted equal	
Polyethylene Encasement	Christy's "AWWA Polywrap"	Anaheim, CA
	Dupont Alathon	Wilmington, DE
	Northtown Company	Huntington Beach, CA
	Trumbull Industries, Inc.	Youngstown, OH
	Accepted equal	
Tape for Polyethylene Encasement	Berry Plastics "Polyken No 900"	Franklin, MA
	J-M Manufacturing Co., No V-10	Livingston, NJ
	Plicoflex No 340	
	Protecto Wrap No 200	Denver, CO
	Scotchwrap (3M), No 50	St Paul, MN
	Tapecoat Co., CT	Evanston, IL
	Accepted equal	
Third-Party Ductile Iron Pipe Follower-Gland-Type Mechanical Joint Restraints	EBAA Iron Megalug Series 1100 1100 for new MJ fittings 3"-48" 1100SD for existing MJ fittings 3"-48"	Eastland, TX
	Ford Uni-Flange Series 1300 Restrained End Cap for MJ fittings 4"-16" Series 1400 for MJ fittings 4"-36"	Wabash, IN
	Romac "RomaGrip"	Bothell, WA
	Smith Blair, Inc. Cam-Lock 111	Texarkana, TX
	Star Pipe Products "Stargrip" Series 3000	Houston, TX
	Accepted equal	
Third-Party Ductile Iron Pipe Restraint Harness for Push-on Bells	EBAA Iron (Series 1700 Megalug) Restraint Harness	Eastland, TX
	Romac 600 Series	Bothell, WA
	Star National Products Division Dresser Industries Style 443 Tie-Anchor	Columbus, OH
	Accepted equal	
Ceramic Epoxy Lining (NSF-61 Approved)	Enduron "Supercoat"	Birmingham, AL
	Accepted equal	
Ceramic Epoxy Lining	Enduron "Protecto 401"	Birmingham, AL
	Accepted equal	
Polyurethane Lining	U.S. Pipe and Foundry	Birmingham, AL
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.

Ductile-iron pipe and fittings shall meet or exceed the following materials and manufacturing requirements:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT		
Pipe	Standards	AWWA C151/ANSI 21.50 NSF 61 for potable water pipe		
	Material	Ductile-iron		
	Size	As shown on plans.		
	Wall Thickness	4" pipe	Thickness Class 52	
		6" pipe	Thickness Class 52	
		8" pipe	Thickness Class 50	
		10" pipe	Thickness Class 50	
		12" pipe	Thickness Class 50	
		Pipe sizes 14" and larger = Thickness Class 50, unless otherwise specified.		
		OR		
		Pressure class pipe may be substituted for thickness class pipe as follows:		
		4"-14" pipe	not allowed	
		16"-18" pipe	Pressure class 350	
		20"-24" pipe	Pressure class 300	
		30"-36"	Pressure class 250	
		42"-64"	Pressure class 200	
	Pipe with Grooved Couplings	Thickness Class 53		
	Markings	Per AWWA C151 Section 4.6.		
	Lengths	18 or 20-foot lengths per AWWA C151/ANSI A21.51, except where shorter lengths are required to fit horizontal or vertical alignment.		
	Coatings	Buried	Shop coat with one prime coat of asphaltic coating approximately 1-mil thick per AWWA C151	
Above ground and in vaults		See Section 09 90 00.		
Cement Mortar Lining	Double thickness cement-mortar lined per AWWA C104 using Type II cement, unless otherwise specified.			
Cement Mortar Lining Double Thickness Dimensions	3-12" Pipe	1/8"		
	14-24" Pipe	3/16"		
	30-64" Pipe	1/4"		
Option A Polyurethane Lining, where shown on Plans	Polyurethane "Polythane" lined ductile-iron pipe for sewer service provided by U.S. Pipe, or equal			
	Surface Preparation	SSPC SP1 Solvent Cleaning followed by SSPC SP10/NACE 2 Near White Blast		
	Lining Thickness	40 mils		
Option B Polyethylene Lining, where shown on Plans	Virgin polyethylene per ASTM D1248			
	Surface Preparation	Cleaning SSPC SP6/NACE 3 Commercial Blast Cleaning		
	Lining Thickness	40 mils on pipe 10 mil on spigot interior on bells		

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT		
	Option C Fusion-bonded Epoxy Lining, where shown on Plans	Epoxy Lining	See Section 09 96 56.	
	Option D Ceramic Epoxy Lining, where shown on Plans	Amine cured novalac epoxy lining		
		Minimum 20% by volume ceramic quartz pigment.		
		Permeability rating of 0.00		
		Abrasion resistance = Less than 4 mils loss after one million cycles on $\pm 22.5^\circ$ sliding aggregate slurry abrasion tester using a sharp natural siliceous gravel with particle size between 2 mm and 10 mm.		
U.S. Pipe Protecto 401 pipe, or equal.				
Joints	Standard Push-on Style	AWWA C111/ANSI 21.11		
	Mechanical Joint	AWWA C111/ANSI 21.11		
	Restrained Style	Special push-on type joint providing longitudinal restraint in lieu of concrete thrust block.		
		Boltless, restrained push-on joint design with positive axial locking restrained system capable of deflection after assembly.		
Use one type of restrained joint exclusively for all Work.				
Joint Gaskets	Material	AWWA C111/ANSI 21.11 Vulcanized Styrene Butadiene Rubber (SBR)		
	Material for Hydrocarbon Applications and Contaminated Soils	Nitrile (NBR) (acrylonitrile butadiene) FLUOREL or Viton (FKM) (fluorocarbon)		
	Age	<180 days old or <2 years old but retested <60 days prior to installation		
Fittings	Material	Ductile-iron		
	Standards	AWWA C110/ANSI 21.10 or AWWA C153/ANSI A21.53		
	Style	Push-on (standard) or restrained joint (as specified). Mechanical joint fittings not allowed unless otherwise shown on Plans.		
	Marking	Cast letters "DI" or "DUCTILE" into fittings, unless otherwise specified.		
	Coatings	Same coating as adjacent pipe, as described above		
	Linings	Same lining as adjacent pipe, as described above		
Ductile Iron Pipe Joint Restraints	Material	Ductile Iron		
	Style	Gripping Wedge		
	Working Pressure Rating	3"-64"	350 psi	
		18"-64"	250 psi	
Flanges	Material	Ductile Iron		
	Pressures 0-250 psi	ASME/ANSI B16.42 Class 150 Raised or plain faced		
	Pressures 250-300 psi	ASME/ANSI B16.42 Class 300 Raised or plain faced		
	Screwed-on Type for Pipe	AWWA C115/ANSI A21.15		
	Integrally-cast Type for Fittings	AWWA C110/ANSI A21.10		
	Alignment for Valve Mating	Boltholes of flanged valves shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.		
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.		
Flange Gaskets		See Section 33 05 31.		

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Grooved Ends	Provide where shown	AWWA C606 Compatible with adjacent coupling
Shop Coat	Prime Coat	12 mils MDFT Koppers 11-S primer
Polyethylene PE Film Wrap for Corrosion Protection	Standards	AWWA C105/ANSI A21.50
	Material	Polyethylene plastic tube
	Thickness	8-mil, single layer on pipe 8-mil double layer on fittings and appurtenances
	Adhesive tape to connect plastic film tubes and plastic film wrap at fittings and appurtenances	2" wide polyethylene adhesive tape
Alternate to Plastic Film Wrap for Corrosion Protection	Finish Coat	15 mils MDFT Koppers Bituplastic No 33

C. Provide identification for buried AWWA C151 ductile-iron pipe in the following manner:

PIPE CONTENTS	IDENTIFICATION/ WARNING/ LOCATING	TYPE	MATERIALS/METHOD	
Potable Water	Pipe Contents Identification	Identification Tape	2" high letters reading "POTABLE WATER"	
			Color = blue with white letters	
			Polyethylene	
			4 mils minimum thickness	
			6" width	
				Attached to top of polyethylene wrap on pipe with adhesive tape
	Pipe Warning	Warning Tape	2" high letters reading "CAUTION: WATERLINE BURIED BELOW"	
			Color = blue with white letters	
			Polyethylene	
			4 mils minimum thickness	
6" width				
			Installed in pipe trench 18" above pipe	
Reclaimed (Recycled, Non- Potable) Water	Pipe Contents Identification	Identification tape	2" high letters reading "CAUTION: RECLAIMED WATER – DO NOT DRINK"	
			Color = purple with white letters	
			Polyethylene	
			4 mils minimum thickness	
			6" width	
				Attached to top of polyethylene wrap on pipe with adhesive tape
	Pipe Warning	Warning Tape	2" high letters reading "CAUTION: RECLAIMED WATERLINE BURIED BELOW – DO NOT DRINK"	
			Color = purple with white letters	
			Polyethylene	
			4 mils minimum thickness	
6" width				
			Installed in pipe trench 18" above pipe	

PIPE CONTENTS	IDENTIFICATION/ WARNING/ LOCATING	TYPE	MATERIALS/METHOD
Sewage	Pipe Contents Identification	Identification tape	2" high letters reading "CAUTION: SEWER"
			Color = green with white letters
			Polyethylene
			4 mils minimum thickness
			6" width
	Attached to top of pipe with adhesive tape		
	Pipe Warning	Warning Tape	2" high letters reading "CAUTION: SEWER BURIED BELOW"
			Color = green with white letters
			Polyethylene
			4 mils minimum thickness
6" width			
Installed in pipe trench 18" above pipe			

- D. Gauge pipe shall be required for all of the following applications
- a. Pipe within property designated for water or wastewater pumping plants
 - b. Pipe within property designated for reservoirs.
 - c. Pipe within right-of-way of existing or future street crossings where right-of-way is shown on plans.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install DIP pressure pipe and fittings before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Prior to installing pipe, grade and prepare trench bottom to provide uniform bearing throughout entire length of each joint of pipe. Dig bell holes of ample dimension in trench bottom at locations of each joint to facilitate joining. Form flat or semi-circular trench bottom conforming to grade to which pipe is to be installed.
- C. Dewater trench so trench bottom and bedding material are dry.

Minimum trench width at crown of pipe shall be as follows based on AWWA M41 Table 11-2:

NOMINAL PIPE OD	MINIMUM BEDDING DEPTH (in below bell)	MINIMUM TRENCH WIDTH B _d (in)	PARALLEL PIPE CLEARANCE (in)
3"	4"	27"	6"
4"	4"	28"	6"
6"	4"	30"	6"
8"	4"	32"	6"
10"	4"	34"	6"
12"	4"	36"	6"
14"	4"	38"	6"
16"	4"	40"	6"
18"	4"	42"	6"
20"	4"	44"	6"
24"	4"	48"	6"
30"	4"	54"	12"
36"	4"	60"	12"
42"	4"	66"	12"
48"	4"	72"	12"
54"	4"	78"	12"
60"	4"	84"	12"
64"	4"	88"	12"

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Refer to Section 31 23 00 for open trench requirements.
- C. Furnish and install pipe and fittings at locations shown on Plans and Submittals.
- D. The following installation standards shall be followed:
 1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. Applicable building, fire, plumbing and mechanical code requirements
 4. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances
 5. AWWA Manual M41 Ductile-Iron Pipe and Fittings
- E. Refer variances between above documents and Contract Documents to Owner's Representative.
- F. Excavation and backfill, including pipe bedding, shall conform to provisions of Section 31 23 00, AWWA C600, and AWWA M41, Chapter 11.
- G. Accurately place pipe to lines and grades shown. Support fittings independently of pipe.

Assemble push-on joints per AWWA C600 and as follows:

1. On long radius curves, excavate trench wider than normal to allow for straight-line assembly before deflection.
2. Cut and machine pipe per AWWA C600, AWWA M41, and Manufacturer's standard procedures.
3. Do not cut pipe with cold chisel, standard iron pipe cutter, or any other method that may fracture pipe or produce ragged, uneven edges.
4. Clean groove and bell socket of pipe or fitting and plain end of mating pipe. Joint shall be dirt-free.
5. Lubricate plain end, socket and gasket using soapy water or accepted pipe lubricant as recommended in AWWA C600.
6. Insert rubber ring into groove making sure ring is completely seated. Lubrication for spigot and instruction for lubricant use shall be supplied by pipe Manufacturer.
7. Spigot and bell shall slide together without displacement of rubber gasket. Where possible install pipe with bell facing in direction of laying.
8. Insert spigot into bell and force slowly into position using large bar lever and wood block across pipe end. For large pipe, a come-along (with padding that will not scratch pipe) may be used.
9. After assembling pipe in straight line, make horizontal or vertical deflections at joints to comply with alignment shown on Plans.
10. Allowable joint deflections for push-on joints shall not exceed the following

PIPE NOMINAL DIAMETER	ALLOWABLE JOINT DEFLECTION - α PUSH-ON-JOINT	ALLOWABLE JOINT DEFLECTION - α RESTRAINED-JOINT
3"	4.0°	n/a
4"	4.0°	n/a
6"	4.0°	3.2°
8"	4.0°	3.2°
10"	4.0°	3.2°
12"	4.0°	3.2°
14"	2.4°	1.6°
16"	2.4°	1.6°
18"	2.4°	1.6°
20"	2.4°	1.6°
24"	2.4°	1.6°
30"	2.4°	1.6°
36"	2.4°	1.6°
42"	2.4°	1.6°
48"	2.4°	1.6°
54"	2.4°	1.6°
60"	2.4°	1.6°
64"	2.4°	1.6°

11. Values shown above are based on 80% of that recommended by AWWA M41 Table 11-4 and 11-5 or Manufacturer.

12. Minimum radii shall not be less than the following unless pipe lengths shorter than 18 or 20 feet are used:

PIPE NOMINAL DIAMETER	ALLOWABLE JOINT DEFLECTION - α PUSH-ON-JOINT		ALLOWABLE JOINT DEFLECTION - α RESTRAINED-JOINT	
	18' SPOOLS	20' SPOOLS	18' SPOOLS	20' SPOOLS
3"	241'	268'	n/a	n/a
4"	241'	268'	n/a	n/a
6"	241'	268'	322'	358'
8"	241'	268'	322'	358'
10"	241'	268'	322'	358'
12"	241'	268'	322'	358'
14"	430'	477'	645'	716'
16"	430'	477'	645'	716'
18"	430'	477'	645'	716'
20"	430'	477'	645'	716'
24"	430'	477'	645'	716'
30"	430'	477'	645'	716'
36"	430'	477'	645'	716'
42"	430'	477'	645'	716'
48"	430'	477'	645'	716'
54"	430'	477'	645'	716'
60"	430'	477'	645'	716'
64"	430'	477'	645'	716'

- I. Assemble mechanical joints per AWWA C600 and as follows:
1. On long radius curves, excavate trench wider than normal to allow for straight-line assembly before deflection.
 2. Cut and machine pipe per AWWA C600, AWWA M41, and Manufacturer's standard procedures.
 3. Do not cut pipe with cold chisel, standard iron pipe cutter, or any other method that may fracture pipe or produce ragged, uneven edges.
 4. Lubricate plain end, socket and gasket using soapy water or accepted pipe lubricant as recommended in AWWA C600.
 5. Insert rubber ring into groove making sure ring is completely seated. Lubrication for spigot and instruction for lubricant use shall be supplied by pipe Manufacturer.
 6. Spigot and bell shall slide together without displacement of rubber gasket. Joint shall be dirt free. Where possible install pipe with bell facing in direction of laying.
 7. Insert spigot into bell and force slowly into position using large bar lever and wood block across pipe end. For large pipe, a come-along (with padding that will not scratch pipe) may be used.
 8. Push gland toward socket and center it around pipe with gland lip against gasket. Insert bolts and hand-tighten nuts.
 9. After assembling pipe in straight line, make horizontal or vertical deflections at joints to comply with alignment shown on Plans.

10. Allowable joint deflections for mechanical joints shall not exceed:

PIPE NOMINAL DIAMETER	ALLOWABLE JOINT DEFLECTION - α MECHANICAL-JOINT	ALLOWABLE JOINT DEFLECTION - α RESTRAINED-JOINT
3"	6.6°	n/a
4"	6.6°	n/a
6"	5.7°	3.2°
8"	4.3°	3.2°
10"	4.3°	3.2°
12"	4.3°	3.2°
14"	2.9°	1.6°
16"	2.9°	1.6°
18"	2.4°	1.6°
20"	2.4°	1.6°
24"	1.8°	1.6°

11. Values shown above are based on 80% of that recommended by AWWA M41 Table 11-4 and 11-5 or Manufacturer.

12. After making joint deflection, tighten bolts to normal range of bolt torque recommended by Manufacturer or AWWA M41 Table 11-3.

J. Assemble flanged joints per Section 33 05 31.

K. Provide PE film wrap on ductile iron and cast iron fittings and pipe as follows:

1. Comply with AWWA C105.
2. Wrap PE film snugly around all exterior ferrous surfaces and 8" beyond bells, overlapping at least 2" at each seam.
3. Take care to completely encase pipe and prevent contact between pipe and surrounding soil. Prevent soil or bedding material from becoming trapped between pipe and PE wrap.
4. Do not install PE wrap on pipe sections or fittings to be concrete encased, installed within casing or installed through concrete slope anchors.
5. Leave stainless steel nuts and bolts exposed.
6. Secure PE wrap in place using 2" wide plastic tape.
7. At least 3 circumferential turns of plastic tape shall seal PE wrap ends over pipe and above valve bonnets.
8. Place circumferential wraps of tape at 2-foot intervals along pipe barrel to minimize space between PE wrap and pipe.
9. Repair cuts, tears, punctures or damage to PE wrap with adhesive tape or with short length of PE tube cut open, wrapped around pipe and secured in place.
10. A 15-mil coat of Koppers Bituplastic No 33 may be applied as an alternate to PE wrapping.

L. In addition to PE wrapping ductile iron pipe, wrap service lines of dissimilar metals and attendant corporation stop with PE wrap or a suitable dielectric tape for minimum clear distance of 3 feet from main.

M. Provide thrust blocks as follows:

1. Place concrete thrust blocks in accordance with Section 03 30 00 as shown using Portland cement concrete containing not less than 5 sacks of cement per cubic yard.
2. Place concrete blocks between undisturbed ground and fittings to be anchored.
3. Quantity of concrete and bearing area of pipe undisturbed soil shall be as shown, unless otherwise determined by Owner's Representative.
4. Place concrete, unless specifically shown otherwise, so pipe joints and fittings remain accessible to repairs.

H. Push-on restrained joints shall incorporate Flex-Ring, split ring or ring segments, and shall be installed in accordance with Manufacturer's installation instruction for joint design used.

I. Third-party ductile iron pipe restraint systems shall not be used.

3.3 Field Quality Control

A. Do not backfill any joint until Owner's Representative has observed it. Leave open sufficient trench space in vicinity of each joint to permit visual observation around entire periphery of joint.

B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Ductile Iron Pipe	Hydrostatic Test	Section 33 08 11, AWWA C600 and AWWA M41	All new ductile iron pipe	Contractor	Contractor
	Disinfection	Section 33 13 00 and AWWA C651.	All new ductile iron potable water pipe	Contractor	Contractor
	Anchorage and Support of Exposed Pipe	Visual inspection of finished installation. Support per UPC Table 3-1 and 3-2	1 inspection	Owner	Owner
	Installation	Visual inspection of finished installation	1 inspection	Owner	Owner
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

C. Remove damaged pipe or fittings upon discovery and without delay from Project Site.

3.4 Cleaning and Disinfection

A. Clean and disinfect pipe in accordance with Section 33 13 00.

3.5 Protection

A. Close open end of pipe with tight-fitting cap or plug to prevent entrance of foreign matter into pipe at all times when pipe installation is not in progress. These provisions shall apply during noon hour as well as overnight. Do not use pipeline to drain or remove water that has infiltrated into trench. Maintain inside of pipe free from foreign materials and in clean and sanitary condition until acceptance by Owner.

END OF SECTION

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**SECTION 33 11 21
BRASS AND COPPER PIPE**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of brass and copper pipe and brass and bronze fittings.
- B. Do not use brass pipe under any of the following circumstances:
 - 1. To convey ammonia.
 - 2. To convey brine.
 - 3. To convey sodium hypochlorite
 - 4. To convey sodium hydroxide
- C. All pipe conveying potable water shall conform to NSF 372 lead requirements.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 01 73 33: Mechanical Identification
- I. Section 09 90 00: Painting and Coating
- J. Section 22 10 00: Plumbing Piping
- K. Section 31 05 50: Protecting Existing Utilities
- L. Section 31 23 00: Excavation and Fill
- M. Section 33 05 31: Pipeline Joint Materials
- N. Section 33 05 32: Flange Insulating Kits
- O. Section 33 05 33: Couplings, Tie Rods, Flange Connectors and Unions
- P. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- Q. Section 33 12 22: Bronze Valves 3-inches and Smaller
- R. Section 33 12 31: Water Services and Flowmeter Assemblies
- S. Section 33 13 00: Disinfecting of Water Utility Distribution

1.3 System Description

- A. Furnish and install complete operating pipe system as shown, including appurtenant structural and/or mechanical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. National Sanitation Foundation marking shall appear on all potable water valves.

- C. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of the California Health and Safety Code.
- D. Stainless steel products may be substituted for bronze products provided dielectric protection is provided between stainless steel and bronze or copper alloys.
- E. National Sanitation Foundation Marking is not required for piping in nonpotable water or drainage service.

1.5 References

- A. ASME/ANSI B1.20.1 Pipe Threads, General Purpose (inch)
- B. ASME/ANSI B16.15 Cast Bronze Threaded Fittings
- C. ASME/ANSI B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
- D. ASME/ANSI B16.22 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
- E. ASME/ANSI B16.23 Cast Copper Alloy Solder Joint Drainage Fittings
- F. ASME/ANSI B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings
- G. ASME/ANSI B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes
- H. ASME/ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings
- I. ASME/ANSI B16.50 Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
- J. ASME/ANSI B31.3 Process Piping
- K. ASME Boiler and Pressure Vessel Code
- L. ASTM A193 Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
- M. ASTM A194 Carbon and Alloy-Steel Nuts for Bolts for High Pressure and High-Temperature Service
- N. ASTM B32 Solder Metal
- O. ASTM B42 Seamless Copper Pipe, Standard Sizes
- P. ASTM B43 Seamless Red Brass Pipe, Standard Sizes
- Q. ASTM B61 Steam or Valve Bronze Castings
- R. ASTM B62 Composition Bronze or Ounce Metal Castings (do not use for potable water wetted surfaces)
- S. ASTM B75 Seamless Copper Tube
- T. ASTM B88 Seamless Copper Water Tube
- U. ASTM B135 Seamless Brass Tube
- V. ASTM B251 General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
- W. ASTM B302 Threadless Copper Pipe, Standard Sizes
- X. ASTM B306 Copper Drainage Tube (DWV)
- Y. ASTM B447 Welded Copper Tube
- Z. AWWA C800 Underground Service Line Valves and Fittings
- AA. California Plumbing Code (CPC)
- BB. NSF/ANSI 61 Drinking Water System Components – Health Effects
- CC. NSF/ANSI 372 Drinking Water System Components – Lead Content

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per pipe shop drawing requirements where pipe runs exceed 50 feet	.
Catalog Data	Required per catalog data requirements for pipe, flanges, insulators, companion flanges and unions showing metal composition and compliance with industry standards	
Certificate of Compliance	Submit certification on request per certificate of compliance requirements.	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of copper pipe and fittings shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Copper Pipe	Cambridge Lee Industries	Reading, PA
	Cerro Flow Products, Inc.	St Louis, MO
	Halstead Div Mueller Industries	Greensboro, NC
	Phelps-Dodge	
	United States Brass and Copper	Downers Grove, IL
	Accepted equal	
Copper Fittings	Apollo Valve Div Conbraco Industries	Matthews, NC
	Accepted equal	
Red Brass Pipe	American Brass and Iron Foundry	Oakland, CA
	Halstead Div Mueller Industries	Greensboro, NC
	United States Brass and Copper	Downers Grove, IL
	Accepted equal	
Pipe Hangers for Brass and Copper Pipe	Warwick Hanger Company	Westerly, RI
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Copper pressure pipe and fittings shall meet or exceed the following materials and manufacturing requirements:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Copper Tubing	Standards	ASTM B88 and ANSI B16.22
	Material	Copper (annealed)
	Size	As shown on plans.
	Wall Thickness	Type K

	Lengths	1-inch	60' to 100' coils (minimum 24" ID) cut to length.
		2-inch	Flexible tube or 20' rigid lengths cut to length
	Coating	AWWA C209 35 mil cold-applied coal-tar tape, or PVC or PE coating.	
Fittings	Copper Fittings	ASME/ANSI B16.18 Cast Copper Alloy Solder Joint Pressure Fittings or ASME/ANSI B16.22 ASTM B75 Wrought Copper Solder-Joint or Flared Tube Fittings or ASTM B75 Seamless Copper Tube Fittings	
Joints	Joints 3/8-inch and Smaller	Flared end or compression joints	
	Joints 1/2-inch and Larger	Solder end joints	
	Solder	ASTM B32 Alloy Grade Sb5 (95% tin/5% antimony)	
	Solder Joints	Grade 50B	

- C. Red brass pipe and fittings for recycled water shall meet or exceed the following materials and manufacturing requirements:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Red Brass Pipe	Standards	ASTM B43
	Material	Red Brass
	Size	As shown on plans.
	Wall thickness	Schedule 80 (Extra strong) for pipe 1-inch and smaller and for pipe nipples Regular wall thickness elsewhere unless otherwise shown
Fittings	Standards	ASME/ANSI B16.15
	Material	ASTM B62 Bronze
	Threads	ANSI B120.1
Solder	Material	Tin-silver solder ASTM B32 Grade SB5. Do not use cored solder. Solder shall have less than 0.2% lead.

- D. Brass flanges, gaskets, bolts and nuts shall be constructed of the following materials:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Flanges	Standards	ASTM B62
	Material	Bronze Tap for iron pipe thread
	Size	As shown on plans.
	Class	ANSI B16.24 Class 125 or Class 150 conforming to adjacent flange
	Style	Solder-end companion flange
Flange Bolts, Nuts, Washers and Gaskets		See Section 33 05 31.
Flange Insulating Kit on Bronze Flanges mating with Ferrous Flanges	Use	Flange insulating kits required where dissimilar cuprous flanges and ferrous flanges mate. See Section 33 05 32.

Copper DWV pipe and fittings shall meet or exceed the following materials and manufacturing requirements:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT		
Copper Tubing	Standards	ASTM B306 type DWV		
	Material	Copper (annealed)		
	Size	As shown on plans.		
	Wall Thickness	Comply with ASTM B306		
	Lengths	1-inch	60' to 100' coils (minimum 24" ID) cut to length.	
		2-inch	Flexible tube or 20' rigid lengths cut to length	
Coating	AWWA C209 35 mil cold-applied coal-tar tape, or PVC or PE coating.			
Fittings	Copper Fittings	ANSI B16.23 Cast bronze or copper fittings size 1¼"-8" or ANSI B16.29 wrought copper or wrought copper alloy solder joint drainage fittings size 1¼"-4"		
Joints	Joints ¾-inch and smaller	Flared end or compression joints		
	Joints ½-inch and larger	Solder end joints		
	Solder	ASTM B32 Alloy Grade Sb5 (95% tin/5% antimony)		
	Solder Joints	Grade 50B		

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install copper pipe and fittings before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Cut tubing square and remove burrs. Clean both inside and outside of fitting and pipe ends with steel wool and muriatic acid before soldering. Take care to prevent annealing of fittings and tubing when making connections. Do not use miter joints in lieu of elbows. Do not notch straight runs of pipe in lieu of tees.
- C. Service saddles shall be no closer than 18 inches to valves, couplings, joints, or fittings except at ends of mains.
- D. Do not install service saddle on any machined section of asbestos cement pipe.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install brass and copper pipe and fittings at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations

3. Applicable building, fire, plumbing and mechanical code requirements

- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install brass and copper piping in neat and workmanlike manner, properly aligned and cut from measurements taken at site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- F. Install pipe without springing, forcing, or stressing pipe or any adjacent connecting valves or equipment.
- G. Firmly support and anchor all piping with fabricated or commercial hangers or supports in accordance with Section 33 05 38. Where necessary to avoid stress on equipment or structural members, pipes shall be anchored or harnessed. Provide expansion joints and guides as needed to compensate for pipe expansion due to temperature differences.
- H. Threaded Joints shall conform to ANSI/ASME B 1.20.1, and joints shall be full and cleanly cut with sharp dies. Not more than three threads shall remain exposed after installation.
- I. Copper pipe shall be installed as follows:
 - 1. Use silver solder and approved solder joint fittings.
 - 2. Thoroughly clean surfaces and apply flux before soldering.
 - 3. Do not connect copper or copper alloy pipe or fittings to ferrous pipe materials except with dielectric coupling expressly made for this purpose and service.
- J. Bends in soft copper tubing shall be long sweep. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning tubing wall at any point.
- K. Brazing procedures shall be in accordance with Articles XII and XIII, Section IX, of ASME Boiler and Pressure Vessel Code. Solder shall penetrate to full depth of cup in joints and fittings. Solders shall comply with ANSI B31.3, paragraph 328.
- L. Install buried piping with slack to provide flexibility in event of load due to settlement, expansion or contraction. Provide minimum cover of 36-inches below finished grade. Embed and cover tubing with sand or select material.
- M. Unless otherwise shown, all connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.
- N. Make connections using compression couplings, angle valves, etc. In accordance with Manufacturer's recommendations and accepted trade practices.
- O. Install flange bolts and nuts as follows:
 - 1. Lubricate bolt threads with graphite and oil prior to installation.
 - 2. Set flanged pipe with flange boltholes straddling pipe horizontal and vertical centerlines.

3.3 Field Quality Control

A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Brass and Copper Pipe and Fittings	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Hydrostatic Test	Section 33 08 11.	All brass and copper pipe	Contractor	Contractor
	Disinfection	Section 33 13 00 and AWWA C651.	All copper potable water pipe	Contractor	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

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SECTION 33 11 31
PVC PRESSURE PIPE (AWWA C900)

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of PVC pressure pipe and fittings 4-inches through 12 inches in diameter.
- B. Do not use PVC AWWA C900 pressure pipe under any of the following circumstances:
 - 1. For pipelines where working pressure exceeds 150 psi.
 - 2. For pipelines where working pressure exceeds 100 psi and pipe wall is not designed to withstand 200-psi test pressure (DR14).
 - 3. For force mains, pump station discharges and pipe subject to repeated pressurization/depressurization cycles.
 - 4. For air or gas piping.
 - 5. For pipelines where normal water temperature exceeds 90°F.
 - 6. For pipelines buried in soils containing organic solvents or petroleum products.
 - 7. For exterior piping exposed to sunlight.
 - 8. For pipeline exposed to changes in temperature where $\frac{3}{8}$ -inch per 100-ft per 10°F thermal expansion of PVC pipe cannot be accommodated.
- C. Use of AWWA C905 or C909 pipe is not permitted in the District

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 01 73 33: Mechanical Identification
- I. Section 03 30 00: Cast-in-Place Concrete
- J. Section 09 90 00: Painting and Coating
- K. Section 31 05 50: Protecting Existing Utilities
- L. Section 31 23 00: Excavation and Fill
- M. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- N. Section 33 08 31: Leakage and Infiltration Testing of Gravity Sewer Pipelines
- O. Section 33 10 11: Pipeline Joint Materials
- P. Section 33 13 00: Disinfecting of Water Utility Distribution
- Q. Section 33 11 33: PVC and CPVC Schedule 48, 80 and 120 Plastic Pipe

1.3 System Description

- A. Furnish and install PVC pressure pipe as shown on Plans including appurtenant fittings and connections in conformance with Manufacturer's installation requirements and in compliance with applicable construction safety codes and standards.

- A. Contractor or subcontractor performing Work of this Section requiring fusion of fusion-bonded PVC pipe shall be licensed by Manufacturer or be Manufacturer of PVC pipe furnished.
- B. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- C. Owner or Owner's Representative shall be entitled to inspect pipes and witness manufacturing process.
- D. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
PVC Pipe and Fittings	AWWA C900 Verification Testing	AWWA C900 Section 5 Verification	Per AWWA C900	Contractor	Contractor
	Hydrostatic Proof Test	AWWA C900 Section 5 Verification	All couplings and spools	Contractor	Contractor

1.5 References

- A. ASME/ANSI 21.10 Ductile Iron and Gray Iron Fittings
- B. ASTM D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- C. ASTM D3139 Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals
- D. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- E. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F. ASTM F1674 Test Method for Joint Restraint Products for Use with PVC Pipe
- G. AWWA C110 Ductile Iron and Gray Iron Fittings
- H. AWWA C153 Ductile Iron Compact Fittings
- I. AWWA C605 Underground Installation of PVC Pipe
- J. AWWA C900 Polyvinyl Chloride PVC Pressure Pipe 4-in through 12-in
- K. AWWA C907 Injected-Molded Polyvinyl Chloride (PVC) Pressure Fittings 4 in through 12 in for Water Distribution
- L. AWWA Manual M23 PVC Pipe Design and Installation
- M. California Plumbing Code (CPC)
- N. NSF 14 Plastics Piping System Components and Related Materials
- O. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION
Catalog Data	Required per catalog data requirements.
Installation Instructions	Use AWWA C605 for pipe installation
	Submit supplementary information as needed to cover proprietary methods of joint restraint.
	Submit supplementary information on joints, allowable deflections, joint lubricants and approved methods of joining pipe.
Certificate of Compliance	Submit torque information and installation instructions on any service saddles furnished.
	Deliver with pipe an affidavit from pipe Manufacturer documenting compliance with requirements of AWWA C900 and Contract Documents Submit affidavit of compliance with NSF 61 requirements
Warranty	Furnish one-year warranty from date of final acceptance

- B. Refer to Section 01 33 00 for definition of requirements for catalog data, installation instructions, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.
- B. Packaging, shipping, handling, and storage of pipe shall be performed in accordance with Manufacturer’s instructions.
- C. Do not allow surface temperatures on pipe and fittings to exceed 120°F.
- D. Use proper care to prevent damage in handling, moving, and placing pipe. Lower (do not drop) pipe from truck. Dropped pipe will be rejected.
- E. Unload pipe by hand or mechanical means, such as crane or backhoe, or by rope and skids, as recommended by Manufacturer. In using skids, prevent pipes from striking other pipe.
- F. Store pipe and fittings in accordance with Manufacturer’s recommendations to prevent damage and contamination.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.
- B. Payment by linear foot shall be for each diameter and for each pipe strength designation measured horizontally over pipe centerline.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
C900 PVC Distribution Pipe	North American Specialty Products, LLC	Valley Forge, PA
	Diamond Plastics	Golconda, NV
	IPEX	Saskatoon, SK, Canada
	North American Pipe Corporation	Houston, TX
	Vinyltech Corporation	Phoenix, AZ
	Accepted equal	
C900 PVC Restrained-Joint Distribution Pipe	Certainteed Corporation C900/RJ	Valley Forge, PA
	Accepted equal	
Ductile Iron Pipe Fittings	American Cast Iron Pipe	Birmingham, AL
	Clow Water Systems Company	Coshocton, OH
	Griffin Pipe Products	Council Bluffs, IA
	Star Pipe Products	Columbus, OH
	Tyler Union Div. McWane, Inc.	Tyler, TX
	U.S. Pipe and Foundry	Birmingham, AL
	Accepted equal	
Bell Stops (where specified to prevent overinsertion)	EBAA Iron Series 5000 “Mega-Stop”	Eastland, TX
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Couplings – C900 PVC High Deflection	North American Specialty Products, LLC	Valley Forge, PA
	U.S. Pipe and Foundry Xtra-Flex	Birmingham, AL
	Accepted Equal	

- B. Manufacturer of pipe and fittings shall employ manufacturing methods and material formulations in use for at least 5 years.
- C. Owner may require bell stops for PVC pipe “accepted equal” manufacturers as a condition of acceptance.

2.2 Materials

- A. Refer to Section 01 61 00 for delivery storage and handling requirements.
- B. PVC transmission pipe shall meet or exceed the following materials and manufacturing requirements:

MATERIAL/ COMPONENT	PHYSICAL CHARACTERISTICS	SPECIFICATION/REQUIREMENT		
Pipe	Standards	AWWA C900		
	Material	ASTM D1784 Cell Class 12454B or better Virgin rigid PVC Conform to NSF 14 See AWWA C900 Section 4.2.		
	Hydrostatic Design Basis	4000 psi for water at 73.4°F		
	Markings (each pipe)	Per AWWA C900 Section 6.1		
		Mark AWWA standard complied with		
		Show nominal pipe diameter		
		Show AWWA pressure class or DR		
		NSF 61 stamp (for potable water service)		
	Size	Manufacturer and manufacturing date code		
		4-inch through 12-inch diameter as shown. Match outside diameter of cast-iron pipe unless otherwise shown.		
		Wall Thickness	WORKING PRESSURE CLASS ON PLANS	MINIMUM DIMENSION RATIO (DR) (to AWWA C900 Table 1 tolerances.)
			0-100 psi	DR 14 (Class 305)
			150 psi	DR 14 (Class 305)
			200 psi	DR 14 (Class 305)
250 psi	Use Ductile iron pipe			
Not shown	DR 14 (Class 305)			
Lengths	Laying lengths shall be 20-feet with Manufacturer's option to supply up to 15% random (minimum length 10-feet) sections.			
Hydrostatic Design Pressure (HDB)	Equal to or greater than 4,000 psi for water at 73.4 degrees F (23 degrees C)			
Color	See below.			
Joints	Style	Push-on, integral bell and spigot per ASTM D3139		
	Gaskets	Elastomeric Membrane per AWWA C900 Section 4.2.4 (Gaskets and Lubricants) and ASTM F477		

MATERIAL/ COMPONENT	PHYSICAL CHARACTERISTICS	SPECIFICATION/REQUIREMENT
	Lubricants	NSF 61 compatible for potable water service
	Working Pressure	As required by class of pipe shown on Plans
Gaskets	Material	Ethylene Propylene (EPM or EPDM) Elastomeric Membrane per AWWA C900 Section 4.2.4 (Gaskets and Lubricants) and ASTM F477 Verify chemical resistance against AWWA M23 Table 12
	Age	<180 days old or <2 years old but retested <60 days prior to installation

C. Fittings shall be constructed of the following materials:

MATERIAL/ COMPONENT	TEST/PHYSICAL CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Fittings	Standards	ANSI A21.10, AWWA C110, or AWWA C153
	Material	Ductile iron
	Markings	Letters "DI" or "DUCTILE" shall be cast on fittings
	Bell Size	Compatible with class of cast-iron equivalent PVC water transmission pipe
	Lining	Cement mortar (double thickness)
	Coating	1 mil petroleum asphaltic coating
	Plastic Film Wrap for Corrosion Protection	AWWA C105
	Style	Push-on, integral bell and spigot with rubber ring retaining groove
Joints	Style	Push-on, integral bell and spigot
	Working pressure	As required by class of pipe shown on Plans

D. Provide identification for buried AWWA C900 PVC water transmission pipe in the following manner:

PIPE CONTENTS	IDENTIFICATION/WARNING/LOCATING	TYPE	MATERIALS/METHOD	
Potable Water	Pipe Contents Identification	Pipe Color	Blue	
		<u>AND</u>		
		Identification Tape	2-inch high letters reading "POTABLE WATER"	
			Color = blue with white letters	
			Polyethylene	
			4 mils minimum thickness	
	6-inch width			
	Attached to top of pipe with adhesive tape			
	Pipe Warning and Locating	Warning and Locating Tape	2-inch high letters reading "CAUTION: WATERLINE BURIED BELOW"	
			Color = blue with white letters	
Polyethylene				
4 mils minimum thickness				
6-inch width				
Metallic strip that can be registered by a magnetic field locating device				
Place in pipe trench 18 inches above pipe				
Locating Wire	In lieu of installing metallic warning tape; non-metallic warning tape and 10-gauge copper wire attached to top of pipe may be used.			
Reclaimed (Recycled, Non-Potable) Water	Pipe Contents Identification	Pipe Color	Purple	
		<u>AND</u>		
		Identification Tape	2-inch high letters reading "CAUTION: RECLAIMED WATER – DO NOT DRINK"	
			Color = purple with white letters	
			Polyethylene	
			4 mils minimum thickness	
	6-inch width			
	Attached to top of pipe with adhesive tape			
	Pipe Warning and Locating	Warning and Locating Tape	2-inch high letters reading "CAUTION: RECLAIMED WATERLINE BURIED BELOW – DO NOT DRINK"	
			Color = purple with white letters	
Polyethylene				
4 mils minimum thickness				
6-inch width				
Metallic strip that can be registered by a magnetic field locating device				
Place in pipe trench 18 inches above pipe				
Locating Wire	In lieu of installing metallic warning tape; non-metallic warning tape and 10-gauge copper wire attached to top of pipe may be used.			

PIPE CONTENTS	IDENTIFICATION/WARNING/LOCATING	TYPE	MATERIALS/METHOD	
Sewage	Pipe Contents Identification	Pipe color	Green	
		<u>AND</u>		
		Identification tape	2-inch high letters reading "CAUTION: SEWER"	
			Color = green with white letters	
			Polyethylene	
			4 mils minimum thickness	
			6-inch width	
	Attached to top of pipe with adhesive tape			
	Pipe Warning and Locating	Warning and Locating Tape	2-inch high letters reading "CAUTION: SEWER BURIED BELOW"	
			Color = green with white letters	
			Polyethylene	
			4 mils minimum thickness	
			6-inch width	
		Metallic strip that can be registered by a magnetic field locating device		
Place in pipe trench 18 inches above pipe				
	Locating Wire	In lieu of installing metallic warning tape; non-metallic warning tape and 10-gauge copper wire attached to top of pipe may be used.		

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install PVC pressure pipe and fittings before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Prior to installing pipe, grade and prepare trench bottom to provide uniform bearing throughout entire length of each joint of pipe. Dig bell holes of ample dimension in trench bottom at locations of each joint to facilitate joining. Form flat or semi-circular trench bottom conforming to grade to which pipe is to be installed.
- C. Dewater trench so trench bottom and bedding material are dry.
- D. Minimum bedding depth and trench width at crown of pipe shall be as follows based on AWWA M23 Chapter 7 page 79:

NOMINAL PIPE OD	MINIMUM BEDDING DEPTH (in below bell)	MINIMUM TRENCH WIDTH B _d (in)	PARALLEL PIPE CLEARANCE (in)
3"	4"	18"	6"
4"	4"	18"	6"
6"	4"	18"	6"
8"	4"	21"	6"
10"	4"	23"	6"
12"	4"	25"	6"

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Refer to Section 31 23 33 for open trench requirements.
- C. Furnish and install pipe and fittings at locations shown on Plans and Submittals.
- D. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire and plumbing code requirements
 - 4. AWWA C605 "Underground Installation of PVC Pipe"
 - 5. AWWA Manual M23 PVC Pipe Design and Installation
- E. Refer variances between above documents and Contract Documents to Owner's Representative.
- F. Excavation and backfill, including pipe bedding, shall conform to provisions of Section 31 23 00 and AWWA M23, Chapter 7.
- G. Accurately place pipe to lines and grades shown. Support fittings independently of pipe.
- H. Assemble joints as follows:
 - 1. Spigot and bell shall slide together without displacement of rubber gasket. Joint shall be dirt free. Where possible install pipe with bell facing in direction of laying.
 - 2. Confirm pipe spigot is clean. Wipe with clean dry cloth around entire pipe end circumference to 1" beyond reference mark.
 - 3. Do not lubricate gasket or gasket groove in bell.
 - 4. Lubricate full spigot end circumference including beveled end using lubricant supplied by pipe Manufacturer. If dirt or sand adhere to lubricant, wipe spigot clean and relubricate.
 - 5. Insert rubber ring into groove making sure ring is completely seated and reference mark on spigot is flush with bell end.
 - 6. Insert spigot into bell and force slowly into position using large bar lever and wood block across pipe end. For large pipe, a come-along (with padding that will not scratch pipe) may be used.
 - 7. If undue resistance to spigot insertion is encountered or reference mark does not reach flush position, disassemble joint and check position of rubber gasket. If it is twisted or dislodged, clean gasket, bell, and spigot and repeat assembly steps. If gasket is not out of position, measure distance between reference mark and spigot end and check it against correct values provided by pipe Manufacturer.

8. Allowable joint deflections shall not exceed the following

PIPE NOMINAL DIAMETER	ALLOWABLE JOINT DEFLECTION - α	ALLOWABLE JOINT DEFLECTION - α - WITH HIGH-DEFLECTION COUPLING	ALLOWABLE LONGITUDINAL BENDING FOR 20-FT LENGTH - β
4"	2.0°	4.0°	9.2°
6"	2.0°	4.0°	6.4°
8"	2.0°	4.0°	Longitudinal bending not permitted
10"	2.0°	4.0°	
12"	1.68°	4.0°	

9. Values shown above are based on 80% of that recommended by AWWA M23 Table 13 or coupling Manufacturer. In no case shall deflection exceed two degrees in any direction without use of high-deflection couplings.

10. Minimum radii shall not be less than the following unless pipe lengths shorter than 20 feet are used:

PIPE NOMINAL DIAMETER	ALLOWABLE JOINT DEFLECTION - α	ALLOWABLE JOINT DEFLECTION - α - WITH HIGH-DEFLECTION COUPLING	ALLOWABLE LONGITUDINAL BENDING FOR 20-FT LENGTH - β
4"	573'	286'	125'
6"	573'	286'	179'
8"	573'	286'	Longitudinal bending not permitted
10"	573'	286'	
12"	682'	286'	

I. Join flanges on PVC pipe as follows:

1. Clean flange surfaces to mate with gasket, removing loose dirt, scale and detritus.
2. Inspect flange bolts and studs for proper size, threading and length.
3. With gasket in place, align mating flange bolt holes. Make sure mating flange faces are flush against gasket prior to bolt-up.
4. Insert bolts, nuts and washers. Tighten by hand until snug.
5. Before tightening bolts beyond hand-tight, operate adjacent valves through full range of motion to ensure clear unobstructed operation of discs and other internal parts.
6. Tighten bolts in sequence by 5-lb. increments following a 180° opposing sequence.
7. Flange bolt torques shall be as follows:

FLANGE SIZE	RECOMMENDED TORQUE
4"	25 ft-lb
5"	30 ft-lb
6"	40 ft-lb
8"	40 ft-lb
10"	64 ft-lb
12"	95 ft-lb

8. Clean and lubricate bolt threads using lubricant chemically compatible with all materials involved.
- J. Provide PE wrap on ductile iron and cast iron fittings as follows:
9. Comply with AWWA C105.
 10. Wrap film snugly around all exterior ferrous surfaces and 8 inches beyond bells, overlapping at least 2 inches at each seam.
 11. Do not install plastic film wrap on sections of pipe to be concrete encased, installed within casings, or through concrete slope anchors.
 12. Leave stainless steel nuts and bolts exposed.
 13. Secure polyethylene wrap in place using 2-inch wide plastic tape.
 14. At least 3 circumferential turns of plastic tape shall seal film wrap ends over pipe and above valve bonnets.
 15. A 15-mil coat of Koppers Bituplastic No 33 may be applied instead of polyethylene wrapping.
- K. Provide thrust restraint as follows:
16. Place concrete thrust blocks in accordance with Section 03 30 00 as shown using Portland cement concrete containing not less than 5 sacks of Portland cement per cubic yard.
 17. Place concrete blocks between undisturbed ground and fittings to be anchored.
 18. Quantity of concrete and bearing area of pipe undisturbed soil shall be as shown, unless otherwise determined by Owner's Representative.
 19. Place concrete, unless specifically shown otherwise, so pipe joints and fittings remain accessible to repairs.
 20. Use of mechanical thrust restraint devices in lieu of thrust blocks will be permitted only where sufficient right of way for thrust blocks is unavailable due to conflicts with existing buried or surface improvements, utilities or right of way limits. In such case, Contractor shall submit:
 - a. Catalog cuts for restraint method proposed.
 - b. Certification from pipe Manufacturer that thrust restraint system will not compromise pressure rating of pipe below that required for pressure testing.
 - c. Wall thickness of pipe used with mechanical thrust restraint devices shall be no less than DR14. For working pressures in excess of 150 psi, use ductile iron pipe on restrained joint sections to achieve necessary pressure class and wall thickness.
- L. Install pipe identification, warning, and locating measures continuously along entire length of pipe. Fasten pipe identification tape to pipe at maximum 5' intervals using adhesive tape banded around pipe. Provide 5' minimum overlap of warning tape at each end of pipe for tape attached to pipe outside of trench.

3.3 Field Quality Control

A. Do not backfill any joint until Owner's Representative has observed it. Leave open sufficient trench space in vicinity of each joint to permit visual observation around entire joint periphery.

B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
PVC Pressure Pipe and Fittings	Hydrostatic Test	Section 33 08 11 and AWWA C605	All new PVC potable water pipe	Contractor	Contractor
	Leakage and Infiltration Testing	Section 33 08 31	All new PVC sewer pipe	Contractor	Contractor
	Disinfection	Section 33 13 00 and AWWA C651.	All new PVC potable water pipe	Contractor	Contractor
	Anchorage and Support of Exposed Pipe	Visual inspection of finished installation. Support per UPC Table 3-1 and 3-2	1 inspection	Owner	Owner
	Installation	Visual inspection of finished installation	1 inspection	Owner	Owner
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

C. Remove damaged pipe or fittings upon discovery and without delay from Project Site.

3.4 Cleaning and Disinfection

A. Clean and disinfect pipe in accordance with Section 33 13 00.

3.5 Protection

A. Close open end of pipe with tight-fitting cap or plug to prevent entrance of foreign matter into pipe at all times when pipe installation is not in progress. These provisions shall apply during noon hour as well as overnight. Do not use pipeline as drain for removing water that has infiltrated into trench. Maintain inside of pipe free from foreign materials and in clean and sanitary condition until acceptance by Owner.

END OF SECTION

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SECTION 33 11 33
PVC AND CPVC SCHEDULE 40, 80, and 120 PLASTIC PIPE

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of PVC and CPVC plastic pipe.
- B. Do not use PVC schedule 40, 80, and 120 plastic pressure pipe under any of the following circumstances:
 - 1. For pipelines where working pressure > 50 psi for Schedule 40 pipe.
 - 2. For pipelines ≤ 6" where working pressure > 70 psi
 - 3. For force mains, pump station discharges and pipe subject to repeated pressurization / depressurization cycles.
 - 4. For pipelines having fluid velocities > 5 fps.
 - 5. For pipelines buried in soils containing organic solvents or petroleum products
 - 6. For potable water piping on public side of meter.
 - 7. For pipe > 6" diameter.
 - 8. For applications under authority of Office of Statewide Health Planning and Development.
- C. Outdoor piping exposed to sunlight shall be painted with a coat of water-based latex paint per Section 09 90 00. Use pastel shades or white to reduce thermal expansion.
- D. For pipe larger than 6" diameter, see Section 33 11 31.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 01 73 33: Mechanical Identification
- I. Section 09 90 00: Painting and Coating
- J. Section 31 23 00: Excavation and Fill
- K. Section 31 05 50: Protecting Existing Utilities
- L. Section 33 05 31: Pipeline Joint Materials
- M. Section 33 05 26: Utility Identification
- N. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- O. Section 33 08 31: Leakage and Infiltration Testing of Gravity Sewer Pipelines
- P. Section 33 11 39: FRP, PP, PVDF and other Plastic Pipe and Fittings
- Q. Section 33 13 00: Disinfecting of Water Utility Distribution
- R. Section 33 11 31: PVC Pressure Pipe C900
- S. Section 33 11 32: PVC Pressure Pipe C905
- T. Section 33 11 34 PVC Irrigation Pipe (SDR Series)
- U. Section 33 12 24: Plastic Valves
- V. Section 33 30 31: PVC Gravity Sewer Pipe

System Description

- A. Furnish and install complete operating piping system including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer’s installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Pipe, tubing and fittings shall bear NSF seal except for drainage piping.
- C. Pipe and fittings shall be produced by same Manufacturer
- D. Mark pipe with nominal size, type, class, schedule or pressure rating, and Manufacturer.
- E. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
CPVC Piping	ASTM Compliance	Mark pipe and fittings in accordance with ASTM F441	At least one mark ea item	Contractor	Contractor
PVC Piping, Schedule Type	ASTM Compliance	Mark pipe and fittings in accordance with ASTM D1785	At least one mark ea item	Contractor	Contractor

1.5 References

- A. ASME/ANSI B1.20.1 (ANSI B2.1) Pipe Threads – NPT National Pipe Thread Taper
- B. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
- C. ASTM D656 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- D. ASTM D1599 Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings
- E. ASTM D1784 Rigid Poly(Vinyl-Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl-Chloride) (PVC) Compounds
- F. ASTM D1785 Poly(Vinyl-Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
- G. ASTM D2241 Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
- H. ASTM D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- I. ASTM D2464 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings
- J. ASTM D2466 Poly(Vinyl-Chloride) (PVC) Plastic Pipe Fittings, Schedules 40, 80 and 120
- K. ASTM D2467 Socket-Type Poly(Vinyl-Chloride) (PVC) Plastic Pipe Fittings Schedule 80
- L. ASTM D2485 Recommended Practice for Making Solvent-Cemented Joints with Poly(Vinyl-Chloride) (PVC) Plastic Pipe and Fittings
- M. ASTM D2564 Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Pipe and Fittings
- N. ASTM D2774 Underground Installation of Thermosetting Pressure Piping
- O. ASTM D2846 Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
- P. ASTM D2855 Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

- . ASTM F402 Safe Handling of Solvent Cements, Primers and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- R. ASTM F437 Threaded Chlorinated Poly(Vinyl-Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- S. ASTM F438 Socket-Type Chlorinated Poly(Vinyl-Chloride) (CPVC) Plastic Pipe Fittings Schedule 40
- T. ASTM F439 Socket-Type Chlorinated Poly(Vinyl-Chloride) (CPVC) Plastic Pipe Fittings Schedule 80
- U. ASTM F441 Chlorinated Poly(Vinyl-Chloride) (CPVC) Plastic Pipe Schedules 40 and 80
- V. ASTM F442 Chlorinated Poly(Vinyl-Chloride) (CPVC) Plastic Pipe (SDR-PR)
- W. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- X. ASTM F493 Solvent Cements for Chlorinated Poly(Vinyl-Chloride) (CPVC) Plastic Pipe Fittings
- Y. ASTM F645 Selection, Design and Installation of Thermoplastic Water Pressure Piping Systems
- Z. ASTM F656 Primers for Use in Solvent Cement Joints of Poly(Vinyl-Chloride) (PVC) Plastic Pipe and Fittings
- AA. ASTM F1498 Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings
- BB. ASTM F1970 Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems
- CC. California Green Building Standards Code (CALGreen Code)
- DD. Code of Federal Regulations Title 49
- EE. IAPMO IS20 CPVC Solvent-Cemented Hot and Cold Water Distribution Systems
- FF. NSF/ANSI 14 Plastics Piping System Components and Related Materials
- GG. NSF/ANSI 61 Drinking Water System Components – Health Effects
- HH. Plastic Pipe Institute PE 3408

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation or application instruction requirements.	
Certificate of Compliance	Submit Manufacturer's certification of plastic pipe and tubing for each lot delivered per certificate of compliance requirements.	
	Submit copies of solvent cement Manufacturer's report and certification in accordance with ASTM D2564 for PVC piping and ASTM F493 for CPVC piping.	
Test Record Transcripts	Submit test results for factory tests per foundry or test record transcript requirements.	
Warranty	Furnish one -year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, certificates of compliance, and test record transcripts.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Protect piping materials from sunlight, scoring and distortion.
- C. Do not allow surface temperatures on pipe and fittings to exceed 120°F.
- D. Manufacturer's instruction and warranty requirements for delivery, storage and handling of PVC and CPVC plastic pipe and fittings shall be strictly followed.

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
PVC Plastic Pipe and Fittings 3/8"-24"	North American Specialty Products, LLC	Valley Forge, PA
	Harrington Industrial Plastics, Inc.	Chino, CA
	Harvel Plastics, Inc.	Easton, PA
	J.M. Eagle Manufacturing Company	Los Angeles, CA
	Pacific Plastics	Brea, CA
	Spears Manufacturing Company	Sylmar, CA
	Accepted equal	
PVC or CPVC Saddles	Spears Manufacturing Company	Sylmar, CA
	Accepted equal	
PVC or CPVC Self-aligning Tank Adaptors	Spears Manufacturing Company	Sylmar, CA
	Accepted equal	
PVC or CPVC Flanges	Spears Manufacturing Company	Sylmar, CA
	Accepted equal	
Solvent Cement PVC	Christy's Red Hot Blue Glue, Low VOC	Anaheim, CA
	IPS Corporation Weld-On 705 or 711	Collierville, TN
	Spears Manufacturing Company PVC 05 or PVC 11	Sylmar, CA
	Accepted equal compatible with pipe material, and CALGreen Code and SCAQMD requirements	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. The following is being conveyed:

FLUID	VISCOSITY (77°F)	SPECIFIC GRAVITY	TEMP	FREEZING POINT	BOILING POINT	VAPOR PRESS (77°F)	pH	SOLIDS CONTENT
Potable Water	0.894cP	1.00	33-90°F	32°F	212°F	0.46 psia	6.5-8.5	<500 ppm
Recycled Water	0.894cP	1.00	33-90°F	32°F	212°F	0.46 psia	6.5-8.5	<1.0%
Wastewater	0.894cP	1.01	33-90°F	32°F	212°F	0.46 psia	6.5-8.5	<1.0%

- C. Adhesives and solvent welding materials used on Work shall comply with VOC limits set forth in Section 5.504.4.1 of CALGreen Code.

PVC pipe may be used for temperatures to 110°F, and shall be constructed of the following materials:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Pipe	Standards	ASTM D1785
	NSF Certification	NSF 61-certified for potable water pipe
	Material	ASTM D1784 Cell Class 12454 Virgin rigid PVC Conform to NSF 14
	Size	As shown on plans.
	Wall Thickness	Schedule 80
	Color	Gray / White / Standard Clear / Near Water Clear / Blue for potable water / Green for wastewater / Purple for recycled water / Orange
Joints	Restrained Style	Solvent-welded socket joints except at valve connections Provide threaded or flanged adaptors as required for valve connections
Fittings	Standards	ASTM D2466
	Weight	Use same schedule as adjacent pipe
	Threads	Injection molded type where required Conform to ASTM F1498
	Threaded Nipples	ASTM D2464, Schedule 80 with molded threads
	Threaded Fittings (Use only where specifically allowed on plans)	ASTM D2464 with PTFE tape
	Tees and Ells	Side-gated
	Socket Fittings	ASTM D2467
	Tapping Saddles	For dimensions and test performance, see ASTM D2466 and D1599
	Transition Fittings	Required per CPC 606.2 for transitioning between metal and PVC pipe
	Material and Color	Same as pipe
Solvent Cement	Material	ASTM D656 primer
		ASTM D2564 solvent cement
Flanges	Pressures 0-150 psi	Plain-faced 125 or 150 psi flanges per ANSI B16.5
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal centerlines of pipe run to which flanges are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which flanges are attached.
Flange Bolts, Nuts and Washers and Gaskets		See Section See Section 33 05 31.
Painting/Coating	Exterior Where Exposed to Sunlight or Required in Vaults and Buildings for Color Coding	See Section 09 90 00.

Provide identification for buried PVC or CPVC pipe in the following manner:

PIPE CONTENTS	IDENTIFICATION/ WARNING/ LOCATING	TYPE	MATERIALS/METHOD	
Potable Water	Pipe Contents Identification	Pipe Color	Blue	
		<u>AND</u>		
		Stenciling	Stenciling marked on pipe in contrasting color to background color of pipe stating "POTABLE WATER"	
			5/8"-high letters	
			Repeated at 1' intervals	
		<u>OR</u>		
	Identification Tape	2"-high letters reading "POTABLE WATER"		
		Color = blue with white letters		
		Attached to top of pipe with adhesive tape		
		Specification – See Section 33 05 26		
	Pipe Warning and Locating	Warning and Locating Tape	2"-high letters reading "CAUTION: WATERLINE BURIED BELOW"	
			Color = blue with white letters	
Place in pipe trench 18" above pipe				
Specification – See Section 33 05 26				
Locating Wire		Metallic strip that can be registered by magnetic field locating device		
		In lieu of installing metallic warning tape; non-metallic warning tape and 10-gauge copper wire attached to top of pipe may be used.		
Reclaimed (Recycled, Non-Potable) Water	Pipe Contents Identification	Pipe Color	Purple	
		<u>AND</u>		
		Stenciling	White stenciling marked on purple pipe stating "CAUTION: RECLAIMED WATER – DO NOT DRINK"	
			5/8"-high letters	
			Repeated at 1' intervals	
		<u>OR</u>		
	Identification Tape	2"-high letters reading "CAUTION: RECLAIMED WATER – DO NOT DRINK"		
		Color = purple with white letters		
		Attached to top of pipe with adhesive tape		
		Specification – See Section 33 05 26		
	Pipe Warning and Locating	Warning and Locating Tape	2"-high letters reading "CAUTION: RECLAIMED WATERLINE BURIED BELOW – DO NOT DRINK"	
			Color = purple with white letters	
Place in pipe trench 18" above pipe				
Specification – See Section 33 05 26				
Locating Wire		Metallic strip that can be registered by a magnetic field locating device		
		In lieu of installing metallic warning tape; non-metallic warning tape and 10-gauge copper wire attached to top of pipe may be used.		

PIPE CONTENTS	IDENTIFICATION/ WARNING/ LOCATING	TYPE	MATERIALS/METHOD	
Sewage	Pipe Contents Identification	Pipe color	Green	
		AND		
		Stenciling	Green stenciling marked on pipe stating "SEWER"	
			5/8"-high letters	
			Repeated at 1' intervals	
		OR		
		Identification Tape	2"-high letters reading "CAUTION: SEWER"	
			Color = green with white letters	
			Attached to top of pipe with adhesive tape	
	Specification – See Section 33 05 26			
	Pipe Warning and Locating	Warning and Locating Tape	2"-high letters reading "CAUTION: SEWER BURIED BELOW"	
			Color = green with white letters	
			Place in pipe trench 18" above pipe	
			Specification – See Section 33 05 26	
			Metallic strip that can be registered by a magnetic field locating device	
Locating Wire		In lieu of installing metallic warning tape; non-metallic warning tape and 10-gauge copper wire attached to top of pipe may be used.		

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install PVC and CPVC plastic pipe before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Clean dirt and moisture from pipe and fittings. Bevel pipe ends per Manufacturer's instructions with chamfering tool or file. Remove burrs.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Refer to Section 31 23 00 for open trench requirements.
- C. The following installation standards shall be followed:
 1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. Applicable building, fire and plumbing code requirements
 4. ASTM D2855 Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

5. ASTM F402 Safe Handling of Solvent Cements, Primers and Cleaners Used for Joining Thermoplastic Pipe and Fittings
 6. ASTM F645 Selection, Design and Installation of Thermoplastic Water Pressure Piping Systems
 7. ASTM D2774 Underground Installation of Thermosetting Pressure Piping
 8. ASTM F1668 Construction Procedures for Buried Plastic Pipe
- C. PVC and CPVC plastic pipe shall be furnished and installed by Contractor at location shown on Plans and Submittals.
- D. Install PVC and CPVC plastic pipe to tolerances recommended by Manufacturer. Unless otherwise shown, install PVC and CPVC plastic pipe true, plumb, and level using precision gauges and levels.
- E. Install threaded pipe as follows:
1. Install threaded PVC or CPVC pipe only where specifically called out on plans or for mating with unions.
 2. Do not use threaded pipe joints for applications having pressures in excess of 100 psi.
 3. Use Schedule 80 pipe or thicker for threaded applications. Do not thread Schedule 40 pipe.
 4. Do not use Teflon tape as lubricant. Use paste recommended by Manufacturer such as Spears 75 thread paste.
 5. Use a strap wrench that will not damage pipe for tightening joints.
 6. Do not tighten threaded pipe more than 2 turns beyond finger tight.
- F. Provide molded transition fittings for transitions from plastic to metal or IPS pipe. Do not thread plastic pipe.
- G. Locate unions where shown and where needed for easy access and assembly of piping system.
- H. Install solvent-welded PVC or CPVC pipe as follows:
1. Do not solvent weld joints when ambient temperatures are below 40°F or above 90°F unless solvents specifically formulated for these conditions are used.
 2. De-burr and bevel pipe surfaces to be solvent-welded.
 3. Clean and dry pipe surfaces to be solvent-welded.
 4. Use only solvent recommended by Manufacturers of pipe and fittings.
 5. Apply solvent with a non-synthetic bristle brush no less than ½ nominal size of pipe diameter.

6. Follow proper primer and cement application sequence as described in ASTM D2855.
 7. Apply even coat of solvent to inside of fitting and to outside of pipe on full area to be inserted into fitting socket.
 8. Insert pipe into fitting to full depth immediately after coating, and then rotate pipe 90 degrees to distribute solvent and remove air bubbles.
 9. Remove all excess solvent from outside of joint.
 10. Each joint shall remain undisturbed for at least 30 minutes to develop handling strength.
 11. Allow 24 hours drying time before pressure testing.
- I. Install flanges on PVC or CPVC pipe as follows:
1. Clean flange surfaces to mate with gasket, removing loose dirt, scale and detritus.
 2. Inspect flange bolts and studs for proper size, threading and length.
 3. Clean and lubricate bolt threads using lubricant chemically compatible with all materials involved.
 4. With gasket in place, align mating flange bolt holes. Make sure mating flange faces are flush against gasket prior to bolt-up.
 5. Insert bolts, nuts and washers. Tighten by hand until snug.
 6. Before tightening bolts beyond hand-tight, operate adjacent valves through full range of motion to ensure clear unobstructed operation of discs and other internal parts.
 7. Tighten bolts in sequence by 5-lb. increments following a 180° opposing sequence.
 8. Flange bolt torques shall be as follows:

FLANGE SIZE	RECOMMENDED TORQUE
1/2"	12 ft-lb
3/4"	12 ft-lb
1"	12 ft-lb
1 1/4"	12 ft-lb
1 1/2"	12 ft-lb
2"	25 ft-lb
2 1/2"	25 ft-lb
3"	25 ft-lb
3 1/2"	25 ft-lb
4"	25 ft-lb
5"	30 ft-lb
6"	40 ft-lb

- J. Provide serrated nipples where required for transition from plastic pipe to rubber hose.
- K. Refer variances between Manufacturer's installation instructions and Contract Documents to Owner's Representative.

Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Completed Piping Systems	Hydrostatic Test	Section 33 08 11.	All PVC or CPVC pipe	Contractor	Contractor
	Disinfection	Section 33 13 00 and AWWA C651.	All PVC or CPVC potable water pipe	Contractor	Contractor
Completed Piping Systems	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
		Hydrostatic Test to 150 psi	1 each system as directed by Owner	Contractor	Contractor
Double Containment Piping		Hydrostatic Test or Air Test	1 each system as directed by Owner	Contractor	Contractor
		Sensing System - Verify operation by filling with water and then draining	1 each system as directed by Owner	Contractor	Contractor
Field Performance		Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
11-month Warranty Inspection		Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

3.4 Cleaning and Disinfection

A. Clean and disinfect pipe in accordance with Section 33 13 00.

3.5 Protection

A. At all times when pipe laying is not in progress, close open end of pipe with tight-fitting cap or plug to prevent entrance of foreign matter into pipe. These provisions shall apply during noon hour as well as overnight. In no event shall pipeline be used as to drain water which has infiltrated into trench. Maintain inside of pipe free from foreign materials and in clean and sanitary condition until acceptance by Owner's Representative.

END OF SECTION

SECTION 33 12 09 BACKFLOW PREVENTION DEVICES

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of backflow prevention devices.
- B. Use double check valve assemblies or reduced pressure assemblies to prevent backflow of pollutants that are objectionable but not toxic.
- C. Use reduced pressure assemblies to prevent backflow of high-hazard (toxic) fluids from industrial plants, hospitals, morgues, mortuaries and chemical plants.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 09 90 00: Painting and Coating
- I. Section 09 96 56: Epoxy Linings and Coatings
- J. Section 33 05 31: Pipeline Joint Materials
- K. Section 33 12 12: Resilient Wedge Gate Valves

1.3 System Description

- A. Furnish and install complete operating backflow prevention device including appurtenant structural, mechanical and/or electrical mountings, isolation valves, or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building and plumbing codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with the Federal Reduction of Lead in Drinking Water Act and California law AB1953, and shall be marked as complying.
- C. Comply with California Code of Regulations Title 17 and Title 24 Part 5 (California Plumbing Code.)
- D. Kitchen, lavatory and shower fittings with flexible hose shall have backflow protection complying with ASME/ANSI A112.18.3.
- E. Products in contact with hot water shall be rated and designed to operate at temperatures in excess of 110°F

Products shall be IAPMO listed, FM approved, UL classified, and approved by Foundation for Cross Connection Control and Hydraulic Research at University of Southern California.

G. Factory testing for double check valve (DC) assemblies shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Double Check Valve Assemblies	Backflow Prevention	ASSE Standard 1015 AWWA C510 and USC Foundation for Cross Connection Control and Hydraulic Research	All devices shall meet or exceed requirements	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56	1 each valve	Contractor	Contractor

H. Factory testing for reduced-pressure (RP) assemblies shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Reduced Pressure Assemblies	Backflow Prevention	ASSE Standard 1013 AWWA C511 and USC Foundation for Cross Connection Control and Hydraulic Research	All devices shall meet or exceed requirements	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56	1 each valve	Contractor	Contractor

1.5 References

- A. ASME/ANSI A112.1.3 Air Gap Fittings for Use with Plumbing Fixtures, Appliances, and Appurtenances
- B. ASME/ANSI A112.18.3 Performance Requirements for Backflow Protection Devices and Systems in Plumbing Fixture Fittings
- C. ASME/ANSI B1.20.1 (ANSI B2.1) Pipe Threads – NPT National Pipe Thread Taper
- D. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- E. ASME/ANSI B16.4 Cast Iron Threaded Fittings
- F. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
- G. ASME/ANSI B16.15 Cast Bronze Threaded Fittings
- H. ASME/ANSI B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings
- I. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- J. ASSE 1001 Atmospheric Type Vacuum Breakers
- K. ASSE 1011 Hose Connection Vacuum Breakers
- L. ASSE 1012 Backflow Preventer with Intermediate Atmospheric Vent
- M. ASSE 1013 Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
- N. ASSE 1014 Backflow Prevention Devices for Handheld Showers
- O. ASSE 1015 Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
- P. ASSE 1019 Vacuum Breaker Wall Hydrant, Freeze-Resistant Automatic Draining Type
- Q. ASSE 1020 Pressure Vacuum Breaker Assembly
- R. ASSE 1024 Dual Check Valve Backflow Preventers
- S. ASSE 1035 Laboratory Faucet Backflow Preventers
- T. ASSE 1037 Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

- ASSE 1047 Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies
- V. ASSE 1048 Double Check Detector Fire Protection Backflow Prevention Assemblies
- W. ASSE 1052 Hose Connection Backflow Preventers
- X. ASSE 1055 Chemical Dispensing Systems
- Y. ASSE 1056 Spill-Resistant Vacuum Breakers
- Z. AWWA C213 Fusion-Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
- AA. AWWA C510 Double Check Valve Backflow Prevention Assembly
- BB. AWWA C511 Reduced-Pressure Principle Backflow Prevention Assembly
- CC. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- DD. AWWA M14 Backflow Prevention and Cross Connection Control
- EE. University of Southern California Foundation for Cross Connection Control and Hydraulic Research List of Approved Devices
- FF. California Code of Regulations Title 17
- GG. California Plumbing Code (CPC)
- HH. NSF/ANSI 61 Drinking Water System Components – Health Effects
- II. NSF/ANSI 372 Drinking Water System Components – Lead Content (Formerly NSF/ANSI 61 Annex G)

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses on backflow preventers $\geq 4"$	
Installation Instructions	Required per installation or application instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements	
Certificate of Compliance	Submit coating system and application certification per certificate of compliance requirements.	
List of Approved Devices	Submit current copy of University of Southern California Foundation for Cross Connection Control List of Approved Backflow Prevention Devices with device furnished shown highlighted.	
Test Record Transcripts	Submit certificate of adequacy and operational compliance following testing of installed device by independent laboratory as described below.	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for catalog data, installation instructions, O&M instructions, certificates of compliance, and test record transcripts.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of backflow prevention devices shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers for backflow prevention assemblies other than double-check valve assemblies or reduced-pressure assemblies include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Air Gap Fixtures	Febco Div. CMB Industries 601 Series	Fresno, CA
	Wilkins Division Zurn Industries AG Series	Paso Robles, CA
	Accepted Equal	
Bronze Atmospheric Vacuum Breaker (AVB) (1/4"-2")	Febco Div. CMB Industries 710 or 715 Series	Fresno, CA
	Wilkins Division Zurn Industries Model 35	Paso Robles, CA
	Accepted Equal	
Bronze Pressure Vacuum Breaker (PVB) Backflow Prevention Assemblies	Febco Div. CMB Industries 765 Series	Fresno, CA
	Wilkins Division Zurn Industries, Model 420XL	Paso Robles, CA
	Accepted Equal	
Bronze Pressure Vacuum Breaker Spill-Resistant-Type (SVB) Backflow Preventers	Wilkins Division Zurn Industries Model 12-460XL	Paso Robles, CA
	Accepted Equal	
Bronze Hose Connector Backflow Preventers	Febco Div. CMB Industries 731 Series	Fresno, CA
	Wilkins Division Zurn Industries	Paso Robles, CA
	Accepted Equal	

- B. Acceptable Manufacturers for double-check-valve (DC) backflow prevention assemblies for use on irrigation systems include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Double Check Valve (DC) Backflow Prevention Assembly 1/2"-2"	Ames Company "3000 Series"	Woodland, CA
	Febco Div. CMB Industries "850"	Fresno, CA
	Wilkins Division Zurn Industries "Model 350"	Paso Robles, CA
Double Check Valve (DC) Backflow Prevention Assembly 2 1/2"-10"	Ames Company "3000 Series"	Woodland, CA
	Febco Div. CMB Industries "805YD"	Fresno, CA
	Febco Div. CMB Industries "850"	Fresno, CA
	Wilkins Division Zurn Industries "Model 350"	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	
Double Check Valve (DC) Backflow Prevention Assembly 2 1/2"-10" Compact "N-Style"	Febco Div. CMB Industries "870V" with 611 series valve setter	Fresno, CA
	Wilkins Division Zurn Industries Model 450	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	

Acceptable Manufacturers for double-check-valve (DC) backflow prevention assemblies for use on fire systems include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
	Febco Div. CMB Industries "806YD"	Fresno, CA
	Febco Div. CMB Industries "856V"	Fresno, CA
	Wilkins Division Zurn Industries	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	
Double Check Valve (DC) Backflow Prevention Assembly with Detector Check for Automatic Fire Sprinkler System ½"-2"	Febco Div. CMB Industries "806YD"	Fresno, CA
	Wilkins Division Zurn Industries "Model 350DA"	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	
Double Check Valve (DC) Backflow Prevention Assembly with Detector Check for Automatic Fire Sprinkler System 2½"-10" Compact "N-Style"	Febco Div. CMB Industries "876V" with 611 series valve setter	Fresno, CA
	Wilkins Division Zurn Industries "Model 450DA"	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	

D. Acceptable Manufacturers for reduced-pressure backflow prevention assemblies to protect against downstream high-hazard (toxic) fluids include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Reduced Pressure Type (RP) Backflow Prevention Assembly ¾"-2"	Ames Company "4000 Series"	Woodland, CA
	Febco Div. CMB Industries "825Y" or "825YA"	Fresno, CA
	Wilkins Division Zurn Industries Model 375	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	
Reduced Pressure Type (RP) Backflow Prevention Assembly 2½"-10"	Ames Company "4000 Series"	Woodland, CA
	Febco Div. CMB Industries "825YD"	Fresno, CA
	Wilkins Division Zurn Industries Model 375	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	
Reduced Pressure Type (RP) Backflow Prevention Assembly with Detector Check for Automatic Fire Sprinkler System 2½"-10" Compact "N-Style"	Febco Div. CMB Industries "876V" with 611 series valve setter	Fresno, CA
	Wilkins Division Zurn Industries "Model 475"	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	
Reduced Pressure Type (RP) Backflow Prevention Assembly with Detector Check for Automatic Fire Sprinkler System	Febco Div. CMB Industries "826YD"	Fresno, CA
	Wilkins Division Zurn Industries "Model 375DA"	Paso Robles, CA
	Accepted equal on California (USC) "List of Approved Devices"	

E. Acceptable Manufacturers shall be listed on most current list of approved backflow prevention devices published by University of Southern California Foundation for Cross Connection Control:

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Comply with requirements of Chapter 6 of California Plumbing Code, "Water Supply and Distribution."
- C. Backflow prevention devices shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body	Bronze (for pressures 0-150 psi)	ASTM B584 Alloy C89836, ASTM B763, AWWA C800, and NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications AWWA C510 or C511 as appropriate
Internals and Springs	Stainless Steel	AISI Type 304 or 316
Seal Rings	EPDM	FDA-approved
O-Rings	Buna Nitrile	FDA-approved
Flanges Sizes 2½" - 10" Working Pressures 0-150 psi	Bronze	ASME/ANSI B16.24 Class 125 Raised or plain faced
Flange Alignment	Horizontal Pipelines	Bothholes shall straddle horizontal and vertical centerlines of pipe run to which flanges are attached.
	Vertical Pipelines	Bothholes shall straddle plant North-South and plant East-West centerlines of pipe run to which flanges are attached.
Flange Bolts, Nuts, and Washers	Various steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Gate Valves		See Section 33 12 12.
Epoxy Lining (devices ≥ 4")	Fusion-Bonded Epoxy	See Section 09 96 56. AWWA C213 and C550 12-mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas or bronze or stainless steel parts.
Exterior Finish Coat	Epoxy Urethane	See Section 09 90 00.
Coating Color	Domestic Service	Blue
	Fire Service	Red
	Irrigation Service	Green

- D. Brass vacuum breakers for potable water service shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body	Lead-Free Brass	ASTM B584 Alloy C89836, ASTM B763, AWWA C800, and NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications
Poppet or Ball	Stainless Steel	SAE Types 302, 304, or 305
	Plastic	
Seat	NBR Synthetic Rubber (Nitrile Butadiene Rubber) (Buna N)	ASTM D1418 Do not expose to acetone, esters, ketones, chlorinated hydrocarbons, nitro hydrocarbons, ozone or direct sunlight

- E. Air gap fixtures shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Air Gap Fixtures	Body	ASTM A126 Class B

The following product design criteria, options and accessories are required for double check valve (DC) backflow prevention devices:

ITEM	DESCRIPTION	
Design Criteria	Double-Check-Valve Backflow Prevention Device	Double Check Valve per AWWA C510 and ASSE 1015
	Gate Valves	Resilient Wedge Non Rising Stem (NRS)
	Minimum Rated Working Pressure	125 psi for cold water service Class 150 (300 WOG psi at 150F) Class 200 (400 WOG psi at 150F) Class 300 (600 WOG psi at 150F)
	Fluid Conveyed	Cold potable water
	Maximum Water Temperature	110°F
	Ends	Flanged

G. The following product design criteria, options and accessories are required for reduced pressure (RP) backflow prevention devices:

ITEM	DESCRIPTION	
Design Criteria	Reduced-Pressure Backflow Prevention Device	Reduced Pressure Device per AWWA C511 and ASSE 1013
	Gate Valves	Resilient Wedge
	Strainers	Required / Not required
	Minimum Rated Working Pressure	125 psi for cold water service Class 150 (300 WOG psi at 150F) Class 200 (400 WOG psi at 150F) Class 300 (600 WOG psi at 150F)
	Fluid Conveyed	Cold potable water
	Maximum Water Temperature	110°F
	Ends	Flanged

H. The following product design criteria, options and accessories are required for atmospheric vacuum breakers (AVB's):

ITEM	DESCRIPTION	
Design Criteria	Atmospheric Vacuum Breaker	Comply with ASSE 1001
	Minimum Rated Working Pressure	125 psi for cold water service Class 150 (300 WOG psi at 150F) Class 200 (400 WOG psi at 150F) Class 300 (600 WOG psi at 150F)
	Fluid Conveyed	Cold potable water
	Maximum Water Temperature	110°F
	Ends	Soldered

I. The following product design criteria, options and accessories are required for vacuum breakers:

ITEM	DESCRIPTION	
Design Criteria	Vacuum Breaker	Pressure Vacuum Breaker Backflow Prevention Assembly (PVB) per ASSE 1020 / Pressure Vacuum Breaker Spill-Resistant-Type Backflow Prevention Assembly (SVB) per ASSE 1056 / Hose Connection Vacuum Breaker per ASSE 1011 / Wall Hydrant Vacuum Breaker per ASSE 1019
	Functional Description	Required on plumbing fixtures and equipment furnished with hose connectors Shall allow air to enter water line in event vacuum occurs in line. Air inlet shall close without spillage on initial application of line pressure.

ITEM	DESCRIPTION	
	Minimum Rated Working Pressure	125 psi for cold water service Class 150 (300 WOG psi at 150F) Class 200 (400 WOG psi at 150F) Class 300 (600 WOG psi at 150F)
	Fluid Conveyed	Cold potable water
	Maximum Water Temperature	110°F
	Ends	Soldered

- J. The following product design criteria, options and accessories are required for air gap fixtures:

ITEM	DESCRIPTION	
Air Gap Fixtures	Air Gap Fixture	Comply with ASME/ANSI A112.1.3
	Inlet	Threaded inlet or inlet with set screw
	Outlet	No hub outlet
	Air Gap	Minimum air gap of 2 diameters but $\geq 1"$
	Ends	Soldered

- K. Backflow preventers with intermediate atmospheric vents shall comply with ASSE 1012.
- L. Backflow preventers for handheld showers shall comply with ASSE 1014.
- M. Dual check valve backflow preventers shall comply with ASSE 1024.
- N. Backflow preventers for laboratory faucets shall comply with ASSE 1035.
- O. Backflow prevention for pressurized flushing devices (Flushometers) shall comply with ASSE 1037.
- P. Hose connection backflow preventers shall comply with ASSE 1052.
- Q. Backflow prevention devices for chemical dispensing systems shall comply with ASSE 1055

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install backflow prevention devices before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install backflow prevention devices at locations shown on Plans and Submittals. Locate device as close as possible to user's connection. Owner and Water Utility shall have final authority in determining required location of backflow prevention devices.
- C. The following installation standards shall be followed:
1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations

3. California Plumbing Code Chapter 6 “Water Supply and Distribution” Section 603 “Cross-Connection Control,” and Tables 6-2 “Backflow Prevention Devices, Assemblies and Methods” and 6-3 “Minimum Airgaps for Water Distribution.”
 4. Other applicable fire, plumbing, and electrical code requirements
 5. Section 7603 of Title 17 of California Code of Regulations
- D. Refer variances between above documents and Contract Documents to Owner’s Representative.
- E. Install backflow prevention devices to tolerances recommended by Manufacturer. Unless otherwise shown, install backflow prevention devices true and level using precision gauges and levels.

3.3 **Field Quality Control**

- A. Test backflow prevention devices immediately following installation. Do not place into service until test results are submitted to and approved by Owner and servicing water utility.
- B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Backflow Prevention Device	Backflow	Test by County-approved independent laboratory per County Department of Health Services Standards	1 each unit immediately after installation	Contractor	Contractor
	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer’s printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer’s printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 33 12 12 RESILIENT-WEDGE GATE VALVES

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of resilient-wedge gate valves.
- B. Do not use resilient-wedge gate valves under any of the following circumstances:
 - 1. For throttling service.
 - 2. For slurry handling service.
 - 3. In shallow pipelines where insufficient clearance is available for stems.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 33: Mechanical Identification
- H. Section 09 96 56: Epoxy Linings and Coatings
- I. Section 31 05 50: Protecting Existing Utilities
- J. Section 33 05 31: Pipeline Joint Materials
- K. Section 33 08 11: Pressure Testing and Flushing of Water Utilities

1.3 System Description

- A. Furnish and install complete operating valve including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and applicable building codes and standards.
- B. Gate valves shall provide positive shutoff when valve is in closed position and shall provide unobstructed flow when valve is in open position.
- C. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of California Health and Safety Code.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Resilient Wedge Gate or Tapping Valve	Proof of Design Test	AWWA C515 Section 5.1.1	1 each prototype	Contractor	Contractor
	Operation Test	AWWA C515 Section 5.1.2.1	1 each valve	Contractor	Contractor
	Shell Test	AWWA C515 Section 5.1.2.2 at 400 psi	1 each valve	Contractor	Contractor
	Seat Test	AWWA C515 Section 5.1.2.3 at 200 psi	1 each valve	Contractor	Contractor
	Metal to Rubber Bond	ASTM D429	1 each valve	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56	1 each valve	Contractor	Contractor

1.5 References

- A. API/ANSI 598 Valve Inspection and Testing
- B. API/ANSI 600 Steel Gate Valves – Flanged and Butt-Welding Ends, Bolted Bonnets
- C. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- D. ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
- E. ASME/ANSI B16.10 Face-to-Face and End-to-End Dimensions of Valves
- F. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- G. ASME/ANSI B16.47 Large Diameter Steel Flanges: NPS 26 Through NPS 60
- H. ASTM A126 Gray Iron Castings for Valves, Flanges and Pipe Fittings
- I. ASTM A217 Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
- J. ASTM A276 Stainless Steel Bars and Shapes
- K. ASTM A473 Stainless Steel Forgings
- L. ASTM A536 Ductile Iron Castings
- M. ASTM A582 Free Machining Stainless Steel Bars
- N. ASTM A743 Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
- O. ASTM B16 Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
- P. ASTM B62 Composition Bronze or Ounce Metal Castings (do not use for potable water wetted surfaces)
- Q. ASTM B98 Copper Silicon Alloy Rod, Bar, and Shapes
- R. ASTM B124 Copper and Copper Alloy Forging Rod, Bar, and Shapes
- S. ASTM B138 Manganese Bronze Rod, Bar, and Shapes
- T. ASTM B148 Aluminum Bronze Sand Castings
- U. ASTM B283 Copper and Copper Alloy Die Forgings (Hot Pressed)
- V. ASTM B584 Copper Alloy Sand Castings for General Applications
- W. ASTM B763 Copper Alloy Sand Castings for Valve Applications
- X. ASTM D429 Rubber Property—Adhesion to Rigid Substrates
- Y. ASTM D2000 Classification System for Rubber Products in Automotive Applications
- Z. AWWA C105 Polyethylene Encasement for Ductile Iron Pipe Systems
- AA. AWWA C223 Fabricated Steel and Stainless Steel Tapping Sleeves
- BB. AWWA C509 Resilient Seated Gate Valves for Water Supply Service
- CC. AWWA C515 Reduced Wall, Resilient Seated Gate Valves for Water Supply Service
- DD. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- EE. AWWA C606 Grooved and Shouldered Joints
- FF. MSS SP111 Gray-Iron and Ductile-Iron Tapping Sleeves
- GG. NSF/ANSI 61 Drinking Water System Components – Health Effects
- HH. NSF/ANSI 372 Drinking Water System Components – Lead Content

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required for valves larger than 16 inches diameter per valve shop drawing requirements.	
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements.	
Certificate of Compliance	Submit certified test results for leakage and hydrostatic tests	
	Submit certified report of testing of factory-applied linings	
	Submit affidavit of compliance with AWWA C509	
Warranty	Furnish one-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of gate valves shall be strictly followed.

1.8 Unit Prices

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers for valves include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Resilient Wedge Gate Valves (Potable Water C509)	Clow Valve Series F-6000	Corona, CA
	Kennedy Valve Div., McWane, Inc. Kenseal II	Birmingham AL
	Mueller Co. Series 2360	Decatur IL
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Resilient-wedge gate valves and tapping valves shall comply with AWWA C509
- C. The following is being conveyed:

FLUID	VISCOSITY (77°F)	SPECIFIC GRAVITY	TEMP	FREEZING POINT	BOILING POINT	VAPOR PRESS (77°F)	pH	SOLIDS CONTENT
Potable Water	0.894cP	1.00	33-90°F	32°F	212°F	0.46 psia	6.5-8.5	<500 ppm

D. Resilient wedge gate valves and tapping valves for potable water service shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, Bonnet	Ductile Iron (for pressures 0-300 psi)	ASTM A536 Grade 65-45-12
Dimensions	Laying Length	ASME/ANSI B16.10 Table 1 (Class 125 or 150)
Gate (same material as valve body)	Ductile Iron	ASTM A536 Grade 65-45-12
Wedge Resilient Coating	Vulcanized Rubber	
Stem and Stem Nut	Bronze	ASTM B16, B98, B138, B148, B283, B584, or B763 Use alloy listed in AWWA C515 Table 5 Comply with NSF/ANSI 372 lead threshold for potable water applications Maximum 7% zinc, 2% aluminum Minimum tensile strength = 70,000 psi Minimum yield strength = 40,000 psi Elongation >15 percent in 2-inches Visibly mark stem to show compliance with above.
Bonnet Bolts	Stainless Steel	SAE Type 316 with antiseize lubricant
O-Rings	Synthetic Rubber	ASTM D2000
Flanges Sizes 3"-48" Working Pressures 0-150 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flanges Sizes 3"-48" Working Pressures 0-200 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flanges Sizes 3"-48" Working Pressures 200-250 psi	Carbon Steel	AWWA C207 Class E, or ANSI /ASME 16.5 Class 150 Raised or plain faced ASME/ANSI B16.47 Class 150 Raised or plain faced for valves 26-inch and larger
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Grooved Ends	Provide where shown	AWWA C606 Compatible with adjacent coupling
Lining		See Section 09 96 56. AWWA C550 12-mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas or bronze or stainless steel parts.
Exterior Finish Coat	Epoxy	See Section 09 90 00.
Polyethylene Encasement on Buried Valves	Polyethylene	AWWA C105 2 layers of 8 mil wrap

The following product design criteria, options and accessories are required for resilient-wedge gate valves and tapping valves:

ITEM	DESCRIPTION	
Design Criteria	Design Standard	AWWA C509
	Stem Seal	Double O-Ring Type
	Wedge	Sealing surface permanently bonded and fully encapsulated with resilient material
	Thrust Bearings	Low-friction torque-reduction type located both above and below stem collar.
	Valves Connecting to Mains	Provide flange on main side unless otherwise shown.
	Markings	Manufacturer's name or symbol, size of valve, year of manufacture, and working pressure shall be cast in valve bonnet or body. Body shall have arrow cast in metal to show direction of opening,
Rated Working Pressure	Suction Piping	150 psi
	Discharge Piping	150 psi
Valve Actuators - Buried	Operator	Enclosed gear or screwed rod type with 2-inch AWWA nut
	Stem	Nonrising stem
	Position Indicator	Required
	Operation	Valve shall open with counterclockwise operator rotation
Valve Stem Input Torque	AWWA C509 Table 1	
Stem Nut Extension	Where Required	Required on valves buried 4 feet or deeper.
	Construction	Center extension in valve well using guide.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install gate valves before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Gate valves shall be furnished and installed by Contractor at location shown on Plans and Submittals.
- C. The following installation standards shall be followed:
1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
- D. Install gate valves or tapping valves to tolerances recommended by Manufacturer. Unless otherwise shown, install valves true, plumb, and level using precision gauges and levels.
- E. Refer variances between Manufacturer's installation instructions and Contract Documents to Owner's Representative.
- F. Buried gate valves shall be installed as follows:

1. Install and connect gate valve according to Manufacturer's installation and warranty requirements.
2. Wrap two layers of 8-mil AWWA C105 polyethylene encasement around valve and flanges and secure with plastic adhesive tape wrapped around valve stem below operating nut to prevent entrance of soil. Fold overlaps twice and tape. Backfill with care to protect polyethylene.
3. Place and compact backfill to height of valve stem.
4. Place block pads under extension pipe to maintain valve box in vertical position during backfilling and repaving and to prevent extension pipe from contacting valve bonnet.
5. Mount upper slip pipe of extension in mid-position and secure with backfill around extension pipe.
6. Pour concrete ring allowing a depression so valve box cap will be flush with finished surface.

G. Refer to Section 31 05 50 for additional requirements associated with tapping existing water lines.

3.3 **Field Quality Control**

A. Valves shall be tested at same time connecting pipelines are pressure tested and in accordance with Contract Document sections covering testing. During pressure testing, protect or isolate valves, operators, or control and instrumentation elements whose pressure rating is less than test pressure.

B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Gate Valve	Installation & Leakage	Visual inspection for drip tight finished installation under pressure.	1 inspection	Owner	Owner
	Pressure Test	See Section 33 08 11.	1 test	Contractor	Contractor
	Actuator	Operate valve through 10 full cycles of opening and closing. Valve shall operate from full open to full close without sticking, or binding and without required operating torque exceeding 150 ft-lbs at any point	1 test	Contractor	Contractor
	Actuator Torque	No valve or actuator component shall show any evidence of deformity after application of the following torques in presence of Owner's Representative. 4-inch – 240 ft-lbf 6-inch – 330 ft-lbf 8-inch – 400 ft-lbf 10-inch – 460 ft-lbf 12-inch – 550 ft-lbf	1 test	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 33 12 14 BUTTERFLY VALVES

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of butterfly valves.
- B. For working pressures in excess of 250 psi, use double- or triple-offset valves.
- C. Zero-leakage butterfly valves – double- or triple-offset type are specified in Section 33 12 15.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 09 96 56: Epoxy Linings and Coatings
- H. Section 33 05 31: Pipeline Joint Materials
- I. Section 33 05 39: Manual Valve Operators
- J. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- K. Section 33 12 46: Electric Motor Actuators

1.3 System Description

- A. Furnish and install complete operating butterfly valve including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
- B. Butterfly valves shall provide positive shutoff when valve is in closed position and shall permit flow when valve is in open position.
- C. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of California Health and Safety Code.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Butterfly Valves	Seat Bond	ASTM D429 Method B withstand 75-lb pull	1 each valve	Contractor	Contractor
	Performance Test	AWWA C504 Section 5.1	1 each valve	Contractor	Contractor
	Leakage Test	AWWA C504 Section 5.2	1 each valve	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Hydrostatic Test	AWWA C504 Section 5.3	1 each valve	Contractor	Contractor
	Proof of Design	AWWA C504 Section 5.4	1 each prototype	Contractor	Contractor
Powered Actuators	Proof of Design	See Section 33 12 46.	1 each prototype	Contractor	Contractor
	Performance	See Section 33 12 46.	1 each actuator	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56.	1 each valve	Contractor	Contractor

1.5 References

- A. API/ANSI 598 Valve Inspection and Testing
- B. API/ANSI 609 Butterfly Valves: Double Flanged, Lug- and Wafer-Type
- C. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- D. ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
- E. ASME/ANSI B16.10 Face to Face and End to End Dimensions of Valves
- F. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- G. ASME/ANSI B16.47 Large Diameter Steel Flanges: NPS 26 Through NPS 60
- H. ASTM A48 Gray Iron Castings
- I. ASTM A126 Gray Iron Castings for Valves, Flanges and Pipe Fittings
- J. ASTM A216 Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
- K. ASTM A217 Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service
- L. ASTM A276 Stainless Steel Bars and Shapes
- M. ASTM A536 Ductile Iron Castings
- N. ASTM A743 Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
- O. ASTM D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- P. ASTM D429 Test Methods for Rubber Property—Adhesion to Rigid Substrates
- Q. ASTM D1599 Time to Failure of Plastic Pipe under Constant Internal Pressure
- R. ASTM D2000 Classification System for Rubber Products in Automotive Applications
- S. AWWA C105 Polyethylene Encasement for Ductile Iron Pipe Systems
- T. AWWA C504 Rubber-Seated Butterfly Valves 3-inch through 72-inch
- U. AWWA C516 Large-Diameter Rubber-Seated Butterfly Valves, Sizes 78-in and Larger
- V. AWWA C540 Power-Actuating Devices for Valves and Sluice Gates
- W. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- X. AWWA C606 Grooved and Shouldered Joints
- Y. MSS SP67 Butterfly Valves
- Z. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per valve shop drawing requirements.	.
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation instruction requirements.	
O & M Instructions	Required per operation and maintenance Instruction requirements.	
Certificate of Compliance	Submit certified test results for proof of design, leakage (bi-directional) and hydrostatic tests	
	Submit certified report of testing of factory-applied linings	

SUBMITTAL	DESCRIPTION	
	Submit certified report of actuator testing against stops	
	Submit affidavit of compliance with AWWA C504	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of butterfly valves shall be strictly followed.
- C. Actuator and valve shall be shipped and delivered to jobsite as a unit.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Butterfly Valves for Buried Service (Class 150B)	DeZurik "BAW"	Sartell, MN
	Henry Pratt Co. "Groundhog II"	Aurora, IL
	Mueller Co. B-3211 "Lineseal XP"	Birmingham, AL
	Accepted equal	
Butterfly Valves for Use Above Ground with Resilient Seat on Valve Body (Class 150B)	DeZurik "BAW" with hand lever up to 4" with M series handwheel actuator 6" and larger	Sartell, MN
	Henry Pratt Co. Model 2FII with hand lever up to 4" with Pratt MDT operator 6" and larger	Aurora, IL
	Henry Pratt Co. Groundhog	Aurora, IL
	Mueller Co. B-3211 "Lineseal XP"	Birmingham, AL
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Butterfly valves shall comply with AWWA C504.
- C. Butterfly valves having resilient seats secured to valve body rated for pressures below 250 psi shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body	Ductile Iron (for pressures 0-300 psi)	ASTM A536 Grade 65-45-12
Dimensions	Laying Length	AWWA C504 Table 2 Short-Body

ITEM	MATERIAL	SPECIFICATION
Valve Seat	EPDM Synthetic Rubber (Ethylene-Propylene Diene Monomer)	ASTM D1418 ASTM D429 Peroxide cured Do not expose to petroleum oils or aromatic hydrocarbon fuels
O-Rings	EPDM Synthetic Rubber (Ethylene-Propylene Diene Monomer)	ASTM D1418 ASTM D429 Peroxide cured Do not expose to petroleum oils or aromatic hydrocarbon fuels
Valve Disc (same material as valve body)	Ductile Iron	ASTM A536 Grade 65-45-12
Valve Disc Seating Surface	Stainless Steel	SAE Type 316
Valve Shaft	Stainless Steel	SAE Type 316
Body Bolts, Cap Screws, Nuts including Squeeze Pins	Stainless Steel	ASTM A276 SAE Type 316
Flanges Sizes 3"-72" Working Pressures 0-150 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East- West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, Washers and Gaskets	Various Steels	See Section 33 05 31.
Grooved Ends	Provide where shown	AWWA C606 Compatible with adjacent coupling
Wafer Ends	Provide where shown	Compatible with adjacent flanges
Epoxy Lining	Fusion-Bonded Epoxy	See Section 09 96 56. AWWA C550 12-mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas and bronze or stainless steel parts.
Exterior Finish Coat	Fusion-Bonded Epoxy	See Section 09 96 56.
Polyethylene Encasement on Buried Valves	Polyethylene	AWWA C105 2 layers of 8 mil wrap

D. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Design	Shaft Bearing Trunions	Two shaft bearing trunnions shall be integral with valve body.
	Disc Rotation	Discs shall rotate 90 degrees from full open position to tight shut position.
Body Style	Ends	Flanged
Bearings	Sleeve-type	Corrosion-resistant self-lubricating
	Thrust Bearings	One or more required Do not use thrust bearings with ferrous bearing surface in rubbing contact with opposing ferrous surface
Resilient Seat (secured to valve body)	Connection to body	Molded in, vulcanized and bonded to body with seat bond factory tested. Do not use valves using complete rubber liner.
Rated Working Pressure	Suction Piping	150 psi
	Discharge Piping	200 psi

ITEM	DESCRIPTION	
Valve Actuators – Above Ground	Operator	Handwheel Provide traveling nut operator on valves 3-30-inch diameter Actuator shall be capable of withstanding 450 ft-lbf at stops
		Size actuator per AWWA C504 for bi-directional pressures.
		Valve operator shall hold valve in any intermediate position between fully open and fully closed without creeping or fluttering
		Position Indicator
		Operation
Valve Actuators - Buried	Operator	Enclosed gear or screwed rod type with 2-inch AWWA nut
		Sealed for entry of dirt and at least 90% grease packed
		Provide traveling nut operator on valves 3-30-inch diameter Actuator shall be capable of withstanding 450 ft-lbf at stops
		Size actuator per AWWA C504 for bi-directional pressures.
		Valve operator shall hold valve in any intermediate position between fully open and fully closed without creeping or fluttering
Stem Nut Extension	Where Required	Required on valves buried 4 feet or deeper.
	Construction	Center extension in valve well using guide.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install butterfly valves before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Section 01 73 00 basic execution and installation requirements.
- B. Furnish and install butterfly valves at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 1. Manufacturer’s installation and warranty requirements
 2. AWWA C504 Appendix A “Installation, Operation and Maintenance of Rubber-Seated Butterfly Valves”
 3. Applicable OSHA and Cal OSHA regulations

4. Applicable fire, plumbing, mechanical and electrical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install butterfly valves to tolerances recommended by Manufacturer. Unless otherwise shown, install butterfly valves true, plumb and level using precision gauges and levels.
- F. Buried butterfly valves shall be installed as follows:
1. Install and connect valve according to Manufacturer's installation and warranty requirements.
 2. Wrap two layers of 8-mil AWWA C105 polyethylene encasement around valve and flanges and secure with plastic adhesive tape wrapped around valve stem below operating nut to prevent entrance of soil. Fold overlaps twice and tape. Backfill with care to protect polyethylene.
 3. Place and compact backfill to height of valve stem.
 4. Place block pads under extension pipe to maintain valve box in vertical position during backfilling and repaving and to prevent extension pipe from contacting valve bonnet.
 5. Mount upper slip pipe of extension in mid-position and secure with backfill around extension pipe.
 6. Pour concrete ring allowing depression so valve box cap will be flush with finished surface.

3.3 **Field Quality Control**

- A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Butterfly Valve	Installation & Leakage	Visual inspection for drip-tight finished installation under pressure.	1 inspection	Owner	Owner
	Pressure Test	See Section 33 08 11.	1 test	Contractor	Contractor
	Actuator	Operate valve through 10 full cycles of opening and closing. Valve shall operate from full open to full close without sticking, or binding and without required operating torque exceeding 150 ft-lbs at any point	1 test	Contractor	Contractor
	Actuator Torque	No valve or actuator component shall show any evidence of deformity after application of 300 ft-lbf torque in presence of Owner's Representative.	1 test	Contractor	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and	1 test	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
		Manufacturer's printed literature			
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

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**SECTION 33 12 16
PLUG VALVES**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of plug valves.
- B. Do not use plug valves under any of the following circumstances:
 - 1. For slurry handling service.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 09 90 00: Painting and Coating
- H. Section 09 96 56: Epoxy Linings and Coatings
- I. Section 33 05 31: Pipeline Joint Materials

1.3 System Description

- A. Furnish and install complete operating valves including appurtenant mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable standards.
- B. Valves shall provide positive shutoff when valve or port is in closed position and shall permit unobstructed flow when valve or port is in open position.
- C. Valves shall seat drip tight against seating pressure equal to rated design pressure of valve.
- D. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of California Health and Safety Code.

1.4 Quality Assurance

- A. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Resilient-Seated	Shell Test	AWWA C517 Section 5.2.1.1	1 each valve	Contractor	Contractor
Cast Iron Eccentric Plug Valve	Seat Test	AWWA C517 Section 5.2.1.2	1 each valve	Contractor	Contractor
	Proof of Design	AWWA C517 Section 5.2.2	1 each prototype	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56	1 each valve	Contractor	Contractor

- A. API/ANSI 598 Valve Inspection and Testing
- B. API/ANSI 599 Metal Plug Valves – Flanged, Threaded and Welding Ends
- C. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- D. ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
- E. ASME/ANSI B16.10 Face-to-Face and End-to-End Dimensions of Valves
- F. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- G. ASME/ANSI B16.47 Large Diameter Steel Flanges: NPS 26 Through NPS 60
- H. ASTM A48 Gray Iron Castings
- I. ASTM A126 Gray Iron Castings for Valves, Flanges and Pipe Fittings
- J. ASTM A193 Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
- K. ASTM A194 Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
- L. ASTM A217 Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service
- M. ASTM A536 Ductile Iron Castings
- N. ASTM A743 Castings, Iron-Chromium, Iron Chromium Nickel, Corrosion Resistant for General Application
- O. AWWA C517 Resilient-Seated Cast-Iron Eccentric Plug Valves
- P. AWWA C540 Power-Actuating Devices for Valves and Sluice Gates
- Q. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- R. AWWA C606 Grooved and Shouldered Joints
- S. MSS SP78 Cast Iron Plug Valves
- T. NSF/ANSI 60 Drinking Water Treatment Chemicals – Health Effects
- U. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per valve shop drawing requirements.	.
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation instruction requirements.	
O & M Instructions	Required per operation and maintenance Instruction requirements.	
Certificate of Compliance	Submit certified test results for proof of design, hydrostatic and leakage tests.	
	Submit certified report of testing of factory-applied linings	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of valves shall be strictly followed.
- C. Actuator and valve shall be shipped and delivered to jobsite as unit.

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Eccentric Plug Valves and Actuators – Rectangular Port	DeZurik PEF	Sartell MN
	Accepted equal	
Eccentric Plug Valves and Actuators – Round Port	Henry Pratt Company “Ballcentric / Milliken Valve	Aurora, IL
	Accepted equal	
Torque-Limiting Device	Aunspach Controls Company	High Ridge, MO
	Approved equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Eccentric plug valves for waterworks service shall conform to AWWA C517.
- C. The following is being conveyed:

FLUID	VISCOSITY (77°F)	SPECIFIC GRAVITY	TEMP	FREEZING POINT	BOILING POINT	VAPOR PRESS (77°F)	pH	SOLIDS CONTENT
Potable Water	0.894cP	1.00	33-90°F	32°F	212°F	0.46 psia	6.5-8.5	<500 ppm
Recycled Water	0.894cP	1.00	33-90°F	32°F	212°F	0.46 psia	6.5-8.5	<1.0%
Wastewater	0.894cP	1.01	33-90°F	32°F	212°F	0.46 psia	6.5-8.5	<1.0%

- D. Eccentric plug valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body	Ductile Iron (for pressures 0-300 psi)	ASTM A536 Grade 65-45-12
	Cast Iron (for pressures 0-150 psi)	ASTM A126 Class B
Body Seat (2½" valves)	Epoxy	
Body Seat (3" and larger valves)	Nickel	½" welded overlay seat of >90% nickel.
Body Seat (Stainless Steel Valves)	Stainless Steel	API 599 ASTM A743-CF-8M SAE Type 316
Dimensions	Laying Length	AWWA C517 Table 1 ASME/ANSI B16.10 Table 1 (Class 125 or 150) Short-Body

ITEM	MATERIAL	SPECIFICATION
Plug	Ductile Iron	ASTM A536 Grade 65-45-12
	Cast Iron	ASTM A126 Class B
	Cast Carbon Steel	API 599 ASTM A216 Grade WCB
	Stainless Steel	Same Material as body
Plug Elastomer	EPDM Synthetic Rubber (Ethylene-Propylene Diene Monomer)	ASTM D1418 ASTM D429 Peroxide cured Meet NSF 61 for potable water applications Do not expose to petroleum oils or aromatic hydrocarbon fuels
Trim	Stainless Steel	SAE Type 316
Bearings – Valves ½”-36”	Stainless Steel Sleeve Type	SAE Type 316 ASTM A743 Grade CF-8M or SAE Type 317L Sintered, oil impregnated permanently lubricated
Bearings – Valves > 36” (Upper and Lower Plug Journals)	Stainless Steel	ASTM A-240 SAE Type 316 stainless sleeves with bearings of ASTM B30, Alloy C95400 aluminum bronze.
Cover Bolts	Stainless Steel	ASTM A193 Grade B8M SAE Type 316
Cover Nuts	Stainless Steel	ASTM A194 Grade 8M SAE Type 316
Centered Oil Bearings	Stainless Steel	ASTM A743 Grade CFBM SAE Type 316
Stem Packing Seals	NBR Synthetic Rubber (Nitrile Butadiene Rubber) (Buna N)	ASTM D1418 Meet NSF 61 for potable water applications Do not expose to acetone, esters, ketones, chlorinated hydrocarbons, nitro hydrocarbons, ozone or direct sunlight
Grit Seals (Top and Bottom)	PTFE Fluoropolymer (Polytetrafluoroethylene) (Teflon)	ASTM D1418 Meet NSF 61 for potable water applications
Flanges Sizes 3”-72” Working Pressures 0-150 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East- West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Grooved Ends	Provide where shown	AWWA C606 Compatible with adjacent coupling
Epoxy Lining	Fusion-Bonded Epoxy	See Section 09 96 56. AWWA C550 12-mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas or bronze or stainless steel parts.
Exterior Finish Coat	Epoxy	See Section 09 90 00.
Polyethylene Encasement on Buried Valves	Polyethylene	AWWA C105 2 layers of 8 mil wrap

PART 3 - EXECUTION

3.1 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install plug valves at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:

1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. Applicable fire, plumbing, mechanical and electrical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install plug valves to tolerances recommended by manufacturer. Unless otherwise shown, install plug valves true, plumb, and level using precision gauges and levels.
- F. Install valve so seat is opposite the high-pressure side.
- G. For suspended solids applications, install plug horizontal and rotating to top of valve when open. For buried or submerged service, this requires actuator to be mounted 180° from standard mounting position.

3.2 Field Quality Control

- A. Test valves at same time connecting pipelines are pressure tested. Valves, operators, or control and instrumentation elements whose pressure rating is less than test pressure shall be protected or isolated during pressure testing.
- B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Plug Valve	Installation & Leakage	Visual inspection for drip tight finished installation under pressure.	1 inspection	Owner	Owner
	Pressure Test	See Section 33 08 11.	1 test	Contractor	Contractor
	Actuator	Operate valve through 10 full cycles of opening and closing. Valve shall operate from full open to full close without sticking, or binding and without required operating torque exceeding 150 ft-lbs at any point	1 test	Contractor	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 33 12 18 CHECK VALVES

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of check valves.
- B. Refer to Section 33 12 45 for electric-motor-actuated pump control check valves.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 09 90 00: Painting and Coating
- H. Section 09 96 56: Epoxy Linings and Coatings
- I. Section 33 05 31: Pipeline Joint Materials
- J. Section 33 08 11: Pressure Testing and Flushing of Water Utilities

1.3 System Description

- A. Furnish and install complete operating check valve including appurtenant mountings or connections required for compliance with Manufacturer's installation requirements and applicable standards.
- B. Check valves shall prevent backflow of fluid when downstream pressure exceeds upstream pressure. Valves shall seat drip tight against a downstream seating pressure equal to rated design pressure of valve.
- C. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of California Health and Safety Code.

1.4 Quality Assurance

- A. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Swing Check Valve	Hydrostatic Shell Test	AWWA C508 Section 5.2.1	1 each valve	Contractor	Contractor
	Hydrostatic Seat Leakage Test	AWWA C508 Section 5.2.2	1 each valve	Contractor	Contractor
Dual-Disc Swing Check Valve	Hydrostatic Seat Leakage Test	AWWA C518 Section 5.2.1	1 each valve	Contractor	Contractor
	Hydrostatic Test	AWWA C518 Section 5.2.2	1 each valve	Contractor	Contractor
	Proof of Design Test	AWWA C518 Section 5.2.3	1 each prototype	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56	1 each valve	Contractor	Contractor

- A. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- B. ASME/ANSI B16.10 Face-to-Face and End-to-End Dimensions of Valves
- C. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- D. API/ANSI 594 Check Valves: Flanged, Lug, Wafer and Butt-welding
- E. ASTM A48 Gray Iron Castings
- F. ASTM A126 Gray Iron Castings for Valves, Flanges and Pipe Fittings
- G. ASTM A193 Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
- H. ASTM A194 Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
- I. ASTM A269 Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- J. ASTM A216 Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
- K. ASTM A217 Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
- L. ASTM A276 Stainless and Heat Resisting Steel Bars and Shapes
- M. ASTM A313 Stainless Steel Spring Wire
- N. ASTM A351 Castings, Austenitic, for Pressure-Containing Parts
- O. ASTM A536 Ductile Iron Castings
- P. ASTM A582 Free-Machining Stainless and Heat Resisting Steel Bars
- Q. ASTM B584 Copper Alloy Sand Castings for General Applications
- R. ASTM B16 Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
- S. ASTM B62 Composition Bronze or Ounce Metal Castings (do not use for potable water wetted surfaces)
- T. ASTM B148 Aluminum-Bronze Sand Castings
- U. ASTM B271 Copper-Base Alloy Centrifugal Castings
- V. ASTM B584 Copper Alloy Sand Castings for General Applications
- W. ASTM D2000 Rubber Products in Automotive Applications
- X. AWWA C508 Swing Check Valves for Waterworks Service
- Y. AWWA C518 Dual Disc Swing Check Valves for Waterworks Service
- Z. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- AA. MSS SP71 Gray Iron Swing Check Valves, Flanged and Threaded
- BB. MSS SP125 Gray Iron and Ductile Iron In-Line Spring-Loaded Center-Guided Check Valves
- CC. MSS SP126 Steel In-Line Spring-Loaded Center-Guided Check Valves
- DD. MSS SP136 Ductile Iron Swing Check Valves
- EE. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per valve shop drawing requirements. Include detail of any penetration of valve body by hinge pin showing packing gland, hinge pin gland, cap and other pieces used.	
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements.	
Certificate of Compliance	Submit certified report of testing of factory-applied linings	
	Submit affidavit of compliance with AWWA C508 for swing check valves	
Warranty	Furnish one-year warranty from date of final acceptance	

Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of check valves shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Swing Check Valves 2-66"	APCO Willamette Valve and Primer Corp Series 6000	Schaumburg, IL
	Clow Valve Series F-5300	Oskaloosa, IA
	Crispin Valve SWC or SWL Series	Berwick, PA
	Henry Pratt Company / Milliken "CC&E"	Aurora, IL
	Accepted equal	
Rubber Sleeve Inline Reduced Cross Section Insertion Check Valves 1-24"	Onyx Valve Company	Cinnamons, NJ
	Proco Products, Inc. 700 Series	Stockton, CA
	Tidflex Technologies Series 37	Carnegie, PA
	Accepted equal	
Rubber Sleeve Inline Full Cross Section Insertion Check Valves	Proco Products, Inc. 750 Series	Stockton, CA
	Tidflex Technologies Checkmate	Carnegie, PA
	Accepted equal	
	No exception	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Swing check valves for waterworks service shall conform to AWWA C508.
- C. Dual-disc check valves for waterworks service shall conform to AWWA C518.
- D. Swing check valves 2 inches through 66 inches shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cap (Bonnet)	Ductile Iron (for pressures 0-300 psi)	ASTM A536 Grade 65-45-12
	Bronze (for pressures 0-150 psi)	ASTM B584 Alloy C89836, ASTM B763, AWWA C800, and NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications ASTM B62 bronze may be used for nonpotable water applications
Dimensions	Laying Length	ASME/ANSI B16.10 Table 7(Class 125 or 150)

ITEM	MATERIAL	SPECIFICATION
Disc	Ductile Iron	ASTM A536, Grade 65-45-12
Seat	Aluminum Bronze	ASTM B148
Hinge Pin	Stainless Steel	ASTM A582 Type 303, 304 or 410
Cover Bolts	Stainless Steel	ASTM A193 Grade B8M
Cover Nuts	Stainless Steel	ASTM A194 Grade 8M
Outside Lever and Weight		Required
Flanges Sizes 2-66" Working Pressures 0-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Grooved Ends	Provide where shown	AWWA C606 Compatible with adjacent coupling
Epoxy Lining (valves 4 inches and larger)	Fusion-Bonded Epoxy	See Section 09 96 56. AWWA C550 12-mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas or bronze or stainless steel parts.
Exterior Finish Coat	Epoxy	See Section 09 90 00.

E. Rubber sleeve inline check valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body	Ductile Iron (for pressures 0-300 psi)	ASTM A536 Grade 65-45-12
Laying Length		Fit within existing dimensions
Rubber Flapper	EPDM Synthetic Rubber (Ethylene-Propylene Diene Monomer)	ASTM D1418 ASTM D429 Meet NSF 61 for potable water applications Peroxide cured Do not expose to petroleum oils or aromatic hydrocarbon fuels
Threaded Ends Sizes 3/8"-2" Working Pressures 0-400 psi	Ductile Iron	Female-threaded ASME/ANSI B1.20.1
Flanges Sizes 1-24" Working Pressures 0-250 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Grooved Ends	Provide where shown	AWWA C606 Compatible with adjacent coupling
Epoxy Lining (valves 4 inches and larger)	Fusion-Bonded Epoxy	See Section 09 96 56. AWWA C550 12-mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas or bronze or stainless steel parts.
Exterior Finish Coat	Epoxy	See Section 09 90 00.

F. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Rated Working Pressure	200 psi on discharge side piping 150 psi on all other piping	
Swing Check Valves 2" - 66"	Style	Outside lever and weight
	Dashpot	Required / Valve shall be factory equipped for field dashpot retrofit.
	Position Indicator	Required on valves 6-inches and larger

PART 3 - EXECUTION

3.1 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install check valves at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable fire, plumbing, mechanical and electrical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.

3.2 Field Quality Control

- A. Valves shall be tested at same time connecting pipelines are pressure tested and in accordance with sections of Contract Documents covering testing. Valves, operators, or control and instrumentation elements whose pressure rating is less than test pressure shall be protected or isolated during pressure testing.
- B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Check Valve	Installation & Leakage	Visual inspection for drip tight finished installation under pressure.	1 inspection	Owner	Owner
	Pressure Test	See Sections 33 08 11.	1 test	Contractor	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

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**SECTION 33 12 20
WET-BARREL FIRE HYDRANTS**

PART 1 - GENERAL

1.1 Work Included

A. This section includes materials, testing, and installation of fire hydrants.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 09 90 00: Painting and Coating
- H. Section 09 96 56: Epoxy Linings and Coatings
- I. Section 33 05 31: Pipeline Joint Materials
- J. Section 33 12 12: Resilient-Wedge Gate Valves
- K. Section 33 08 11: Pressure Testing and Flushing of Water Utilities

1.3 System Description

A. Furnish and install complete operating fire hydrant including appurtenant structural, and mechanical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of California Health and Safety Code.
- C. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Wet Barrel Fire Hydrants	Mechanical Test	AWWA C503 Section 5	1 each hydrant	Contractor	Contractor
	Hydrostatic Test	AWWA C503 Section 5	1 each hydrant	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56.	1 each valve	Contractor	Contractor

1.5 References

- A. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- B. ASME/ANSI B26 Fire-Hose Coupling Screw Threads
- C. ASTM A126 Gray Iron Castings for Valves, Flanges and Pipe Fittings
- D. AWWA C503 Wet Barrel Fire Hydrants

AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

- F. NFPA 1963 Fire Hose Connections
- G. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per pipeline equipment shop drawing requirements.	.
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation or application instruction requirements.	
Certificate of Compliance	Submit certified report of testing of factory-applied linings	
	Submit affidavit of compliance with AWWA C503.	
Warranty	Furnish one-year warranty from date of final acceptance	

- A. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of fire hydrants shall be strictly followed.

1.8 Unit Prices

- A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Wet Barrel Fire Hydrants (Commercial Cast Iron 4" x 2½" x 2½")	Clow Valve Model F860 / F865	Corona, CA
	James Jones Company Model J4060B	El Monte, CA
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Fire hydrants shall comply with AWWA C503
- C. Fire hydrants shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Hydrant	Bronze	AWWA C503 Lead-free
	Cast Iron	AWWA C503

ITEM	MATERIAL	SPECIFICATION
Outlet Nozzles	Bronze	AWWA C503 Lead-free
	Cast Iron	AWWA C503
Flanges	Cast Iron or Ductile Iron	Raised or plain faced
	Pressures 0-250 psi	ASME/ANSI B16.1 Class 125 Cast Iron or ASME/ANSI B16.42 Class 150 Ductile Iron
	Pressures 250-300 psi	ASME/ANSI B16.1 Class 250 Cast Iron or ASME/ANSI B16.42 Class 300 Ductile Iron
	Alignment	Boltholes of flanged valves shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, Washers and Gaskets	Various steels	See Section 33 05 31.
Frangible (Breakaway) Bolts	Stainless Steel	AWWA C503
Epoxy Lining	Fusion-Bonded Epoxy	See Section 09 96 56. AWWA C550 12-mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas and bronze or stainless steel parts.
Exterior Finish Coat	Epoxy Urethane	See Section 09 90 00. Color – Chrome yellow
Polyethylene Encasement on Valve buries	Polyethylene	AWWA C105 2 layers of 8 mil wrap

D. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION
Design	“California” or Wet-Barrel Type AWWA C503
Body	6-inch inlet
Hydrant Bury	Same Diameter as Hydrant
Hose and Pumper Nozzles (Residential)	One 4-inch hose nozzle One 2½ -inch pumper nozzles Nozzles shall have ANSI B26 standard fire hose threads
Hose and Pumper Nozzles (Commercial)	One 4-inch hose nozzle Two 2½ -inch pumper nozzles Nozzles shall have ANSI B26 standard fire hose threads
Hose and Pumper Nozzles (Commercial Double Steamer)	Two 4-inch hose nozzle One 2½ -inch pumper nozzles Nozzles shall have ANSI B26 standard fire hose threads
Outlet Nozzle Cap Chain and Cap Gasket	Required per AWWA C503 §4.6.10
Threads	Conform to National Standard for Fire Hose Connections per ANSI B26 and NFPA Standard 1963
Rated Working Pressure	150 psig
Hydrant Flange	6-inch Flange with Standard 8-hole drilling
Main Valve Opening	5-1/4-inch
Frangible (Breakaway) Hollow Metal Bolts at Junction of Hydrant and Hydrant Spool	Provide frangible section near ground line designed to break on impact ASTM A307 Grade A Heavy hexagon series ANSI B1.1 Class 2A fit ⅝- ¹ / ₈ -inch bolt with 11/32” hole drilled ⅜ deep into shank and 100% silicon -filled to prevent internal corrosion ¼-inch to ½-inch shall project through tightened nut. Threading per ANSI/ASME B18.2.1 Bolt-Head Identification Mark – “A 307 A”

3.1 Preparation

- A. Make field measurements needed to install fire hydrants before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install hydrants at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable fire, plumbing and mechanical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install fire hydrants to tolerances recommended by Manufacturer. Unless otherwise shown, install fire hydrants true, plumb, and level using precision gauges and levels.
- F. Install hydrants with face of bottom flange of barrel 4 to 6 inches above adjacent ground or paving.
- G. Install hydrants so:
 - 1. 4-inch outlet faces street at 90° to street centerline.
 - 2. Outlet is at least 15" above ground level.
 - 3. Operating nut is at least 18" above ground level.
 - 4. Three feet of clear space is maintained radially from hydrant centerline.
 - 5. Distance from curb face to hydrant outlet is at least 2 feet and no greater than 6 feet.

Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Fire Hydrant	Installation & Leakage	Visual inspection for drip tight finished installation under pressure.	1 inspection	Owner	Owner
	Pressure Test	See Section 33 08 11.	1 test	Contractor	Contractor
	Actuator	Operate hydrant through 10 full cycles of opening and closing. Hydrant shall operate from full open to full close without sticking, or binding and without required operating torque exceeding 150 ft-lbs at any point	1 test	Contractor	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 33 12 22
BRONZE VALVES 3-INCHES AND SMALLER

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of valves 3-inches and smaller on customer side of meters and laterals including
 - 1. Potable water and irrigation systems.
 - 2. Recycled water and irrigation systems.
- B. Utility work on Utility side of meters and laterals is typically covered by other sections which reflect standards for Servicing Utility.
- C. Backflow prevention devices are covered in Section 33 12 09.
- D. Do not use bronze valves for sodium hypochlorite service.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 33: Mechanical Identification
- H. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- I. Section 33 11 21: Brass and Copper Pipe
- J. Section 33 12 09: Backflow Prevention Devices
- K. Section 33 13 00: Disinfecting of Water Utility Distribution

1.3 System Description

- A. Furnish and install complete operating valves as shown including appurtenant structural, mechanical and/or electrical mountings, connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. National Sanitation Foundation marking shall appear on all potable water valves.
- B. Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with Section 116875 of the California Health and Safety Code.
- C. Stainless steel products may be substituted for bronze products provided dielectric protection is provided between stainless steel and bronze or copper alloys.
- D. National Sanitation Foundation marking is not required for piping in nonpotable water or drainage service.

E. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Butterfly Valve	Seat Bond	ASTM D429 Method B withstand 75 lb pull	1 each valve	Contractor	Contractor
	Proof of Design	ASTM C504 Section 5	Cycle testing per C504	Contractor	Contractor
	Leakage Test	AWWA C504 Section 5 and ASTM D1599	1 each valve	Contractor	Contractor
	Hydrostatic Test	AWWA C504 Section 5	1 each valve	Contractor	Contractor
Powered Actuators	Proof of Design	See Section 33 12 46.	1 test on one actuator	Contractor	Contractor
	Performance	See Section 33 12 46.	1 test on each actuator	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56.	1 each valve	Contractor	Contractor

1.5 References

- A. ASME/ANSI A112.4.14 Manually Operated Quarter-Turn Shutoff Valves for Use in Plumbing Systems Valves
- B. ASME/ANSI A112.14.1 Backwater Valves
- C. ASME/ANSI B1.20.1 NPT National Pipe Thread Taper
- D. ASME/ANSI B2.4
- E. ASME/ANSI B16.3 Malleable Iron Threaded Fittings, Class 150 and 300
- F. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
- G. ASME/ANSI B16.10 Face-to-Face and End-to-End Dimensions of Valves
- H. ASME/ANSI B16.23 Cast Copper Alloy Solder Joint Drainage Fittings (DWV)
- I. ASME/ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings
- J. ASME/ANSI B16.33 Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psi (Sizes NPS 1/2 –NPS24)
- K. ASME/ANSI B16.34 Valves – Flanged, Threaded and Welding End
- L. ASSE 1003 Water Pressure Reducing Valves
- M. ASTM A217 Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
- N. ASTM B32 Solder Metal
- O. ASTM B61 Steam or Valve Bronze Castings
- P. ASTM B62 Composition Bronze or Ounce Metal Castings (Do not use for potable water wetted surfaces)
- Q. ASTM B98 Copper-Silicon Alloy Rod, Bar and Shapes
- R. ASTM B99 Copper-Silicon Alloy Wire for General Applications
- S. ASTM B124 Copper and Copper Alloy Forging Rod, Bar, and Shapes
- T. ASTM B371 Copper-Zinc-Silicon Alloy Rod
- U. ASTM B584 Copper Alloy Sand Castings for General Applications
- V. ASTM B763 Copper Alloy Sand Castings for Valve Applications
- W. AWWA C504 Rubber-Seated Butterfly Valves 3-inch through 72-inch
- X. AWWA C800 Underground Service Line Valves and Fittings
- Y. California Plumbing Code (CPC)
- Z. MSS SP67 Butterfly Valves
- AA. MSS SP80 Bronze Gate, Globe, Angle and Check Valves

- BB. MSS SP 110 Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- CC. MSS SP139 Copper Alloy Bronze Gate, Globe, and Check Valves for Low-Pressure/Low-Temperature Plumbing Applications
- DD. NEMA/ANSI 250 Enclosures for Electrical Equipment
- EE. NFPA 70 National Electric Code
- FF. NSF/ANSI 61 Drinking Water System Components – Health Effects
- GG. NSF/ANSI 372 Drinking Water System Components – Lead Content

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required for each type of valve per shop drawing requirements.	
Catalog Data	Required for each type of valve per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements.	
O & M Instructions	Required per operation and maintenance Instruction requirements.	
Certificate of Compliance	Submit certified report of testing of factory-applied linings	
Warranty	Furnish one-year warranty from date of final acceptance.	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawing, catalog data, installation instructions, O&M instructions and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of plumbing, fixtures, and appurtenant equipment shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers for bronze valves include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
GENERAL PURPOSE VALVES		
Bronze Globe Valves 2" and Smaller Class 150 for Potable Water Service	Apollo Valve Div Conbraco Industries Series 33-LF	Matthews, NC
	Accepted equal	
Bronze Angle Valves 3" and Smaller Class 150	A. Y. McDonald Co.	Dubuque, IA
	Crane Valves Fig 17	Bolingbrook, IL
	Fairbanks Valves Fig U-03	Bakersfield, CA
	Hammond Valve Fig IB454-T	Prairie du Sac WI
	Jenkins Valves Inc. Fig 108A	Bolingbrook, IL
	Lunkenheimer Co. Fig 214	Cincinnati, OH
	Stockham Valves & Fittings Fig B222	Birmingham, AL
	Walworth Co. Fig 96	Houston, TX
	William Powell Co. Fig 151	Cincinnati, OH
Accepted equal		

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Bronze Hose Bibbs	A. Y. McDonald Co	Dubuque, IA
	Conbraco Industries 35 Series	Matthews, NC
	Jenkins Valves Inc. Fig 112, 113, or 372	Bolingbrook, IL
	Nibco Inc. Fig T113HC	Elkhart, IN
	Wilkins Div Zurn Valve Co. 195 Series	Gardena, CA
	William Powell Co. Fig 503H	Cincinnati, OH
	Accepted equal	
Bronze Ball Valves 3" and Smaller for Potable Water Service	Apollo Valve Div Conbraco Industries Series 70-LF Series	Matthews, NC
	Accepted equal	
CHECK VALVES		
Bronze Direct-Acting Pressure Reducing or Pressure Regulating Valves ¼" through 2" for Potable Water Service	Apollo Valve Div Conbraco Industries Series 36-LF	Matthews, NC
	Cla-Val Model CRA and 990	Newport Beach, CA
	Accepted equal	
Bronze Direct-Acting Pressure Relief Valves ¼" through 2"	ASCO RedHat	Alpharetta GA
	Cla-Val Model CRL and 55F	Newport Beach, CA
	Conbraco	Matthews, NC
	Watts Water Technologies	Lawrence, MA
	Wilkins Div Zurn Valve Co.	Gardena, CA
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Comply with requirements of Chapter 6 of the California Plumbing Code, "Water Supply and Distribution."
- C. Materials in contact with potable water shall be NSF-61 approved and shall use lead-free brass in accordance with California regulations.
- D. Valve materials shall be chemically compatible with chemicals and solutions handled. If any portion of specified valve is chemically incompatible with chemicals or solutions handled, substitute appropriate valve during submittals, stating reason for exception.
- E. Valves shall have name of Manufacturer and size of valve cast or molded onto valve body or bonnet or shown on a permanently attached plate.
- F. Bronze globe valves 2 inches and smaller for potable water service shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, Bonnet	Bronze	ASTM B584 Alloy C89836, NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications
Dimensions	Laying Length	ASME/ANSI B16.10 Table 1 (Class 125)
Disc	PTFE (Teflon)	Renewable composition disc
Stem	Bronze	ASTM B371 Alloy C69400 or AWWA C800, NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications
Handwheels	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Packing	PTFE (Teflon) or Kevlar Aramid Fiber	

- G. Bronze angle valves 3 inches and smaller for potable water service shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, Bonnet	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Disc	PTFE (Teflon)	Renewable composition disc
Stem	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Handwheels	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
	Malleable Iron	
Packing	Teflon or Kevlar Aramid Fiber	

- H. Bronze backwater valves shall comply with ASME/ANSI A112.14.1 and shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, Bonnet	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Ball Float	Plastic	

- I. Bronze ball valves 2 inches and smaller for potable water service shall comply with ASME/ANSI A112.4.14 and shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, and Plug Ball Retainer	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Ball	Lead-Free Brass with Chrome Plating	ASTM B584, AWWA C800, NSF 61, and NSF 372
Stem	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Seats	Reinforced PTFE (Teflon)	
Lever Operators	Bronze with Plastic Coating	

- J. Bronze ball valves 2 inches and smaller shall comply with ASME/ANSI A112.4.14 and shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, and Plug Ball Retainer	Bronze	ASTM B61 or B62
Ball	Bronze with Chrome Plating	ASTM B61 or B62
Stem	Bronze	ASTM B61 or B62
Seats	Reinforced PTFE (Teflon)	
Lever Operators	Bronze with Plastic Coating	

- K. Bronze check valves 3 inches and smaller for potable water service shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, and Cap	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Disc	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372

- L. Bronze hose bibbs shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, Bonnet	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Disc	PTFE (Teflon)	Renewable composition disc
Stem	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
	Copper Silicon	ASTM B99 Alloy C65100, or ASTM B371 (Alloy C69400), AWWA C800, NSF 61, and NSF 372

ITEM	MATERIAL	SPECIFICATION
Handwheels	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
	Malleable Iron	
Packing	PTFE (Teflon) or Graphite	

- M. Bronze or brass diaphragm valves for potable water service shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body, Bonnet	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
Trim (Plunger, Core Tube Plunger Spring, and Cage Assembly)	Stainless Steel	SAE Types 302, 304, or 305
Seat	PTFE (Teflon)	Renewable composition disc
Stem	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
	Copper Silicon	ASTM B99 Alloy C65100, or ASTM B371 (Alloy C69400), AWWA C800, NSF 61, and NSF 372
Handwheels	Lead-Free Brass	ASTM B584, AWWA C800, NSF 61, and NSF 372
	Malleable Iron	
Packing	PTFE (Teflon) or Graphite	

- N. The following product design criteria, options and accessories are required on bronze valves:

ITEM	DESCRIPTION	
Bronze Angle Valves 3-inches and Smaller	Standard	MSS SP80
	Actuator	Quarter-turn handle operator
	Stem	Rising
	Bonnet	Screwed Union
	Back Seating Capacity	Required
	Function	Shutoff
	Fluid Conveyed	Potable water & Recycled water
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150°F)
	Fluid Temperature	33°F-120°F
	Ends	Female threaded ASME/ANSI B1.20.1
Bronze Ball Valves 2-inches and smaller	Actuator	Quarter-turn handle operator
	Fluid Conveyed	Potable water & Recycled water
	Function	Shutoff
	Flow Pattern	2-way
	Style (Multiport Valves)	Horizontal
	Position Indicator	Required
	Nonblowout stem	
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150°F)
	Fluid Temperature	33°F-120°F
Ends	Female threaded ASME/ANSI B1.20.1	
Bronze Swing Check Valves 3-inches and smaller	Standard	MSS SP80
	Pattern	Wye
	Disc	Swing Type
	Function	Backflow prevention
	Fluid Conveyed	Potable water & Recycled water
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150°F)
	Fluid Temperature	33°F-120°F
	Ends	Female threaded ASME/ANSI B1.20.1
	Ends	Female threaded ASME/ANSI B1.20.1

ITEM	DESCRIPTION	
Bronze Globe Valves 2-inches and smaller	Standard	MSS SP80
	Actuator	Handwheel
	Stem	Rising
	Bonnet	Screwed Union
	Back Seating Capacity	Required
	Function	Shutoff
	Fluid Conveyed	Potable water & Recycled water
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150°F)
	Fluid Temperature	33°F-120°F
	Ends	Female threaded ASME/ANSI B1.20.1
Bronze Hose Bibbs	Actuator	Handwheel
	Stem	Nonrising
	Vacuum Breaker	Provide vacuum breaker per Section 33 12 09 and approved by local Health Department
	Fluid Conveyed	Potable water & Recycled water
	Minimum Rated Working Pressure	125 psi for cold water service
	Fluid Temperature	33°F-120°F
	Inlet End	Female threaded ASME/ANSI B1.20.1
	Outlet End	Male threaded for standard garden hose
Bronze Pressure Reducing Valves (Regulators)	Function	Automatic, direct pressure actuated Capacity labeled and ASME certified.
	Standard	ASSE 1003
	Fluid Conveyed	Potable water & Recycled water
	Minimum Rated Working Pressure	Class 150 (300 WOG psi at 150°F)
	Fluid Temperature	33°F-120°F
	Ends	Female threaded ASME/ANSI B1.20.1

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install valves before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Remove scale and dirt on inside and outside of valves before assembly.

3.2 Installation

- A. Refer to Section 01 73 00 for execution and installation requirements.
- B. Furnish and install valves at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations
 3. California Plumbing Code Chapter 6 "Water Supply and Distribution" Section 605 "Valves."

4. California Plumbing Code Chapter 6 “Water Supply and Distribution” Section 608 “Water Pressure, Pressure Regulators, Pressure Relief Valves and Vacuum Relief Valves.”
 5. Other applicable fire, plumbing, and electrical code requirements
- D. Refer variances between above documents and Contract Documents to Owner’s Representative.
 - E. Use valve hangers and supports as detailed on the drawings, as specified, and as required by applicable plumbing codes.
 - F. Obtain and review dimensioned shop drawings from valve suppliers before roughing in for any equipment.
 - G. Provide clearance for installation of insulation and access to valves and fittings.
 - H. Install vacuum breakers to entirely eliminate any danger of siphoning waste materials into the water supply system.
 - I. Painting and Coating shall comply with Division 9.

3.3 Field Quality Control

- A. Use adequate numbers of skilled plumbers trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods needed for proper performance of Work of this section.
- B. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
All Valves	Installation & Leakage	Visual inspection for drip tight finished installation under pressure.	1 inspection	Owner	Owner
	Pressure Test	See sections of Contract Documents covering pressure tests	1 test	Contractor	Contractor
	Actuator	Operate valve through 10 full cycles of opening and closing. Valve shall operate from full open to full close without sticking, or binding and without required operating torque exceeding 150 ft-lbs at any point	1 test	Contractor	Contractor
	Field Performance	Demonstrate compliance of fixtures and equipment to Contract Documents and Manufacturer’s printed Literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance of all work to Contract Documents and Manufacturer’s printed literature	1 inspection	Owner	Contractor

END OF SECTION

SECTION 33 12 25 AIR AND VACUUM VALVES FOR WATER SERVICE

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of air and vacuum valves for water service, including air release valves, air/vacuum valves, combination air and vacuum valves, air release and breaker valves and well service air valves using traditional design described in AWWA C512

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 01 73 33: Mechanical Identification
- I. Section 09 90 00: Painting and Coating
- J. Section 09 96 56: Epoxy Linings and Coatings
- K. Section 33 05 31: Pipeline Joint Materials
- L. Section 33 12 26: Air and Vacuum Valves for Water Service – Rolling Seal Design

1.3 System Description

- A. Furnish and install complete operating air and vacuum valve including appurtenant structural and/or mechanical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
- B. Air release valves shall automatically release small pockets of air that accumulate at high points in system.
- C. Air and vacuum valves shall automatically exhaust large air quantities on pump start or pipeline filling and shall automatically prevent vacuum collapse of pipe.
- D. Combination air and vacuum valves shall automatically release small pockets of air that accumulate at high points in system and shall allow air to enter or exit pipe to alleviate excess air or vacuum conditions in pipe.
- E. Vacuum breaker/air release valve shall automatically open due to vacuum admitting air into pipeline to fill vacuum created by column separation and then instantly close to trap air to form a cushion preventing surge and water hammer

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods or proper performance of Work of this section.
- B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Air and Vacuum Valves	Hydrostatic Test	AWWA C512 Section 5 "Verification"	1 each valve	Contractor	Contractor
	Seat Leakage Test	AWWA C512 Section 5 "Verification"	1 each valve	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56.	1 each valve	Contractor	Contractor

1.5 References

- A. ASCE 7 Minimum Design Loads for Buildings and Other Structures Chapter 13 and Chapter 15
- B. ASME/ANSI B2.1
- C. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- D. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- E. ASTM A47 Ferritic Malleable Iron Castings
- F. ASTM A126 Gray Iron Castings for Valves, Flanges and Pipe Fittings
- G. ASTM A240 Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
- H. ASTM A217 Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
- I. ASTM A536 Ductile Iron Castings
- J. ASTM B124 Copper and Copper-Alloy Forging Rod, Bar and Shapes
- K. AWWA C512 Air Release, Air/Vacuum and Combination Air Valves for Water Service
- L. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required on valves 6 inches and larger per valve shop drawing requirements. Required for lateral supports for valves weighing more than 30 lbs.	.
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation or application instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements	
Certificate of Compliance	Submit certified test results for leakage and hydrostatic tests	
	Submit certified report of testing of factory-applied linings	
	Submit affidavit of compliance with AWWA C512	
Engineering Calculations (California only)	For valves weighing more than 30 lbs, submit engineering calculations supporting lateral support design showing valve support can resist moment from minimum of either: <ul style="list-style-type: none"> • Lateral force of 1.0 times weight of valve applied at valve center of mass. or • Site-specific lateral forces computed per Section 01 73 24 & ASCE 7. 	
Warranty	Furnish one-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, engineering calculations and certificates of compliance.

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of air and vacuum valves shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers for water applications include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Air Release Valves (for working pressures to 175 psi)	APCO Willamette Valve and Primer Corp Model 50	Schaumburg, IL
	Cla-Val Company Series 34	Newport Beach, CA
	Crispin Multiplex Manufacturing Co. Series AR/PL	Berwick, PA
	Val-Matic Valve and Manufacturing Corp. Model 15, 22 or 25	Elmhurst, IL
	See additional options under Section 33 12 26	
	Accepted Equal	
Air Release Valves (for working pressures over 175 psi)	APCO Willamette Valve and Primer Corp Model 200A	Schaumburg, IL
	Cla-Val Company Series 34	Newport Beach, CA
	Crispin Multiplex Manufacturing Co.	Berwick, PA
	Val-Matic Valve and Manufacturing Corp. Model 22, 25, 38, 45 or 50	Elmhurst, IL
	See additional options under Section 33 12 26	
	Accepted Equal	
Air and Vacuum Valves	APCO Willamette Valve and Primer Corp Series 140/150	Schaumburg, IL
	Cla-Val Company Series 35	Newport Beach, CA
	Crispin Multiplex Manufacturing Co.	Berwick, PA
	Val-Matic Valve and Manufacturing Corp. Series 100	Elmhurst, IL
	See additional options under Section 33 12 26	
	Accepted Equal	
Combination Air and Vacuum Valves	APCO Willamette Valve and Primer Corp Series 140C/1800	Schaumburg, IL
	Crispin Multiplex Manufacturing Co. Series UL	Berwick, PA
	Cla-Val Company Series 36	Newport Beach, CA
	Val-Matic Valve and Manufacturing Corp. Series 200C	Elmhurst, IL
	See additional options under Section 33 12 26	
	Accepted Equal	
Vacuum Breaker Valve with Controlled Air Release	Cla-Val Company Series 33A	Newport Beach, CA
	Crispin Multiplex Manufacturing Co. Series UL VR/M	Berwick, PA
	Val-Matic Valve and Manufacturing Corp. Series S-1500 TC	Elmhurst, IL
	See additional options under Section 33 12 26	
	Accepted Equal	
Vacuum Breaker/Air Release Valves	Cla-Val Company Series 38VB/AR	Newport Beach, CA
	Accepted Equal	

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Air release valves, air and vacuum valves and combination air and vacuum valves water service shall comply with AWWA C512
- C. Air release valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cover	Ductile Iron (for pressures 0-300 psi)	ASTM A536 Grade 65-45-12
Float, Linkage and Internal Parts	Stainless Steel	ASTM A240 SAE Type 316
Seats	EPDM for Recycled Water	
Body Bolts	Stainless Steel	SAE Type 316
Threaded Ends Sizes 3/8"-4" Working Pressures 0-400 psi	Ductile Iron	Female-threaded ASME/ANSI B1.20.1
Flanges Sizes 6"-8" Working Pressures 0-150 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flanges Sizes 6"-8" Working Pressures 150-250 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flanges Sizes 6"-8" Working Pressures 250-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Epoxy Lining (Cast Iron Surfaces of Valves 3-inches and Larger)	Epoxy	See Section 09 96 56. AWWA C550 12 mil minimum DFT NSF61 Listed for potable water Do not coat sealing areas and bronze or stainless steel parts.
Exterior Finish Coat	Epoxy Urethane	See Section 09 90 00.
Coating Color	Domestic Service	Blue
	Recycled Water	Purple

- D. Air and vacuum valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cover	Ductile Iron (for pressures >250 psi)	ASTM A536 Grade 65-45-12
Float, Linkage and Internal Parts	Stainless Steel	ASTM A240 SAE Type 316
Seats	EPDM for Recycled Water	
Body Bolts	Stainless Steel	SAE Type 316
Threaded Ends Sizes 3/8"-4" Working Pressures 0-400 psi	Ductile Iron	ANSI B2.1

ITEM	MATERIAL	SPECIFICATION
Flanges Sizes 6"-8" Working Pressures 0-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, Washers and Gaskets	Various steels	See Section 33 05 31.
Epoxy Lining	Epoxy	See Section 09 96 56. AWWA C550 12 mil minimum DFT NSF61 Listed for potable water Do not coat sealing areas and bronze or stainless steel parts.
Exterior Finish Coat	Epoxy Urethane	See Section 09 90 00.
Coating Color	Domestic Service	Blue
	Recycled Water	Purple

E. Combination air and vacuum valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cover	Ductile Iron (for pressures >250 psi)	ASTM A536 Grade 65-45-12
Float, Linkage and Internal Parts	Stainless Steel	ASTM A240 SAE Type 316
Needle and Seats	EPDM for Recycled Water	
Plug	Stainless Steel	SAE Type 304
Leverage Frame	Cast Iron	ASTM A126 Grade B
Body Bolts	Stainless Steel	SAE Type 316
Threaded Ends Sizes 3/8"-4" Working Pressures 0-400 psi	Ductile Iron	ANSI B2.1
Flanges Sizes 6"-8" Working Pressures 0-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, Washers and Gaskets	Various steels	See Section 33 05 31.
Epoxy Lining (Cast Iron Surfaces of Valves 3-inches and Larger)	Epoxy	See Section 09 96 56. AWWA C550 12 mil minimum DFT NSF61 Listed for potable water Do not coat sealing areas and bronze or stainless steel parts.
Exterior Finish Coat	Epoxy Urethane	See Section 09 90 00.
Coating Color	Domestic Service	Blue
	Recycled Water	Purple

F. The following product design criteria, options and accessories are required for air release valves:

ITEM	DESCRIPTION	
Design	Comply with AWWA C512	
	Design Pressure on Suction side	150 psi
	Design Pressure on Discharge side	200 psi

The following product design criteria, options and accessories are required for air and vacuum valves:

ITEM	DESCRIPTION	
Design	Comply with AWWA C512	
	Design Pressure on Suction side	150 psi
	Design Pressure on Discharge side	200 psi

H. The following product design criteria, options and accessories are required for combination air and vacuum valves:

ITEM	DESCRIPTION	
Design	Comply with AWWA C512	
	Design Pressure	150 psi

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install air and vacuum valves before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Field tap for valve shall be made in a level section of pipe no closer than 18-inches to a bell, coupling, joint, or fitting. Only factory outlets will be permitted within 18 inches of joint or flange.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install air and vacuum valves at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable fire, plumbing, and mechanical code requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install air and vacuum valves to tolerances recommended by Manufacturer. Unless otherwise shown, install air and vacuum valves true, plumb, and level using precision gauges and levels.
- F. Do not pressure test against air valves. Close isolation valve beneath air and vacuum valves during hydrostatic testing

Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Air and Vacuum Valves	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 33 12 26
AIR AND VACUUM VALVES FOR WATER SERVICE – ROLLING SEAL DESIGN

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of air and vacuum valves for water service, including air release valves, air/vacuum valves, combination air and vacuum valves, air release and breaker valves and well service air valves using rolling seal design as alternate to traditional design described in AWWA C512.
- B. Valves shall be equivalent in function to valves described in AWWA C512.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 24: Seismic Restraint
- H. Section 01 73 33: Mechanical Identification
- I. Section 09 90 00: Painting and Coating
- J. Section 09 96 56: Epoxy Linings and Coatings
- K. Section 33 05 31: Pipeline Joint Materials
- L. Section 33 12 25: Air and Vacuum Valves for Water Service

1.3 System Description

- A. Furnish and install complete operating air and vacuum valve including appurtenant structural and/or mechanical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
- B. Air release valves shall automatically release small pockets of air that accumulate at high points in system.
- C. Air and vacuum valves shall automatically exhaust large air quantities on pump start or pipeline filling and shall automatically prevent vacuum collapse of pipe.
- D. Combination air and vacuum valves shall automatically release small pockets of air that accumulate at high points in system and shall allow air to enter or exit pipe to alleviate excess air or vacuum conditions in pipe.
- E. Vacuum breaker/air release valve shall automatically open due to vacuum admitting air into pipeline to fill vacuum created by column separation and then instantly close to trap air to form a cushion preventing surge and water hammer

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods or proper performance of Work of this section.

Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Air and Vacuum Valves	Hydrostatic Test	AWWA C512 Section 5 "Verification"	1 each valve	Contractor	Contractor
	Seat Leakage Test	AWWA C512 Section 5 "Verification"	1 each valve	Contractor	Contractor
Interior Lining	Holidays and Lining Thickness	See Section 09 96 56.	1 each ferrous valve	Contractor	Contractor

1.5 References

- A. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- B. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- C. ASTM A47 Ferritic Malleable Iron Castings
- D. ASTM A126 Gray Iron Castings for Valves, Flanges and Pipe Fittings
- E. ASTM A240 Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
- F. ASTM A536 Ductile Iron Castings
- G. AWWA C512 Air Release, Air/Vacuum and Combination Air Valves for Water Service
- H. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required on valves 6 inches and larger per valve shop drawing requirements.	.
Catalog Data	Required per catalog data requirements.	
	Show lining and coating data and thicknesses.	
Installation Instructions	Required per installation or application instruction requirements.	
O & M Instructions	Required per operation and maintenance instruction requirements	
Certificate of Compliance	Submit certified test results for leakage and hydrostatic tests	
	Submit certified report of testing of factory-applied linings	
Warranty	In lieu of affidavit of compliance with AWWA C512, furnish 3-year warranty from date of final acceptance	

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of air and vacuum valves shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers for water applications include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Air Release Valves (for working pressures to 175 psi)	ARI Flow Control Accessories D-040-C Series 1"-2" D-015 Series 3"-8"	San Diego, CA
	See additional options under Section 33 12 25.	
	Accepted Equal	
Air Release Valves (for working pressures over 175 psi)	ARI Flow Control Accessories D-065 HF Series	San Diego, CA
	See additional options under Section 33 12 25.	
	Accepted Equal	
Air and Vacuum Valves	ARI Flow Control Accessories D-060 Series	San Diego, CA
	ARI Flow Control Accessories D-040-C Series 1"-2" D-015 Series 3"-8"	San Diego, CA
	See additional options under Section 33 12 25.	
	Accepted Equal	
Combination Air and Vacuum Valves	ARI Flow Control Accessories D-060 Series	San Diego, CA
	ARI Flow Control Accessories D-040-C Series 1"-2" D-015 Series 3"-8"	San Diego, CA
	See additional options under Section 33 12 25.	
	Accepted Equal	
Compact Combination Air and Vacuum Valves (for valves < 2- inch)	ARI Flow Control Accessories D-040-C Series	San Diego, CA
	Accepted Equal	
Air Release and Vacuum Breaker Valve	ARI Flow Control Accessories D-060 NS Series	San Diego, CA
	See additional options under Section 33 12 25.	
	Accepted Equal	

B. Air release and air and vacuum valves shall be same model as combination air and vacuum valves of same size to allow valves to be interchangeable in field.

2.2 Materials

A. Refer to Section 01 61 00 for basic requirements for products and materials.

B. The following is being conveyed:

FLUID	VISCOSITY (77°F)	SPECIFIC GRAVITY	TEMP	FREEZING POINT	BOILING POINT	VAPOR PRESS (77°F)	pH	SOLIDS CONTENT
Potable Water	0.894cP	1.00	33-90°F	32°F	212°F	0.46 psia	6.5- 8.5	<500 ppm
Recycled Water	0.894cP	1.00	33-90°F	32°F	212°F	0.46 psia	6.5- 8.5	<1.0%
Wastewater	0.894cP	1.01	33-90°F	32°F	212°F	0.46 psia	6.5- 8.5	<1.0%

C. Air release valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cover	Ductile Iron (for pressures >300 psi)	ASTM A536 Grade 65-45-12
Float	Polycarbonate	NSF 61 Certified

ITEM	MATERIAL	SPECIFICATION
Seats	EPDM for Recycled Water	
Body Bolts	Stainless Steel	SAE Type 316
Flanges Sizes 1-8" Working Pressures 0-250 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flanges Sizes 1-8" Working Pressures 250-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 300 Raised or plain faced
Flange Alignment	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Epoxy Lining (Cast Iron Surfaces of Valves 3-inches and Larger)	Epoxy	See Section 09 96 56. AWWA C550 12 mil minimum DFT Meet NSF 61 for potable water applications Do not coat sealing areas and bronze or stainless steel parts.
Exterior Finish Coat	Epoxy Urethane	See Section 09 90 00.
Coating Color	Domestic Water Service	Blue
	Recycled Water Service	Purple

D. Air and vacuum valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cover	Ductile Iron (for pressures >300 psi)	ASTM A536 Grade 65-45-12
Float	Polycarbonate	NSF 61 Certified
Seats	EPDM for Recycled Water	
Body Bolts	Stainless Steel	SAE Type 316
Flanges Sizes 1-8" Working Pressures 0-250 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flanges Sizes 1-8" Working Pressures 250-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 300 Raised or plain faced
Flange Alignment	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Flanges	Ductile Iron	Raised or plain faced
	Pressures 0-250 psi	ASME/ANSI B16.42 Class 150 Ductile Iron
	Pressures 250-300 psi	ASME/ANSI B16.42 Class 300 Ductile Iron
Flange Bolts, Nuts, Washers and Gaskets	Various steels	See Section 33 05 31.
Epoxy Lining on Interior Cast Iron Surfaces	Epoxy	See Section 09 96 56. AWWA C550 12 mil minimum DFT NSF61 Listed for potable water Do not coat sealing areas and bronze or stainless steel parts.
Epoxy Finish Coat	Epoxy Urethane	See Section 09 90 00.
Coating Color	Domestic Water Service	Blue
	Recycled Water Service	Purple

Combination air and vacuum valves shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cover	Ductile Iron (for pressures >300 psi)	ASTM A536 Grade 65-45-12
Float	Polycarbonate	NSF 61 Certified
Seats	EPDM for Recycled Water	
Body Bolts	Stainless Steel	SAE Type 316
Flanges Sizes 1-8" Working Pressures 0-250 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flanges Sizes 1-8" Working Pressures 250-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 300 Raised or plain faced
Flange Alignment	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Epoxy Lining on Interior Cast Iron Surfaces	Epoxy	See Section 09 96 56. AWWA C550 12 mil minimum DFT NSF61 Listed for potable water Do not coat sealing areas and bronze or stainless steel parts.
Epoxy Finish Coat	Epoxy Urethane	See Section 09 90 00.
Coating Color	Domestic Water Service	Blue
	Recycled Water Service	Purple

- F. The following product design criteria, options and accessories are required for air release valves:

ITEM	DESCRIPTION	
Design	Use Manufacturer's standard design	
	Design Pressure on Suction side	150 psi
	Design Pressure on Discharge side	200 psi

- G. The following product design criteria, options and accessories are required for air and vacuum valves:

ITEM	DESCRIPTION	
Design	Use Manufacturer's standard design	
	Design Pressure on Suction side	150 psi
	Design Pressure on Discharge side	200 psi

- H. The following product design criteria, options and accessories are required for combination air and vacuum valves:

ITEM	DESCRIPTION	
Design	Use Manufacturer's standard design	
	Design Pressure	150 psi
Tap	Field tap for valve shall be made in a level section of pipe no closer than 18-inches to a bell, coupling, joint, or fitting. Only factory outlets will be permitted within 18 inches of joint or flange.	

- I. The following product design criteria, options and accessories are required for compact combination air and vacuum valves:

ITEM	DESCRIPTION	
Design	Use Manufacturer's standard design	
	Design Pressure	150 psi

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install air and vacuum valves before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Field tap for valve shall be made in level section of pipe no closer than 18-inches to a bell, coupling, joint, or fitting. Only factory outlets will be permitted within 18 inches of joint or flange.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Furnish and install air and vacuum valves at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer’s installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable fire, plumbing, and mechanical code requirements
- D. Refer variances between above documents and Contract Documents to Owner’s Representative.
- E. Install air and vacuum valves to tolerances recommended by Manufacturer. Unless otherwise shown, install air and vacuum valves true and level using precision gauges and levels.
- F. Do not pressure test against air valves. Close isolation valve beneath air and vacuum valves during hydrostatic testing

3.3 Field Quality Control

- A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Air and Vacuum Valves	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer’s printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer’s printed literature	1 test	Owner	Contractor

END OF SECTION

**SECTION 33 12 30
STRAINERS**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of basket strainers.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 09 90 00: Painting and Coating
- H. Section 09 96 56: Epoxy Linings and Coatings
- I. Section 33 05 31: Pipeline Joint Materials
- J. Section 33 08 11: Pressure Testing and Flushing of Water Utilities

1.3 System Description

- A. Furnish and install complete operating strainer including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings – Class 25, 125, 150 and 800
- B. ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
- C. ASME/ANSI B16.42 Ductile Iron Flanged Fittings – Classes 150 and 300
- D. ASME/ANSI B16.47 Large Diameter Steel Flanges: NPS 26 Through NPS 60
- E. ASTM A351 Castings, Austenitic-Ferritic (Duplex) for Pressure Containing Parts
- F. AWWA C207 Steel Pipe Flanges
- G. AWWA C653 Disinfection of Water Treatment Plants
- H. NEMA/ANSI 250 Enclosures for Electrical Equipment
- I. NFPA 70 National Electric Code
- J. NSF/ANSI 61 Drinking Water Standards Health Effects

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION
Shop Drawings	Required per valve and equipment shop drawing requirements.
Catalog Data	Required per catalog data requirements. Show lining and coating data and thicknesses.

SUBMITTAL	DESCRIPTION
Installation Instructions	Required per installation or application instruction requirements.
O & M Instructions	Required per operation and maintenance instruction requirements
Warranty	Furnish one-year warranty from date of final acceptance

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, and O&M instructions.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of strainers shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers for strainers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Metal Basket Strainers	Apollo Valve Div Conbraco Industries	Matthews, NC
	Baker	
	GA Industries, Inc.	Cranberry Twp, PA
	Hayward Industrial Products, Inc.	Clemmons, NC
	Titan Fluid Control	
	Accepted equal	
PVC Basket Strainers	Hayward Industrial Products, Inc.	Clemmons, NC
	Plast-O-Matic	Cedar Grove, NJ
	Spears Manufacturing Company Bulletin BS2	Sylmar, CA
	Accepted equal	

- B. Acceptable Manufacturers for filters include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Tee Filters	Spears Manufacturing Company Bulletin BS2	Sylmar, CA
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Metal strainers shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cover	Ductile Iron (for pressures 0-300 psi)	ASTM A536 Grade 65-45-12
Flanges Working Pressures 0-250 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flanges Working Pressures 250-300 psi	Ductile Iron	ASME/ANSI B16.42 Class 300 Raised or plain faced

ITEM	MATERIAL	SPECIFICATION
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Interior Nuts, Bolts and Plug	Stainless Steel	SAE Type 316
O-Rings and Seals	EPDM	
Basket Screen	Stainless Steel	SAE Type 316
Epoxy Lining	Epoxy	See Section 09 96 56 AWWA C550 12-mil minimum DFT Meet NSF 61 for potable water applications Do not coat bronze or stainless steel parts.
Exterior Finish Coat	Epoxy Urethane	See Section 09 90 00.

- C. Plastic basket strainers shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Body and Cover	Translucent PVC	ASTM D1784 Cell Class 12454
Flanges Working Pressures 0-150 psi	Ductile Iron	ASME/ANSI B16.42 Class 150 Raised or plain faced
Flange Alignment	Horizontal Pipelines	Boltholes shall straddle horizontal and vertical centerlines of pipe run to which valves are attached.
	Vertical Pipelines	Boltholes shall straddle plant North-South and plant East-West centerlines of pipe run to which valves are attached.
Flange Bolts, Nuts, and Washers	Various Steels	See Section 33 05 31.
Flange Gaskets		See Section 33 05 31.
Interior Nuts, Bolts and Plug	Stainless Steel	SAE Type 316
O-Rings and Seals	EPDM	
Basket Screens	Stainless steel	AISI Type 316

- D. The following product design criteria, options and accessories are required for basket strainers:

ITEM	DESCRIPTION	
Basket Strainer	Fluid Conveyed	Potable Water / Recycled Water
	Pressure Rating	250 psig
Pressure Gauge	Pressure Gauge Range	0-300 psi
Basket Openings	Mesh	1/16
		0.92" dia wire
	Perforations	3/16"
Plugged Blowoff	Required / Not required	

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install strainers before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install strainers at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing and electrical code requirements
- D. Refer variances between the above documents and Contract Documents to Owner's Representative.
- E. Install strainers to tolerances recommended by Manufacturer. Unless otherwise shown, install strainers true and level using precision gauges and levels.
- F. Disinfect water treatment units per AWWA C653.

3.3 Field Quality Control

- A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Strainers	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Hydrostatic Pressure Test	See Section 33 08 11.	1 each strainer	Owner	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

**SECTION 33 12 31
WATER SERVICES AND FLOW METER ASSEMBLIES**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of water service laterals, service valves, meter boxes, and flowmeter assemblies.
- B. Materials shall comply with NSF 61.
- C. Materials used for potable water conveyance shall confirm to NSF 372
- D. District will furnish meter.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 01 73 33: Mechanical Identification
- H. Section 09 90 00: Painting and Coating
- I. Section 31 23 00: Excavation and Fill
- J. Section 33 05 31: Pipeline Joint Materials
- K. Section 33 11 21: Brass and Copper Pipe

1.3 System Description

- A. Furnish and install complete operating flow meter assembly including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
- B. Flow meter instrument output variables shall include:

ITEM	VARIABLE	DESCRIPTION
Output signals (Analog)	Water Meter Reading	Compatible with Owner's meter reading system

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. National Sanitation Foundation marking shall appear on all potable water valves.
- C. National Sanitation Foundation Marking is not required for piping in nonpotable water drainage service.

Products coming into contact with potable water shall contain no more than 0.25% lead by average weight in compliance with the Federal Reduction of Lead in Drinking Water Act and California law AB1953, and shall be marked as complying.

1.5 References

- A. ASME/ANSI B1.20.1 (ANSI B2.1) Pipe Threads – NPT National Pipe Thread Taper
- B. ASME/ANSI B16.15 Cast Bronze Threaded Fittings
- C. ASME/ANSI B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- D. AWWA C800 Underground Service Line Valves and Fittings
- E. AWWA M6 Water Meters – Selection, Installation, Testing and Maintenance
- F. California Health and Safety Code Section 116875
- G. NSF/ANSI 61 Drinking Water Standards Health Effects
- H. NSF/ANSI 372 Drinking Water System Components – Lead Content (Formerly NSF/ANSI 61 Annex G)

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION
Catalog Data	Required per catalog data requirements.
Installation Instructions	Required per installation or application instruction requirements.
O & M Instructions	Required per operation and maintenance instruction requirements
Certificate of Compliance	Submit coating system and application certification per certificate of compliance requirements.
Test Record Transcripts	Submit for factory tests per test record transcript requirements.
Warranty	Furnish 3-year warranty from date of final acceptance

- B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, installation instructions, O&M instructions, certificates of compliance, and test record transcripts.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer’s instruction and warranty requirements for delivery, storage, and handling of flowmeter assemblies shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Flow indicators, totalizers and transmitters where shown shall be manufactured by same manufacturer as flow sensing equipment and shall be fully compatible with equipment furnished.

Acceptable Manufacturers of brass service saddles for DIP, ACP, C900 PVC, or DIPS pipe with AWWA “CC” threaded female outlets include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Brass Double- Bale Service Saddles with AWWA “CC” threaded female outlets	A. Y. McDonald Co. 3825 AWWA Series	Dubuque, IA
	Ford Meter Box Co. 202B-CC Series	Wabash, IN
	James Jones J979CC Series	El Monte, CA
	Mueller Company BR2B-CC Series	Decatur IL
	Romac Industries 202B-CC Series	Bothell, WA
	Accepted equal	
Brass Straps on Service Saddles	Everdur	
	Silnic Bronze	
	Accepted equal	

C. Acceptable Manufacturers of ball corporation stops with AWWA “CC” male inlets and flared outlets include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Ball Valve Corporation Stops AWWA “CC”x Flare	A. Y. McDonald Co. Series 74701B – No Lead	Dubuque, IA
	A. Y. McDonald Co. Series 74101BCAP – No Lead	Dubuque, IA
	Ford Meter Box Company FB 600-NL	Wabash, IN
	James Jones J-1930 - No Lead	El Monte, CA
	Mueller Company 300 Series B-15000N	Decatur IL
	Accepted equal	
Ball Valve Corporation Stops Dielectric Bushing and AWWA “CC”x Flare	A. Y. McDonald Co. Series 74701BDB – No Lead	Dubuque, IA
	Accepted equal	
Ball Valve 45°-Bend Corporation Stops	Mueller Company 300 Series B-25010N	Decatur IL
	Accepted equal	
Ball Valve 90°-Bend Corporation Stops AWWA “CC”x Flare	Mueller Company 300 Series B-25020N	Decatur IL
	Accepted equal	

D. Acceptable meter ball valve Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Angle Flare x Meter Swivel Nut Ball Meter Valves	A. Y. McDonald Co.	Dubuque, IA
	Cambridge Brass	Cambridge, ON
	Ford Meter Box Co.	Wabash, IN
	James Jones	El Monte, CA
	Mueller Company 300 Series B-24267N	Decatur IL
	Accepted equal	

E. Acceptable customer service valve Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Angle Flare x FNTP Ball Service Valves	A. Y. McDonald Co.	Dubuque, IA
	Ford Meter Box Co.	Wabash, IN
	James Jones	El Monte, CA
	Mueller Company 300 Series B-24275N	Decatur IL
	Accepted equal	

F. Acceptable polymer concrete meter box Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Polymer-Concrete Meter Box 1” Meter and Smaller	Armorcast Products Company A6001946PCx12 with A6001866 cover 13”x 24”	Ontario, CA
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Polymer-Concrete Meter Box	Armorcast Products Company A6001640PCx12 with A6001643 cover 17" x 30"	Ontario. CA
1½" Meter and 2" Meter	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Service saddles shall be constructed of the following materials:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Service Saddles for DIP and ACP	Standards	AWWA C800, and NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications.
	Threads	AWWA C800 Table 7 "CC" Taper-Thread
	Saddle Material	/ Lead-Free Waterworks Brass
	O-Ring or Gasket	EPDM Synthetic Rubber (Ethylene-Propylene Diene Monomer)
	Strap Material	SAE Type 304 or SAE Type 316 Stainless Steel
	Size	As shown on plans.
	1" Service Saddles	Double-Strap Type with flat straps or bails
	2" Service Saddles	Double-Strap Type with flat straps or bails
	Bolts and Nuts	SAE Type 304 or SAE Type 316 stainless steel
	Published Working Pressure	As required by class of pipe shown on Plans
Service Saddles for C-900 PVC	Standards	AWWA C800, and NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications
	Threads	AWWA C800 Table 7 "CC" Taper-Thread
	Saddle Material	Lead-Free Waterworks Brass
	O-Ring or Gasket	EPDM Synthetic Rubber (Ethylene-Propylene Diene Monomer)
	Strap Material	SAE Type 304 or SAE Type 316 Stainless Steel
	Size	As shown on plans.
	1" Service Saddles	Double-strap type with flat straps or bails
	2" Service Saddles	Double-strap type with flat straps or bails
	Bolts and Nuts	SAE Type 304 or SAE Type 316 stainless steel
	Published Working Pressure	As required by class of pipe shown on Plans
Construction	Cast in 2 sections for use on pipe ≤ 8" diameter. Cast in 2 or 3 sections for use on 10"-12" diameter pipe Each saddle shall fit contour of pipe OD without distorting pipe.	

Corporation stops shall be constructed of the following materials:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Corporation Stops	Standards	ASTM B584 AWWA C800, and NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications.
	Type	Ball Valve
	Material	Lead-Free Waterworks Brass
	Ball Coating	PTFE (Teflon)
	Inlet Connection	Male AWWA C800 Table 7 "CC" Taper-Thread /
	Outlet Connection	Flared

D. Bronze service materials shall be constructed of the following materials:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Couplings in 2" Service Laterals		Make joint with copper tube fittings per ASME/ANSI B16.22 Clearance between tube and fitting shall be 0,004"-0,010". Solder with 95/5 (tin-antimony) solder containing less than 0.2% lead.
Angle Meter Valves	Standards	ASTM B584, AWWA C800, and NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications.
	Material	Lead-Free Waterworks Brass
	Inlet Connection	Compression type or iron-pipe thread
	Outlet Connection	Meter flange or meter coupling. Inlet and outlet shall form angle of 90 degrees on vertical plane through centerline of meter stop.
	Shutoff Mechanism	Rectangular lug and lock wing on top of fitting
	Valve Description	Full-port "ball" type with locking wing on key operator and full 360° rotation of tee head. 2" angle meter stops shall be with "slotted" holes for 1½" or 2" meters.
Customer Service Valves	Standards	ASTM B584 AWWA C800, and NSF 61 Comply with NSF/ANSI 372 lead threshold for potable water applications.
	Material	Lead-Free Waterworks Brass
	Inlet Connection	Meter flange or meter coupling.
	Outlet Connection	Female pipe thread
	Shutoff Mechanism	Lever-type turn handle
Tapping Saddle and/or Meter Bolts, Nuts and Washers	Standards	See Section 33 05 31.
	Material	Silicon Bronze

E. Meter boxes shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Meter Box	Precast Concrete	Compressive strength of 4,000 psi
	Polymer Concrete	Compressive strength of 4,000 psi
Meter Box Cover	Precast Concrete	Compressive strength of 4,000 psi
	Polymer Concrete	Compressive strength of 4,000 psi

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install service saddles, taps, service fittings, and flowmeter assemblies before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Refer to Section 31 23 00 for open trench requirements.
- C. Furnish and install flowmeters and services at locations shown on Plans and Submittals.
- D. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing and electrical code requirements
 - 4. Servicing water utility requirements
- E. Refer variances between above documents and Contract Documents to Owner's Representative.
- F. For dry-tapping 1" and 2" services on PVC pipe, bore hole into pipe with hole saw that retains coupon and allows shavings to fall clear of hole. Center service saddle over hole, seat, tighten, and install corporation stop using pipe thread sealant.
- G. Install service saddles as follows:
 - 1. File pipe surface to remove all loose material and to provide hard, clean surface before placing service saddle.
 - 2. Tighten service saddle to ensure tight seal, taking care to prevent damage or distortion of either corporation stop or service saddle by over-tightening.
 - 3. Tap pipe in accordance with pipe Manufacturer's recommendation.
- H. Make connections using compression couplings, angle valves, etc. In accordance with Manufacturer's recommendations and accepted trade practices.
- I. All domestic service laterals shall be 1" minimum size copper tubing.
- J. Install all 2" size services with straight lengths of soft copper water tube Type K. Only flared fittings are acceptable on only corporation stop and angle meter stop. All couplings and adapters shall be silver-soldered.
- K. Install flowmeter assemblies to tolerances recommended by Manufacturer. Unless otherwise shown, install flowmeter assemblies true and level using precision gauges and levels.

3.3 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Water Service Laterals	Hydrostatic Pressure Test	See Section 33 08 11.	1 each meter tube	Owner	Contractor
	Accuracy	Owner reserves right to either test meter in shop before placing meter in service or test in field using test tap to be furnished by Contractor.	As directed	Owner	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 33 13 00 DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.1 Work Included

- A. Disinfection, flushing and dechlorinating of all potable water mains.
- B. Disinfection, flushing, and dechlorinating other potable water facilities which must be removed from service during construction and re-commissioned prior to final acceptance.
- C. Plan construction activities to allow and facilitate flushing, disinfection, testing, and dechlorinating of all sections of new water facilities, and existing water facilities removed from service during construction and restored to service prior to final acceptance.
- D. Where equipment is added inside existing potable water reservoir, Owner may elect to test tank water for coliform upon completion of Work by Contractor. Contractor will only be required to disinfect tank in event tank water tests positive for coliform when tested in accordance with AWWA C652 Section 5 "Verification" and Standard Methods of Examination of Water and Wastewater. If disinfection is required, Contractor shall be responsible for disposal of tank contents at no cost to Owner, but Owner will not backcharge Contractor for any value of lost water.
- E. Obtain all permits required to complete Work specified herein.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 33 08 11: Pressure Testing and Flushing of Water Utilities

1.3 System Description

- A. Disinfect pipe to meet all AWWA and public health standards.
- B. Disinfect other water facilities to meet all AWWA and public health standards.
- C. Dechlorinate to meet all AWWA and public health standards.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. AWWA C651 Disinfecting Water Mains
- B. AWWA C652 Disinfection of Water Storage Facilities
- C. AWWA C653 Disinfection of Water Treatment Plants

- AWWA C654 Disinfection of Wells
- E. AWWA C655 Field Dechlorination
- F. National Pollutant Discharge Elimination System Permit (NPDES) – Central Coast Regional Water Quality Control Board (CCWQCB) – General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters.
- G. National Pollutant Discharge Elimination System Permit (NPDES) – Colorado River Regional Water Quality Control Board (CRRWQCB) – General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters.
- H. National Pollutant Discharge Elimination System Permit (NPDES) – Los Angeles Regional Water Quality Control Board (LARWQCB) – General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties, Los Angeles Region Order No. 97-047, NPDES Permit No. CAG674001 or most recent order or amendment.
- I. National Pollutant Discharge Elimination System Permit (NPDES) – Santa Ana Regional Water Quality Control Board (SARWQCB) – General Waste Discharge Requirements for Discharges to Surface Waters that Pose an Insignificant Threat to Water Quality, Santa Ana Region Order No. R8-2003-0061, NPDES Permit No. CAG998001 or most recent order or amendment.
- J. National Pollutant Discharge Elimination System Permit (NPDES) – San Diego Regional Water Quality Control Board (SDRWQCB) – General Permit for Discharges of Hydrostatic Test Water and Potable Water to Surface Waters and Storm Drains or Other Conveyance Systems, San Diego Region Order No. R9-2002-0020 or most recent order or amendment.
- K. Standard Methods for Examination of Water and Wastewater

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Disinfection, Flushing and Dechlorinating Plan	On Owner's request, submit detailed plan showing how Contractor intends to test, disinfect and flush pipeline and dechlorinate discharge from flushing operation.	
Written Permission to Discharge into Sewer	Required from owner of any sanitary sewer prior to discharge of flushing water into sewer. Submittal shall include any special requirements for treatment of flushing water prior to sewer discharge, estimate of expected maximum discharge rate of flushing flow and analysis of sewer's capacity.	
Written Permission to Discharge into Storm Drain	Required from owner of any storm drain prior to discharge of flushing water into storm drain. Submittal shall include any special requirements for treatment of flushing water prior to storm drain discharge, estimate of expected maximum discharge rate of flushing flow and analysis of storm drain's capacity.	
Laboratory Report for Disinfection Testing	Submit report from Owner-accepted testing laboratory	

- B. Refer to Section 01 33 00 for definition of requirements for reports and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of chemicals and equipment shall be strictly followed.

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for items to which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Materials

- A. Furnish all labor, water, chemicals, and equipment necessary to complete disinfection process and obtain, transport, and test samples.
- B. Use of chlorine solutions is anticipated as the active disinfecting agent. Contractor shall be solely responsible for safe and proper transportation, storage and handling of chlorine compounds or other hazardous chemicals used.
- C. Only chlorine from hypochlorite solution will be allowed. Direct injection of chlorine gas is prohibited.
- D. Hypochlorite solutions shall be pre-mixed and fed to tanks or piping and not placed dry.
- E. Containers and equipment used in sampling shall be clean and free of contamination. Obtain sampling bottles from testing lab along with instructions for handling.
- F. Use of sodium thiosulfate is anticipated as active dechlorinating agent. Contractor shall be fully responsible for safe and proper transportation, storage and handling of chemical compounds or other hazardous chemicals used.
- G. Other appropriate means and methods of dechlorinating water flushed from pipe may be used with approval by Owner's Representative.

PART 3 - EXECUTION

3.1 Preparation

- A. Flush all mains and services with potable water (or water as otherwise approved by Owner and regulatory agencies) after completion of pressure test. Provide sufficient number of suitable outlets at end(s) of line(s) being flushed in addition to those shown on Plans to permit flushing of main with water at velocity of at least 2.5-feet per second over its entire length. Outlets provided shall meet requirements for fittings specified for type of main constructed. Velocity through outlets and fittings shall not exceed 25 fps during flushing. Construct drainage facilities such that water lines cannot be contaminated through flushing outlets.
- B. Provide sufficient hoses, fittings and equipment to direct flushing water to established point of discharge such as gutter and storm drain inlet or natural drainage channel to prevent damage to public or private property and to prevent creating a public hazard. If flushing water must be discharged into traffic lanes, set up traffic control in accordance with requirements of agency having jurisdiction over public right-of-way. Schedule flushing in or adjacent to public streets during periods of reduced traffic volume.
- C. Contractor shall be solely responsible for providing source of water for flushing and for methods for discharge of water, including all associated costs and permits.

A. Sequence of testing shall ensure discharge of contaminated water does not occur into facilities previously decontaminated, tested and verified as decontaminated. The following test sequence is recommended:

1. Satisfactorily pass all hydrostatic pressure testing on new piping.
2. Satisfactorily pass bacteriological test upon re-commissioning

B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pipe	4-hour Hydrostatic Pressure Test	See Section 33 08 11	All pipe sections	Contractor (Owner's Representative will observe and record results)	Contractor (Owner's Representative will observe and record results)
Pipe Disinfection	Bacteriological Contamination	AWWA C651 Section 5 "Verification" and Standard Methods of Examination of Water and Wastewater as amplified below	All pipe sections at minimum spacing of 2,500 ft	Contractor	Contractor
Reservoir Disinfection	Bacteriological Contamination	AWWA C652 Section 5 "Verification" and Standard Methods of Examination of Water and Wastewater	All re-commissioned reservoirs	Contractor	Contractor
Dechlorination	Residual Chlorine Level	AWWA C655 Section 5 "Verification"	As required to meet local health agency requirements, but at least one measurement per discharge incident	Contractor	Contractor

C. Following pressure testing and flushing described in Section 33 08 11, pipeline disinfection shall proceed as follows:

1. All pipelines, valves, hydrants, service laterals, fittings, tanks and other surfaces exposed to water shall be disinfected in accordance with AWWA C651, except as modified herein.
2. After flushing, disinfect all mains and services with or chlorine compound solution made with liquid chlorine, calcium hypochlorite in solution, or sodium hypochlorite solution, which shall be water mixed and introduced into mains to produce dosage of 50 to 100 mg/l in all sections of pipeline and appurtenances.
3. Treated water shall be retained within system for at least 24-hours and shall produce at end of retention period chlorine residual ≥ 25 mg/l in all sections disinfected.
4. If tests are not satisfactory, provide additional disinfection as required until all tests are passed to Owner's satisfaction.
5. During disinfection process, operate all valves, hydrants, and other accessories.

6. Do not allow chlorinated water to remain in contact with internal waterway ports of pumps, valves, and sensor line assemblies for longer than necessary.
 7. After chlorination, flush water from line at its extremities until replacement water tests are equal chemically and bacteriologically to those of permanent source of supply.
 8. Placing of HTH capsules or powder in pipe sections during laying process will not be considered adequate disinfection.
 9. Keep adequate chlorine residual testing and indicating apparatus available on site during entire disinfection period. After final flushing, plug flushing fittings with devices intended for this purpose at pressure class of pipe.
 10. Where water main is coated, plugs and outlets shall be similarly coated.
- D. Dechlorinate and remove pollutants from water flushed from water mains in accordance with AWWA C655 and NPDES Permit applicable for Water Quality Region in which discharge occurs.
- E. Flushing water may be discharged to sanitary sewer system as alternative to discharging to storm drain, provided Contractor obtains and submits to Owner a copy of written permission to discharge from sanitary sewer owner including supplementary information described above under Submittals. Schedule discharges to sewers during off-peak periods as recommended by sewer owner.
- F. Bacteriologic Samples: On two consecutive days, take bacteriological samples and submit them to Owner's designated laboratory. Passing bacteriological tests on two consecutive days must be achieved prior to placing pipeline or facility in service. If initial chlorination fails to produce two consecutive days of passing bacteriological tests, repeat chlorination until two consecutive days of passing bacteriological tests are achieved.
- G. Samples of water for specified bacteriologic test shall be taken from each end of disinfected main (located downstream of point of introduction of chlorine disinfectant). For mains over 2,400-feet in length, AWWA C651 Section 5.1.1 requires additional samples be taken at intermediate points in such manner that at least one sample is taken for each 2,400-feet of main.
- H. If trench water has entered new pipeline during construction, or if, in opinion of Owner's Representative, excessive dirt or debris have entered new pipeline, AWWA C651 Section 5.1.2 requires bacteriological samples be taken at intervals of approximately 200 feet to extent such sampling is possible.
- I. Satisfactory bacteriological results shall be as follows:
1. No total or fecal coliform.
 2. Heterotrophic plate count less than 500CFU (colony forming units) per ml per AWWA C651 Section 5.1.4.
 3. Presence of chlorine residual.
- J. For non-pipeline facilities, samples shall be taken and tests conducted as stipulated in applicable AWWA standard for that type of facility.

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**SECTION 33 30 31
POLYVINYL CHLORIDE GRAVITY SEWER PIPE**

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of polyvinyl chloride (PVC) gravity sewer pipe and fittings.
- B. Do not use PVC gravity sewer pipe under any of the following circumstances:
 - 1. For force mains or pipelines where working pressure exceeds 10 psi.
 - 2. For applications with ketones, chlorinated hydrocarbons or aromatic solvents.
 - 3. For pipelines buried in soils containing organic solvents or petroleum products
 - 4. For exterior piping exposed to sunlight unless expressly designed for such exposure and advertised as such in Manufacturer's product literature.
 - 5. For pipe smaller than 4" diameter.
 - 6. For exterior piping exposed to sunlight.
 - 7. For pipeline exposed to changes in temperature where $\frac{3}{8}$ " per 100-ft per 10°F thermal expansion of PVC pipe cannot be accommodated.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 02 41 14: Paving Removal and Resurfacing
- H. Section 03 30 00: Cast-in-Place Concrete
- I. Section 31 05 50: Protecting Existing Utilities
- J. Section 31 23 00: Excavation and Fill
- K. Section 33 05 26: Utility Identification
- L. Section 33 08 31: Leakage and Infiltration Testing of Gravity Sewer Pipelines
- M. Section 33 39 13: Pre-Cast Concrete Manholes

1.3 System Description

- A. Furnish and install complete sewer pipe to limits shown on Plans including appurtenant connections in conformance with Manufacturer's installation requirements and compliance with applicable construction safety codes and standards.

1.4 Quality Assurance

- A. Contractor or subcontractor performing Work of this Section requiring fusion of fusion-bonded PVC pipe shall be licensed by Manufacturer or be Manufacturer of PVC pipe furnished.
- B. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- C. Pipe and fittings shall be produced by same Manufacturer

Manufacturer of pipe and fittings shall employ manufacturing methods and material formulations in use for at least 5 years.

- E. Owner or Owner's Representative shall be entitled to inspect pipes and witness manufacturing process.

1.5 References

- A. ASTM C1460 Shielded Transition Couplings for Use With Dissimilar DWV Pipe and Fittings Above Ground
- B. ASTM D1599 Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings
- C. ASTM D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- D. ASTM D1785 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- E. ASTM D2241 2241 Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe SDR Series
- F. ASTM D2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- G. ASTM D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- H. ASTM D2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- I. ASTM D2665 Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- J. ASTM D2729 Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- K. ASTM D3034 Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- L. ASTM D3212 Joints for Drain and Sewer Plastic Pipe Using Elastomeric Seals
- M. ASTM D4396 Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used in Nonpressure Applications
- N. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- O. ASTM F656 Primers for Buried PVC Pipe and Fittings
- P. ASTM F679 Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- Q. ASTM F1417 Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
- R. ASTM F1866 Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings
- S. California Green Building Standards Code (CALGreen Code)
- T. NSF/ANSI 14 Plastic Piping Components and Related Materials
- U. SSPWC Standard Specifications for Public Works Construction (Greenbook)
- V. UNI-B-5 Uni-Bell Recommended Practice for the Installation of PVC Sewer Pipe

1.6 Submittals

- A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Qualifications of Fusion-Bonding Subcontractor	Submit evidence of factory authorization or licensing by Manufacturer of lining system to install product	
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements.	
Certificate of Compliance (Schedule 40 DWV Pipe)	Deliver with pipe affidavit from pipe Manufacturer certifying compliance with requirements of ASTM D1785 and Contract Documents and copy of test data results.	
Certificate of Compliance Type PSM Pipe	Deliver with pipe affidavit from pipe Manufacturer certifying compliance with requirements of ASTM D3034 or ASTM F679 and Contract Documents and copy of test data results.	
Warranty	Furnish one-year warranty from date of final acceptance	

For fusion-bonded PVC pipe, furnish the following additional submittals.

SUBMITTAL	DESCRIPTION	
Qualifications of Fusion-Bonding Subcontractor	Submit evidence of factory authorization or licensing by Manufacturer of lining system to install product	
Installation Instructions	Submit Manufacturer's published instructions for installation of fusion-bonded PVC pipe including recommended minimum bending radius, recommended maximum safe pull force and instructions for proper handling, storage, installation, tapping and testing of fusion-bonded PVC pipe.	
Warranty	Furnish one-year warranty from date of final acceptance	

- C. Refer to Section 01 33 00 for definition of requirements for catalog data, installation instructions, and certificates of compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Manufacturer's instruction and warranty requirements for delivery, storage and handling of PVC gravity sewer pipe and fittings shall be strictly followed.

1.8 Unit Prices

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
PVC Schedule 40 Drainage Waste and Vent (DWV) Pipe	Carlton Div Lamson & Session Co	Beachwood, OH
	Charlotte Pipe and Foundry Company "DWV"	Charlotte, NC
	Diamond Plastics Corporation	Grand Island NB
	North American Pipe Corporation	Houston, TX
	Pacific Plastics	Brea, CA
	Vinyltech Corp.	Phoenix, AZ
	Accepted equal	
PVC Sewer Pipe, Fittings, Couplings, and Gaskets 4"-15"	Carlton Div Lamson & Session Co	Beachwood, OH
	North American Specialty Products, LLC	
	Charlotte Pipe and Foundry Company "DWV"	Charlotte, NC
	Diamond Plastics Corporation	Grand Island NB
	North American Pipe Corporation	Houston, TX
	Pacific Plastics	Brea, CA
	Vinyltech Corp.	Phoenix, AZ
Accepted equal		
PVC Sewer Pipe, Fittings, Couplings, and Gaskets 18"-30"	Carlton Div Lamson & Session Co	Beachwood, OH
	Accepted equal	
Neoprene Stoppers	Gladding McBean, Inc.	South Gate, CA
	Mission Rubber Company "T-Cone"	Corona, CA
	Pacific Clay Pipe	Corona, CA
	Accepted equal	
Transition Couplings for Laterals 4"-8"	Gladding McBean, Inc.	South Gate, CA
	Mission Rubber Company "Band-Seal"	Corona, CA
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Transition Couplings for Sewers 4"-27"	Mission Rubber Company "MR02"	Corona, CA
	Accepted equal	
Sewer Saddles	Mission Rubber Company "T-Flex"	Corona, CA
	Accepted equal	
Buried Pipe Identification Tape	Calpico, Inc.	South San Francisco, CA
	Terra Tape Division Reef Industries	Houston, TX
	Accepted equal	

2.2 **Materials**

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Adhesives and solvent welding materials used on Work shall comply with VOC limits set forth in Section 5.504.4.1 of CALGreen Code.
- C. PVC Schedule 40 drainage waste and vent (DWV) pipe may be used to temperatures of 140°F and shall be constructed of the following materials:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Pipe	Standards	ASTM D1785
	Material	ASTM D1784 Cell Class 12454 Virgin rigid PVC Conform to NSF 14
		Marking
	Show ASTM standard complied with	
	Show nominal pipe diameter.	
	Show SDR	
	Show material, and PVC cell classification	
	Show coded number identifying Manufacturer, plant, machine, date and shift on which pipe was extruded.	
		Mark pipe with home mark on spigot to indicate proper penetration when joint is made
Size	As shown on plans.	
Wall Thickness	Schedule 40	
Joints	Restrained Style	Solvent-welded socket joints
Solvent Cement	Material	ASTM F656 Primer
		ASTM D2564 Solvent Cement
Fittings	Standards	ASTM D2665
	Material	ASTM D1784 Virgin rigid PVC Cell Class 12454 Conform to NSF 14
		Color

- D. PVC solid-wall gravity sewer pipe, fittings, couplings, and gaskets may be used to temperatures of 140°F and shall be constructed of the following materials:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Pipe	Standards	Pipe sizes 4"-15" ASTM D3034
		Pipe sizes 18"-27" ASTM F679

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
	Material	ASTM D1784 Cell Class 12454B, 12454C, , 13364-A, or 13364-B Virgin rigid PVC Conform to NSF 14
	Marking	Mark pipe at 5' maximum intervals.
		Mark ASTM standard complied with
		Show nominal pipe diameter.
		Show SDR
		Show material, and PVC cell classification
		Show coded number identifying Manufacturer, plant, machine, date and shift on which pipe was extruded.
		Mark pipe with home mark on spigot to indicate proper penetration when joint is made
	Size	As shown on plans.
	Wall Thickness	Pipe sizes 4"-15" = SDR 26, unless otherwise specified.
		Pipe sizes 18"-30" = T-1, unless otherwise specified.
Standard Lengths	12.5' and 20' with option to supply up to 15% of pipe delivery in random lengths	
Pipe Stiffness	46 psi per ASTM D2412	
Type of construction	Solid wall with smooth interior and exterior surfaces	
Joints	Type	Integral bell gasketed joint meeting ASTM D3212
	Joint Gasket	Synthetic elastomer per ASTM F477 Factory installed in belled end of pipe and fittings
Fittings and Couplings	Standards	Pipe sizes 4"-15" ASTM D3034
		Pipe sizes 18"-27" ASTM F679
	Material	ASTM D1784 Cell Class 12454-B, 12454-C, or 13343-C Virgin rigid PVC Conform to NSF 14
	Markings	Show nominal pipe diameter
		Show material, and PVC cell classification
		Show coded number identifying Manufacturer, plant, machine, date and shift on which pipe was extruded.
	Show service designation or legend	

E. Provide identification for buried PVC gravity pipe in the following manner:

PIPE CONTENTS	IDENTIFICATION/ WARNING/ LOCATING	TYPE	MATERIALS/METHOD
Sewage	Pipe Contents Identification	Pipe color	Green
		AND	
		Stenciling	Green stenciling marked on pipe stating "SEWER"
			$\frac{5}{8}$ "-high letters
			Repeated at 1' intervals
		OR	
		Identification Tape	2"-high letters reading "CAUTION: SEWER"
			Color = green with white letters
			Attached to top of pipe with adhesive tape

PIPE CONTENTS	IDENTIFICATION/ WARNING/ LOCATING	TYPE	MATERIALS/METHOD
			Specification – See Section 33 05 26
	Pipe Warning and Locating	Warning and Locating Tape	2"-high letters reading "CAUTION: SEWER BURIED BELOW"
			Color = green with white letters
			Place in pipe trench 18" above pipe
			Specification – See Section 33 05 26
			Metallic strip that can be registered by a magnetic field locating device
		Locating Wire	In lieu of installing metallic warning tape; non-metallic warning tape and 10-gauge copper wire attached to top of pipe may be used.

- F. Socket and spigot configurations for fittings and couplings shall be compatible to those used for pipe.
- G. Pipe not installed within 120 calendar days of latest certification test shall not be used without prior approval from Owner’s Representative.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install PVC gravity sewer pipe before submitting shop drawings or ordering materials. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Grade trench bottom to line and grade to which pipe is to be laid, with allowance for pipe thickness. Dig bell holes or coupling holes of ample dimension in trench bottom at locations of each joint to facilitate joining. Remove hard spots that would prevent uniform bedding thickness. Before laying each pipe section, check grade with straight-edge and correct any irregularities found. Trench bottom shall form continuous and uniform bearing and support for pipe at every point between bell or coupling holes, except grade may be disturbed for removal of lifting tackle.
- C. At each joint location dig bell (joint) holes in trench bottom and at sides to permit visual inspection of entire joint.
- D. Provide and maintain means and devices at all times to remove and dispose of all water entering trench during pipe-laying operations. Keep trench dry until pipe-laying and jointing are completed.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. The following installation standards shall be followed:
 1. Manufacturer’s installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations

3. Applicable building, fire and plumbing code requirements
 4. ASTM D2321 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 5. ASTM F1668 Construction Procedures for Buried Plastic Pipe
 6. UNI-B-5 Uni-Bell Recommended Practice for the Installation of PVC Sewer Pipe
- C. Refer variances between Manufacturer's installation instructions, published installation standards and Contract Documents to Owner's Representative.
- D. Protect water and recycled water systems by constructing sewers with separations and materials described in Section 31 05 50.
- E. Install PVC gravity sewer pipe as follows:
1. Install PVC gravity sewer pipe and fittings per ASTM D2321 and Uni-Bell Recommended Practice for the Installation of PVC Sewer Pipe and as herein specified.
 2. Inspect each pipe and fitting before lowering pipe or fitting into trench.
 3. Use proper care to prevent damage in handling, moving, and placing pipe. Hoist pipe with forklift, crane, backhoe or other handling equipment to prevent damage or reduction of pipe service life. Use cloth belt sling or continuous fiber rope to prevent scratching pipe. Lower (do not drop) pipe from truck. Dropped pipe will be rejected.
 4. Install PVC gravity sewer pipe and fittings to tolerances recommended by Manufacturer. Unless otherwise shown, install PVC gravity sewer pipe and fittings at locations and grades shown on Plans using precision gauges and levels.
 5. No longitudinal bending shall be allowed in installation of PVC gravity sewer pipe. Install all deflections at sewer manholes or by using joints and fittings specifically designed for use with PVC pipe of specified SDR.
 6. Install pipe without break, upgrade from structure to structure, with bell ends of pipe upgrade. Install pipe to line and grade given so as to form close concentric joint with adjoining pipe and prevent sudden offsets of flow line.
 7. Clean interior of pipe and fittings of all dirt and superfluous materials of all description immediately prior to installing pipe. Wipe joints clean of all dirt and foreign matter and apply accepted lubricant to mating surfaces of pipe to be joined.
 8. Insert spigot end to proper depth of socket as indicated by home mark on pipe. Spigot end shall slide into bell end without displacement of rubber gasket.
 9. Close open end of pipe with tight-fitting cap or plug to prevent entrance of foreign matter into pipe at all times when pipe installation is not in progress. These provisions shall apply during noon hour as well as overnight.
 10. Do not use pipeline to drain water that has infiltrated into trench. Maintain inside of pipe free from foreign materials and in clean and sanitary condition until its acceptance by Owner.

11. After joint assembly. Bring bedding material up to pipe spring line. Place bedding material on each side of pipe. Do not drop rock or crushed gravel directly onto pipe. Walk and tamp bedding material into final position at pipe spring line and continue to top of pipe.
12. Then place bedding material to top of pipe zone and compact to specified pipe zone compaction.

F. Install wyes and saddles as follows:

1. Unless otherwise specified, incline branch of wye fittings upward at angle $\leq 45^\circ$ from horizontal. Place no wye closer than 5' in downstream side to centerline of any structure. Do not install wyes or tees back to back. There shall be $\geq 4'$ between each branch fitting. Place support of crushed rock or gravel under every wye branch when installed.
2. All wyes shall be $\geq 6"$ diameter. If existing laterals $\leq 4"$ are encountered, or if existing VCP other non-PVC laterals are encountered, install appropriate reducers or transition hardware to connect to new 6" PVC wye.
3. Install all saddle connections into existing sewer lines with a wye saddle. Sewer to be saddled shall be scored to approximate shape of wye or tee and cut by mechanical hole cutters, or by keyhole or sabre saw. Cleanly machine tap holes and complete work by hand to provide true and neat opening for wye or tee saddle. Replace or repair any pipe damaged during operation.
4. Mount saddles on pipe using solvent cement in conformance with requirements of ASTM D2564 or by gaskets with all stainless steel straps. If solvent-welded saddle is used, secure saddle to main with stainless steel straps or with saddle clamps. After connection has set long enough for solvent cement to cure, encase fitting with Class B portland cement concrete.
5. Keep all chips, dirt, solvent cement, mortar and concrete out of sewer being saddled. Flush, clean, and ball reach of sewer main saddle if so directed by Owner's Representative.
6. In lieu of saddle connection, wye connection may be made in existing sewer by cutting sewer and installing wye and 2 sewer clamps with stainless steel bands.

G. Connect PVC sewer pipe to manholes using gasketed plastic manhole coupling to provide watertight connection.

H. Install service laterals as follows:

1. Join laterals to wye using $\frac{1}{8}$ bends.
2. Plug laterals with stopper in socket of last joint of lateral. Seal stopper securely in place to withstand internal pressure from leakage tests but also in such manner to allow removal without damaging socket.
3. Resurface over laterals in accordance with Section 02 41 14.
4. Mark location of lateral at upper end as directed by Owner's Representative. Unless otherwise directed, chisel letter "S" $1\frac{1}{2}"$ high on top of curb. If curb improvements do not exist, furnish and install 2"x2"x36" wood stake at end of service lateral. Paint top of stake white.

5. Restore curbs, gutters, paving, driveways, lawns, shrubs, fences, retaining walls, sprinklers landscaping and other improvements damaged by Contractor's operations in accordance to preconstruction conditions.
6. For sewer replacement projects, reconnect all active or functional laterals as required by Owner.

3.3 **Field Quality Control**

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pipe	Horizontal Alignment	1" maximum horizontal deviation from plan alignment	Mirror each straight section of pipe	Contractor	Contractor
	Vertical Alignment	¼" maximum horizontal deviation from plan grades	Mirror each straight section of pipe	Contractor	Contractor
	Pipe Separations	Section 31 05 50.	All new pipe	Contractor	Contractor
	Pressure Test for Leakage and Infiltration	Section 33 08 31	1 test per run of pipe	Contractor	Contractor
	Mandrel Test for Obstructions and Pipe Deflections	SSPWC Section 306-1.2.12 (See Below)	1 test per run of pipe	Contractor	Contractor
	Video Inspection	Video entire new alignment. Submit copy of video to Owner	All new pipe	Contractor	Contractor
Laterals	Horizontal Alignment	1" maximum horizontal deviation from plan alignment	Survey location of each lateral	Contractor	Contractor
	Vertical Alignment	¼" maximum horizontal deviation from plan grades	Survey location of each lateral	Contractor	Contractor
Sewer System	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed Literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

B. Perform mandrel test after placement and compaction of backfill, installation of utilities, pipe testing, and prior to placing of permanent paving. Correct all obstructions encountered during mandrel test at no additional cost to Owner

3.4 **Cleaning**

A. Prior to testing, thoroughly clean sewers from structure to structure with hydro-flush equipment or sewer scrubbing ball. Remove all debris and trash from each structure. Disinfection of sewer is not required.

END OF SECTION

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**SECTION 33 39 13
PRE-CAST CONCRETE MANHOLES**

PART 1 - GENERAL

1.1 Work Included

- A. This section includes materials, testing, and installation of pre-cast concrete manholes.

1.2 Related Work

- A. Section 01 33 00: Submittal Procedures
- B. Section 01 40 00: Quality Requirements
- C. Section 01 61 00: Common Product Requirements
- D. Section 01 65 00: Product Delivery Requirements
- E. Section 01 66 00: Product Storage and Handling Requirements
- F. Section 01 73 00: Execution
- G. Section 31 23 00: Excavation and Fill
- H. Section 31 23 33: Trenching and Backfilling
- I. Section 03 20 00: Concrete Reinforcing
- J. Section 03 30 00: Cast-in-Place Concrete
- K. Section 07 92 00: Joint Sealants

1.3 System Description

- A. Furnish and install complete pre-cast concrete manholes including cast-in-place concrete bases, and appurtenant structural and mechanical mountings or connections required for compliance with Manufacturer’s installation requirements and compliance with applicable building codes and standards.
- B. Manhole dimensions shown on plans are interior dimensions.

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Manhole	Watertightness	Visual inspection and leakage test	Once per manhole section	Contractor	Contractor

1.5 References

- A. ASTM A48 Gray Iron Castings
- B. ASTM A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- C. ASTM C478 Pre-cast Reinforced Concrete Manhole Sections
- D. ASTM C143 Test Method for Slump of Hydraulic Cement Concrete
- E. ASTM C478 (AASHTO M199) Precast Reinforced Concrete Manhole Sections
- F. ASTM C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
- G. ASTM D4101 Polypropylene Injection and Extrusion Materials

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Required per shop drawing requirements.	.
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation instruction requirements.	
Certificate of Compliance	Submit coating and/or lining system and application certification per certificate of compliance requirements.	
Test Record Transcripts	Submit for factory tests per test record transcript requirements.	
Warranty	Furnish one-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for shop drawings, catalog data, certificates of compliance, and installation instructions.

1.7 Delivery, Storage and Handling

A. Refer to Sections 01 65 00 and 01 66 00 for delivery storage and handling requirements.

B. Manufacturer’s instruction and warranty requirements for delivery, storage and handling of pre-cast concrete manholes shall be strictly followed.

1.8 Unit Prices

A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant thereto.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Pre-Cast Concrete Manhole Sections	NOV Ameron	Rancho Cucamonga, CA
	Associated Concrete Products, Inc.	Santa Ana, CA
	Jensen Precast	Sparks, NV
	Olson Precast Company	Rialto, CA
	Southwest Concrete Products	Ontario, CA
	Accepted equal	
Damp-proofing Agent	Euclid Chemical Company	Cleveland, OH
	W. R. Meadows Inc. (Sealmastic)	Hampshire, IL
	Sonneborn Div. Chemrex Inc. (Hydrocide 600)	Shakopee, MN
	Accepted equal	
Manhole Covers – Cast Iron	Alhambra Foundry Company Ltd.	Alhambra, CA
	Long Beach Iron Works, Inc.	Long Beach, CA
	Neenah Foundry	Neenah, WI
	South Bay Foundry	National City, CA
	U S Foundry and Manufacturing Corp	Medley, FL
	Accepted equal	

2.2 Materials

A. Refer to Section 01 61 00 for basic requirements for products and materials.

B. Pre-cast concrete manholes shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Pre-Cast Concrete Manhole Sections	Pre-Cast concrete	ASTM C478, class A concrete
	Steel Reinforcement	ASTM A 615
Manhole Frames and Covers	Gray Cast Iron	See Section 05 60 00
Manhole Base	Cast-in-Place Concrete	See Section 03 30 00, class A2 (premium non-structural) concrete except slump shall not exceed 2 inches and aggregate shall not exceed ¾ inches Base shall extend at least 10 inches below bottom of lowest pipe and 6 inches above top of largest pipe.
Pipe Penetrations	Watertight Flexible Pipe Connector or Ring-Type Seal	Incorporate watertight flexible pipe connector or ring-type seal per ASTM C923 Precast manholes shall use either integrally cast embedded pipe connector, or boot-type connector installed in circular block out opening per ASTM C 923. Connections to existing manholes shall use boot-type connector per ASTM C 923 installed in cored opening. Cast-in-place bases shall incorporate ring-type seal on pipe to be embedded in concrete.
Manhole Frames and Covers	Gray Cast Iron	ASTM A48 Class 30 or 35 Design for H-20 highway wheel loading Incorporate pick-hole for lifting purposes Castings with blisters, blowholes and shrinkage are not permitted. Clean all castings. Grind and finish cover to fit in its frame without rocking.
	Coating	Dip twice in asphalt or coal tar and oil mixture at temperature between 290°F and 310°F to form firm and tenacious coating
Manhole Steps	Not required	
Joint Sealant	Mortar	One part Portland cement to two parts well-graded sand passing No. 8 sieve per Section 03 30 00.
	Plastic Sealing Compound	See Section 07 92 00

C. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Pre-Cast Concrete Manhole Sections	Minimum Diameter	48 inches unless specified otherwise on plans
	Design Surcharge and Lateral Earth Pressure	AASHTO H-20 Loading
	Minimum 28-day Compressive Strength f_c	4500 psi
	Steel Reinforcing Yield Strength f_y	60 ksi
Reinforcing of "Non-reinforced Manholes"	Hoops of No. 4 wire, minimum, to be cast into each unit at adequate places as a precautionary measure for handling	
Reinforcing of "Reinforced Manholes" (where plans or standard details detail reinforcing)	Steel Reinforcing	As shown on plans, but no less than hoops of No. 4 wire
	Minimum Cover	See Section 03 20 00
Manhole Wall Section	Minimum nominal shell thickness shall be 1/8 of the internal diameter of riser or largest cone section. Fabricate eccentric taper sections and standard cylinder units of proper internal diameter.	
Damp-Proofing	Water Level	See Geotechnical Report
	Damp-proofing Requirement	Apply damp-proofing material to manhole exterior and as directed by Owner's Representative on manholes / wet wells with base at or below water

ITEM	DESCRIPTION	
		table or where moisture or seepage is evident in trench.
Factory-Applied Lining	PVC Lining	See Section 33 01 39
	Flexible Coating Systems – Polyurethane-Based	See Section 33 01 38
Manhole Frames and Covers	Loading	AASHTO H-20 Loading
	Diameter	36 inches
	Manhole Cover Marking	"SCWD SEWER" into cover No other lettering on cover top is permitted
Drop Manholes	Line with epoxy or PVC liner per Section 33 01 39	

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install pre-cast concrete manhole before submitting shop drawings or ordering. Many locations are fixed and cannot be moved to accommodate pipe manufacturing or laying. If necessary, special lengths shall be provided to meet manhole location requirements. If possible, make minor changes in dimensions, alignments, and locations as approved by Owner to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Refer to Section 31 23 00 / 31 23 33 for open trench requirements.
- C. Furnish and install precast concrete manholes at locations shown on Plans and Submittals.
- D. The following installation standards shall be followed:
1. Manufacturer's installation and warranty requirements
 2. Applicable OSHA and Cal OSHA regulations including confined space requirements
 3. Applicable building code requirements
- E. Refer variances between the above documents and Contract Documents to Owner's Representative.
- F. Install pre-cast concrete manholes to tolerances recommended by Manufacturer. Unless otherwise shown, install pre-cast concrete manholes true, plumb, and level using precision gauges and levels.
- G. Do not undertake any work inside an existing manhole that is part of a sewage system in service until all tests and safety provisions of Article 4, Section 1532 "Confined Spaces" State of California Construction Safety Orders have been made.
- H. Core drill new connections through walls and base of existing manholes where stubs have not been provided.
- I. Manhole base construction shall occur as follows:
1. Excavate area large enough to accommodate structure, permit grouting of opening, and accommodate backfilling and compaction.

2. Place manhole base concrete against undisturbed soil.
 3. Locate and set manhole stubs and sewer main of sizes shown on Plans prior to placing base concrete. Invert elevations of connecting sewers may vary depending on pipe sizes. Set crown elevations of all pipes level with crown elevation of largest pipe unless otherwise indicated on Plans.
 4. Set manhole stubs and sewer main before placing manhole base.
 5. Recheck for alignment and grade before concrete hardens.
 6. Extend manhole base minimum of 12 inches below bottom of lowest pipe.
 7. Handwork invert to provide smooth and accurately-shaped channels conforming in size and shape to lower portions of inlets and outlets. Channels may be formed in base or may consist of half-sewer tile laid in base. Channel diameter shall not exceed outside pipe diameter.
 8. Vary channel uniformly in size and shape from inlet to outlet. Construct channel higher than pipe as shown on Plans.
 9. Construct all transitions smoothly and of proper radius to give uninterrupted transition of flow. Shape concrete base with wooden float and finish with hard-steel trowel prior to concrete setting.
 10. Allow bases to set at least 24 hours before manhole construction is continued. In certain critical situations setting time may be reduced upon Owner's Representative's approval.
 11. If additional mortar is required in manhole base after initial set has taken place, prime surface to receive mortar and mix mortar with concrete adhesive in amounts and proportions recommended by Manufacturer and as directed by Owner's Representative to secure as chip-proof a result as possible.
- J. Pipe stubs, stoppers and bulkheads shall be constructed as follows:
1. Furnish and install sewer pipe and stubs at the locations shown on the Plans.
 2. Plug stubs five feet or less in length with stoppers.
 3. Plug stubs from inside an active manhole prior to beginning new construction of a sewer main from an existing manhole. Plug shall remain in place until the new work has been completed and tested.
 4. Seal inlet to existing tie-in manholes with plug to prevent accidental use of new sewer prior to completion and acceptance. Remove plug at time of final acceptance or as directed by Owner's Representative.
 5. Install brick and mortar bulkheads at upstream end of all unused stub channels over 5 feet in length to prevent creation of septic condition from ponding of sewage and debris in unused channels, until such time as stub is connected and normal sewage flow can occur.
- K. Manhole wall sections, cones and grade rings shall be constructed as follows:

1. Do not set wall sections until inverts have been formed and finished, and bases have cured for specified time.
 2. Set each manhole wall section, cone, or grade ring in a minimum ½-inch thick bed of mortar to make a watertight joint.
 3. Set wall sections and cones perfectly plumb.
 4. Neatly point mortar on inside of manhole
 5. Use various heights of grade rings to bring top of manhole to finish grade as shown on Plans or as directed in the field by Owner's Representative.
 6. Limit maximum height of grade rings to 18 inches unless otherwise directed by Owner's Representative.
- L. Apply joint sealants as follows:
1. Band joints inside and out when applying mortar mix
 2. When groundwater is encountered or in "dry" conditions with Owner's Representative's permission, install pre-formed, cold-applied, ready-to-use plastic sealant uniformly along joint without allowing gaps in sealing compound "rope".
- M. Install select backfill around manholes consisting of clean sand and consolidate backfill to 95% relative density per Section 31 23 00 / 31 23 33 unless otherwise shown on Plans.
- N. Apply manhole frames and covers as follows:
1. In existing pavement or traveled way of existing road shoulder, place flush with existing surface.
 2. Outside limits of traveled shoulder, but not in roadside ditch, place 1/10 foot above existing ground surface.
 3. In existing roadside ditch or "offsite" easement, place approximately 18 inches above existing ground surface or as directed by Owner's Representative.
 4. If directed by Owner's Representative, place manhole sections below finished grade in travelways and landscape areas so as not to interfere with construction, set permanent cover below grade to seal manhole, then after finish surfacing is completed, add grade rings to raise manhole cover to finish grade.
 5. Secure frames to top pre-cast manhole shaft or grade ring with cement-mortar bed and fillet.
 6. Install covers following all necessary cleaning and scraping of foreign materials from the frames and covers to ensure satisfactory fit.
 7. After final paving or grading, construct Class A concrete ring around manhole frames that are flush with surface as shown on Plans.

3.3 Field Quality Control

- A. Manholes and appurtenances shall be watertight and free from infiltration.

Plug all inlets and outlets with acceptable stoppers or plugs and fill the manhole with water to limits shown above. Any evidence of leakage as a result of testing shall be repaired to the satisfaction of the Owner's Representative.

- C. Stop any manhole leaks that may be observed, even if leakage is less than amount specified above.
- D. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Ready-Mix Concrete	Slump	ASTM C143	1 minimum each batch	Owner	Contractor
Sewer Main and Stubs	Alignment and grade	Survey	1 test prior to placing concrete	Contractor	Contractor
Manhole Assembly	Installation & Leakage (may be tested in conjunction with sewer pipe tests or individually upon completion of manhole construction)	Visual inspection of finished installation and leakage test as follows: 1. Fill manhole with water to an elevation 1 foot below start of cone section (minimum depth of 4 feet and maximum of 20 feet). 2. Allow water to stand in manhole for 1 hour to allow manhole material to reach maximum absorption. 3. After one hour, refill manhole with water to original depth. 4. Record drop in water surface after 15 to 60 minutes, as directed by Owner's Representative. 5. Maximum allowable drop in the water surface shall be 1/2-inch for each 15-minute period of testing.	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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