

**STANDARD SPECIFICATIONS FOR THE
FURNISHING OF MATERIALS AND THE CONSTRUCTION
OF
WATER and SEWER FACILITIES**

**EAST VALLEY WATER DISTRICT
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SECTION I GENERAL REQUIREMENTS

1-01 DEFINITIONS

The word "District" shall mean the East Valley Water District.

The word "Board" or words "Board of Directors" shall mean the Board of Directors of the District.

The words "District Engineer" shall mean a civil engineer registered as such in the State of California appointed by the Board acting either directly or through his properly authorized agents, assistants, inspectors and superintendents.

The word "Contractor" shall mean the person, persons, partnership or corporation duly licensed as such in the State of California to enter into a contract for the performance of the work required.

The word "Applicant" used herein shall mean the person or persons and duly authorized representatives of the party or parties requesting an extension or an addition to the District's water system.

The word "Plans" shall refer to the Water System Construction Plans that have been prepared by the Applicant's engineer and approved by the District.

The word "Greenbook" shall refer to the "Standard Specifications for Public Works Construction, latest edition".

1-02 CONDITIONS

On all questions relating to the acceptability of the material, machinery or plant equipment, classifications of material or work, the proper execution, progress or sequence of the work, quantities and the interpretation of the specifications or drawings, the decision of the District shall be final.

The Contractor shall obtain copies of and comply with all applicable current statutes, laws, ordinances, rules, regulations and specifications of the United States Government, the State of California, the County of San Bernardino, and any other governmental agencies having jurisdiction and shall make application for all required permits and bear cost of same.

Street cut permits for the construction of the domestic water system shall be obtained from the appropriate governmental agencies, prior to construction.

In the event of conflict between the requirements of these Specifications and the Requirements of the permits, the requirements of the permits shall govern.

The Contractor shall furnish to the District copies of all required permits and licenses prior to initiation of the work. Upon completion of the work, the Contractor shall supply

to the District, a letter of approval from the governing body having jurisdiction that the Contractor has met the requirements and conditions of the permits or licenses.

1-03 SUPERVISION AND INSPECTION

The District Engineer shall decide within the provisions of the specifications all questions which may arise concerning the quality or acceptance of materials furnished and work performed. The Contractor shall be solely and completely responsible for conditions on the job site, including safety to all persons and property during performance of the work. This requirement shall apply continuously and completely and not be limited to normal working hours.

1-04 CAL-OSHA SAFETY CODE

All work shall be done in a manner that complies with all Cal-Osha Title 8 Safety Codes.

1-05 DEFECTIVE WORK OR MATERIALS

No work which is defective in its construction or deficient in any of the requirements of these specifications will be considered as accepted in consequence of the failure of any inspector connected with the work to point out said defects or deficiency during construction. The Contractor shall correct any imperfect work, without compensation from the District, before final acceptance of the work by the District.

All materials not conforming to the requirements of these specifications shall be considered as defective. They shall be rejected, whether in place or not, and shall be removed immediately from the site of the work by the Contractor at his expense. No rejected material, the defects of which have been subsequently corrected, shall be used until approval in writing has been given by the District Engineer.

1-06 MAINTENANCE OF EXISTING IMPROVEMENTS

Unless otherwise indicated in the plans or in these specifications, or unless otherwise cared for by the owner of a public utility or franchise, all water, gas, oil or irrigation lines, structures or house laterals, in place, and other subsurface structures or lines, shall be maintained by the Contractor and shall not be disturbed, disconnected or damaged by him during the progress of the work. Should the Contractor in the performance of the work disturb, disconnect or damage any of the above, all expenses, of whatever nature arising from such disturbance or in the replacement or repair thereof shall be borne of the Contractor.

1-07 AS-BUILT DRAWINGS

The Contractor shall keep a separate set of construction plans upon which he shall designate as-built conditions using sufficient sketches to properly delineate locations of valves, hydrants, services and other pertinent items. All measurements shall be accurate within one foot.

Prior to filing of the Notice of Completion, the Contractor shall certify the as-built information in a letter transmitting the plans and sketches to the District.

SECTION 2
GENERAL MATERIALS

2-01 CRUSHED STONE BEDDING

Crushed rock bedding at locations designated by the District Engineer and required by the Contractor shall be sound, crushed aggregate of good stability, free from lumps or balls of clay, with 100% passing through a 3/4 inch U.S. Standard Series sieve and 0 to 20% passing a No. 4 mesh sieve. All crushed rock shall be approved by the District Engineer.

2-02 SAND BEDDING

Imported sand used in the pipe bedding zone (pipe zone and pipe base) shall conform to the California Standard Specifications for Public Works Construction, Section 200-1.5.1 and shall meet the following gradation:

Sieve Size	Percent Passing by Weight
3/8 - inch	100
No. 4	75 – 100
No. 30	12 – 50
No. 100	5 – 20
No. 200	0 – 11

Minimum sand equivalent shall be 30 for natural imported material and shall be 40 for screened recycled materials per ASTM D 2419.

2-03 CONCRETE

1. Portland Cement shall conform to ASTM Standard Specification C150, latest revision, entitled "Portland Cement", and shall be Type I or II. Cement in containers that have been broken in shipment or handling, may be used only if approved by the District.
2. Sand shall consist of well-graded, natural or artificially washed and that has clean, hard, strong matter. Sand shall not contain over three (3) percent clay or silt by weight.
3. Coarse Aggregate shall consist of gravel, or a combination of gravel and crushed rock, having clean, hard, tough, durable and uncoated pieces free from injurious amounts of soft, friable, thick, elongated pieces, alkali, oil, organic or other deleterious substances. Aggregate shall be properly graded, from 1/4 inch to 3/4 inch in size, to secure the required compressive strength concrete.
4. Water shall be clean, free from injurious amounts of oil, acids, organic matter or other injurious substance.
5. Mixing - Concrete required for thrust blocks and other water system items shall

be composed of the following relative volumes of materials:

- 1 cubic foot of cement (1 sack, 94 lbs.)
 - 2 cubic feet of sand (dry, loose)
 - 3 cubic feet of coarse aggregate
6. Only sufficient water shall be used to produce a concrete with a slump not exceeding 5 inches, as determined by ASTM Standard Method of Test, C143m latest revision. The total volume of sand and coarse aggregate measured separately shall not exceed 6 cubic feet per sack of cement. Concrete shall be placed within 30 minutes of mixing and no re-tempering will be permitted. Batch slips shall be furnished by the Contractor when requested by the District, if Transit Mix Concrete is supplied. Unless otherwise specified, all concrete shall have a 28-day compressive strength of 2,500 psi minimum and shall contain 5.5 sacks of cement per cubic yard of concrete.

2-04 STEEL CASING FOR BORED CROSSINGS

1. Steel pipes shall be in accordance with EVWD Standard Drawings W-120 and S-113 or in accordance with the requirements of the governing agency whichever is greater, and shall be manufactured in accordance with American Water Works Association (AWWA), Standard C200, latest revision entitled "AWWA" Standard for Steel Water Pipe 6 Inches and Larger." The casing shall be round and straight, free from protruding bolts, rivets or welds, and shall have an inside diameter of not less than the maximum diameter of the sewer plus six (6) inches. The ends of the Steel Casing Pipe to be jacked or bored into place shall be prepared to withstand pressures created by jacking the pipe into place.

SECTION 3
MATERIALS FOR WATER CONSTRUCTION

3-01 GENERAL

The Contractor shall furnish Cement Mortar Lined and Cement Mortar Coated Steel Pipe, Ductile Iron Pipe or C900 PVC Water Pipe. All material in the pipeline work shall be new and unused. All material in the pipeline work shall be of the selected type of pipe. All materials shall be suitable for 150 psi working pressure unless specified otherwise. All pipelines shall have a identification tape and tracer wire laid with the pipe as shown in EVWD Standard Drawing no. W-121.

3-02 CEMENT MORTAR LINED AND COATED STEEL PIPE

A. Material

1. Pipe shall conform to AWWA C200, AWWA M-11, latest edition. Steel shall be ASTM A36, ASTM A1011 or A1018, Grade 36, having a 0.25% maximum carbon content.
2. Steel cylinder thickness shall be as shown on the plans, but in no case, shall the pipe thickness be less than the following.
 - a) For pipe less than 30-inches in diameter: Steel cylinder wall thickness shall be a minimum of 10 gauge (0.1345 inches) for straight runs of distribution and transmission pipe.
 - b) For pipe 30-inches in diameter and larger: Steel cylinder wall thickness shall be a minimum of 1/4-inch (0.2500 inches) for straight runs of distribution and transmission pipe.
 - c) For all pipe, regardless of the diameter: Steel cylinder wall thickness shall be 1/4-inch (0.2500 inches) within 10 feet on all sides of the following conditions.
 - i. Wherever the pipe is connecting to structures, vaults and other significant pipe appurtenances including, but not limited to, blow-offs, fittings, manways, PRV vaults, valve vaults, meter vaults, lift stations. Fittings shall include reducers, tees, and bends 45- degrees and greater. For grooved-end fittings, refer to the "Grooved-End Fittings" section herein for the pipe thickness requirements.
 - ii. Wherever the pipe is to be the installed or jacked inside pipe casings.
 - iii. Wherever pipe penetrations are required.

B. Cement Lining and Coating

Cement for cement-mortar lining shall be ASTM C150, Type II or V. Cement for cement-mortar coating shall be ASTM C150, Type V.

C. Fittings

1. Definition: A fitting shall be defined as a piece of pipe other than a straight full length joint. Elbows, manhole sections, reducers, and sections of pipe with outlets shall be considered fittings. Dimensions shall be per AWWA C208.
2. Pressure Rating: Fittings 4 through 10-inches in diameter shall be designed for 250 psi and conform to ANSI B16.9. Fittings 12-inches in diameter and larger shall comply with AWWA C208.
3. Materials: Material for fittings 4 through 10-inches shall comply with ASTM A234, Grade WPB. Material for fittings larger than 10-inches but less than or equal to 30-inches in diameter shall be the same as the pipe. Cement-mortar lining and I.D. dimensions shall be the same as the specified pipe.
4. Grooved-End Fittings: Fittings 24-inches diameter and smaller with grooved ends shall have square cut grooves, flexible type, with dimensions as shown in AWWA C606, Table 3. Steel wall thickness shall be standard weight, ANSI B36.10. Cement-mortar lining and I.D. dimensions shall be the same as for the specified pipe.
5. Welding Fittings: Welding fittings shall be standard weight, Tube Turns.

D. Flanges

Flanges shall be AWWA C207, Class D, flat face, except where Class E or Class F flanges are required.

E. Gaskets

1. Gaskets for Flanged Joints: Gaskets for flanged joints shall be 1/8-inch thick and be made of Ethylene Propylene Diene Monomer (EPDM), or synthetic fiber. Gaskets shall be suitable for a water pressure of 350 psi at a minimum temperature of 180°F. Gaskets shall be NSF 61 certified for potable water applications. For potable and non-potable water applications, gaskets shall be compatible with water that may have a chlorine residual of 25 mg/L.
2. Full Face Type Gaskets or Ring Gaskets for Flanged Joints: Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present.
3. Gaskets for Push-on, Mechanical, and Restrained Joints: Gaskets for push-on, mechanical, and restrained joints shall be synthetic or natural rubber in accordance with AWWA C111.
4. Manufacturers: Gaskets shall be Garlock 3000, 3760, 8314, and 98206; Klinger 4401, Tedit Style NA 1002, or U.S. Pipe Flange-Tyte.

F. Bolts, Nuts and Washers

1. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M, for bolts and ASTM A194, Grade 8M, for nuts. For grooved-end fittings, bolts shall be Type 316 stainless steel and conform to ASTM F593 or ASTM A183 and have a minimum tensile strength of 100,000 psi.

2. Washers shall be provided for each nut, shall be of the same material as the nut, and shall be installed adjacent to the nut, between the nut and the flange.
3. The length of each bolt shall be such that between 1/4-inch and 1/2-inch will project through the nut when drawn tight. Studs may be used instead of bolts only where approved by the District Representative.
4. Bolts for Flange Insulation Kits: Bolts and nuts for flange insulation kits shall conform to the same requirements as outlined in paragraph 2.F.1 above.

G. Flange Insulation Kits

Flange insulation kits suitable for the design pressure of the pipeline shall be provided where shown on the drawings.

H. Grooved End Couplings

Grooved-end couplings shall be ductile iron, ASTM A536, Grade 65-45-12 or greater. Bolts and nuts for couplings shall be type 316 stainless steel and shall conform to ASTM A193 and A-194. Gaskets shall be EPDM and shall conform to ASTM D2000. Couplings for pipe 24-inches in diameter and smaller shall be flexible type, square cut groove, per AWWA C606, and shall be Victaulic Style 77.

I. Outlets

1. Outlets 2-inches in Diameter and Smaller: Outlets of sizes 2-inches in diameter and smaller shall be of the "Thread-o-let" type, per AWWA Manual M-11, Figure 13.26. Outlets shall be 3,000 pound WOG forged steel per ASTM A105 or ASTM A216, Grade WCB. Threads shall comply with ASNI B2.1. Outlets shall be Bonney Forge Co. "Thread-o-let", Allied Piping Products Co. "Branch-let."
2. Outlets larger than 2-inches in Diameter: For outlets larger than 2-inches in diameter, flanged tees shall be used.

J. Length of Pipe Sections

Pipe sections shall be limited to 40 feet or less. For sections longer than 30 feet, spreader beams, and lifting straps shall be used to lift pipe sections at the third points.

K. Joints

1. Above Ground Joints: Joints above ground or in vaults and structures shall be flanged or grooved end, unless specifically indicated otherwise on the project plans.
2. Buried Joints: Buried joints shall be:
 - a) Bell-and-spigot lap welded.
 - b) Butt-strap joints. Closure pieces may also require butt-strap joints with "hand-holes" and threaded-steel plugs welded into place (for proper repair of the lining of the interior pipe joints.)
3. Grooved-End Joints: Grooved-end joints shall be flexible, square-cut grooved, per AWWA C606, Table 5.

L. Product Marking

Each length of straight pipe shall be plainly marked inside and out at the bell end to identify the design pressure or head, the steel wall thickness, the date of manufacture, and the proper location of the pipe item by reference to the layout schedule. For beveled pipe, the degree of bevel and the point on the circumference to be laid uppermost shall be shown.

M. Painting and Coating

1. General: Unless noted otherwise, buried pipe shall be cement-mortar coated per AWWA C205.
2. Exposed Pipe: Pipe located above ground or in vaults and structures shall be painted in accordance with Section 09900, Painting and Coating. Primer shall be shop applied.
3. Grooved-End Couplings: Grooved-end couplings shall be coated the same as the adjacent pipe.

N. Lining

Unless noted otherwise, pipe and fittings shall be cement-mortar lined per AWWA C205.

3-03 DUCTILE IRON (DI) PIPE

A. Material

1. AWWA Reference Standard: Ductile-iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A-21.51.
2. Minimum Wall Thickness: The minimum wall thickness for ductile-iron pipe shall be as specified in AWWA C150 for the design pressure class, and thickness Class 53 for flanged spools, unless indicated otherwise on the plans or in the Project Technical Specifications.
3. Joints: Unless otherwise called out on the plans or Project Technical Specifications, push-on type joints shall be used. The joint dimension and gasket shall be as specified in ANSI/AWWA C111/ A-21.11. All pipe joints shall be bonded to provide electrical continuity for corrosion monitoring and future cathodic protection.
4. Manufacturers: Ductile-iron pipe shall be as manufactured by American Cast Iron Pipe Company, Griffin Pipe Products Company, McWane Cast Iron Pipe Company/McWane Ductile, or U.S. Pipe and Foundry Company.
5. Restrained Joints: Where called for on the plans, pipe and fittings shall be restrained. Restrained joints shall be as specified in this Section and shall be one of the following types:
 - a) Flanged fittings.
 - b) Manufactured locking restraint pipe with fittings.
 - i. Acceptable products and manufacturers include: TR-Flex by U.S. Pipe & Foundry Company or Clow Water Systems, Flex Ring by American Cast Iron

Pipe, or Thrust-Lock by Pacific States Cast Iron Pipe Company.

- ii. Field welding of ductile iron restrained joint or ductile iron components is not acceptable.
- c) Mechanical Joints with Mechanical Joint Restraints.
- d) Push-on joint pipe with restrained harness assembly. Restraint of push-on joints shall only be used where specifically called for on the plans. Shop drawings reflecting every part, material and dimension of the restraint assembly shall be submitted to the District for approval.
 - i. Restraint systems using lugs integral to the pipe shall be cast with the pipe or fitting by the pipe manufacturer. Attachment of angle iron; angle-clips; harness-lugs or tabs by field welding to the ductile iron pipe or fitting is strictly prohibited.
 - (a.) All threaded harness parts shall be manufactured of type 316 stainless steel.
 - ii. Restraint of push-on joints shall be of the type utilizing cast lugs, or retainer rings bearing against the pipe shoulders at the bell or fitting.
- e) Grooved pipe and fittings (for above grade or in vaults).

B. Fittings

1. AWWA Reference Standard: Ductile-iron fittings shall be manufactured in accordance with ANSI/AWWA C110/A-21.10 or ANSI/AWWA C153/A-21.53.
2. Push-on Joints: All pipe fittings shall be made with push-on joints designed for use with the type of pipe to be joined unless noted otherwise on the plans.
3. Restrained Joints: Restrained joints shall be as called for on the plans. Joint restraint type shall be as specified in this Section for ductile iron pipe, and shall be as specified under Part 2, A above.
4. Bell Ends: Bell ends shall be compatible with the pipe ends so as to provide confinement of the rubber rings and prevent damage to the ends of the pipe. Ring grooves and interior surfaces of the bell shall be smooth and free from ridges, notches, or uneven surfaces.
5. Mechanical Joints: Mechanical joint fittings will be allowed only in areas specifically called for on the project plans or as approved by the District as a substitute for other types of fittings. Mechanical joint fittings will be used in areas where there is limited room for a thrust block or in cases where the pipeline needs to be activated in a short period of time. These ductile iron fittings shall comply with ANSI / AWWA C111/A-21.11, with a pressure rating of 250 psi and an ANSI Class 125 and Class 150 bolt pattern. Tee-bolts for mechanical joint fittings shall be Type 316 stainless steel.
6. Field applications where speed of construction to facilitate tie-ins and where there is limited space available for concrete thrust blocks, are examples of where mechanical joint fittings with retainer glands are appropriate.

7. Mechanical Joint Restraint Systems: Mechanical joints with retainer gland fittings will only be allowed in areas specifically called for on the project plans or as approved by the District as a substitute for other types of fittings. Mechanical joint fittings shall meet or exceed the ASTM A536 requirements. Torque off bolts shall be tightened per manufacturer's recommendations and shall be inspected by the District prior to backfill. Approved manufacturers include: EBAA Iron, Ford Products, One-Lok, Romac, RomoGrip, or Sigma.
8. Flanged Fittings: Unless otherwise indicated on the drawings, all fittings with flanged ends shall comply with ANSI/AWWA C110/A21.10, with a pressure rating of 250 psi and a Class 125 ASME/ANSI B-16.1 flange or an ANSI/AWWA C115/A-21.15 Class 125 flange. The gasket surface shall have a serrated finish of approximately 16 serrations per inch, approximately 1/32-inch deep, with serrations in either a concentric or spiral pattern. In addition, all flanges shall meet the following tolerances:

Description	Tolerance (inches)
Bolt circle drilling	+/- 1/16
Bolt hole spacing	+/- 1/32
Eccentricity of bolt-circle & facing with respect to bore	+/- 1/32

9. Manufacturers: Fittings shall be manufactured by American Pipe, McWane Ductile, Sigma, SIP Industries, Star Pipe Products, Tyler, or U.S. Pipe.

C. Gaskets

1. Gaskets for Flanged Joints: Gaskets for flanged joints shall be 1/8-inch thick and be made of Ethylene Propylene Diene Monomer (EPDM), or synthetic fiber. Gaskets shall be suitable for a water pressure of 350 psi at a minimum temperature of 180°F. Gaskets shall be NSF 61 certified for potable water applications. For potable and non-potable water applications, gaskets shall be compatible with water that may have a chlorine residual of 25 mg/L.
2. Full Face Type Gaskets or Ring Gaskets for Flanged Joints: Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present.
3. Gaskets for Push-on, Mechanical, and Restrained Joints: Gaskets for push-on, mechanical, and restrained joints shall be synthetic or natural rubber in accordance with AWWA C111.
4. Manufacturers: Gaskets shall be Garlock 3000, 3760, 8314, and 98206; Klinger 4401, Tedit Style NA 1002, or U.S. Pipe Flange-Tyte.

D. Bolts, Nuts and Washers

1. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M, for bolts and ASTM A194, Grade 8M, for nuts. For grooved-end fittings, bolts shall be Type 316 stainless steel and conform to ASTM F593 or ASTM A183 and have a minimum tensile strength of 100,000 psi.
2. Washers shall be provided for each nut, shall be of the same material as the nut, and shall be installed adjacent to the nut, between the nut and the flange.
3. The length of each bolt or stud shall be such that between 1/4 inch and 1/2 inch will project through the nut when drawn tight.

E. Grooved End Fittings and Couplings

Grooved-end fittings shall conform to AWWA C606, rigid radius-cut groove. Grooved-end couplings shall be ductile iron, ASTM A536, Grade 65-45-12. Gaskets shall be EPDM and shall conform to ASTM D2000. Coupling shall be Victaulic, Style 31, or Grinnell. All of the threaded parts shall be Type 316 stainless steel and shall be lubricated with anti-seize compound. Where the restrained joint is of the grooved type, the wall thickness beneath the groove shall be equal to or greater than the minimum specified wall thickness and shall be sufficient to meet the maximum pressure.

F. Lining for Pipe and Fittings

The interior of all pipe and fittings shall be lined with cement-mortar per ANSI/AWWA C104/A-21.4. Lining shall be the double thickness listed in AWWA C104, Section 4.8. Lining materials shall conform to ASTM C150, Type II.

G. Coating for Pipe and Fittings

Exterior surfaces of buried pipe and fittings shall be coated with an asphaltic material in conformance with ANSI/AWWA C110/A-21.10, and ANSI/AWWA C151/A-21.51. The coating shall be free from blisters and holes and shall adhere to the metal surface at ambient temperatures encountered in the field.

H. Polyethylene Encasement

Unless specified otherwise, pipe and fittings shall be polyethylene encased in accordance with ANSI/AWWA C105/A-21.5.

I. Flange Insulation Kits

Flange insulation kits, suitable for the design pressure of the pipeline, shall be provided where shown on the drawings.

3-04 C900 PVC PIPE

A. Material

1. General: PVC pipe shall be manufactured in accordance with AWWA C900, and shall be of the sizes and pressure classes shown on the plans. The dimension ratio (DR) for C900 PVC pressure pipe shall be DR-14 or thicker walled (lower DR). The pipe shall have gasketed bell end or plain end with elastomeric gasketed coupling.
2. Material: Material used to produce the pipe and couplings shall be made from Class 12454-A or B virgin compounds as defined in ASTM D1785, with an established hydrostatic design basis rating of 4,000 psi for water at 73.4°F (23°C).
3. Pipe Lengths: Laying lengths shall be 20 feet with the manufacturer's option to supply up to 15% random lengths (minimum length 10 feet).
4. Pipe Marking: Each pipe length shall be marked showing the date of manufacture, nominal pipe size and O.D. base, the AWWA DR, and the AWWA specification designation (AWWA C900). For potable water application, the seal of the testing agency that verified the suitability of the material for such service shall be included.
5. Manufacturers: Pipe shall be manufactured by, Diamond Plastics Corporation, Ipex, Inc., North American (NAPCO), or Vinyltech Corporation.

B. Fittings

1. Materials: Fittings shall be ductile-iron conforming to Section 15056, Ductile- Iron Pipe and Fittings.
2. Bell Sizes: Bell size shall be for Class 235 (DR 18) and Class 305 (DR 14) iron- pipe-size equivalent PVC pipe, including the rubber-ring retaining groove.
3. Reference Standard: All castings shall be marked "DI" or "Ductile" and ANSI/AWWA C153/A21.53.

C. Joint Restraints

All restraint devices shall conform to ASTM F1674, Standard Test Method for Joint Restraint Products for use with PVC pipe.

D. Rubber Rings

Rubber rings for use in couplings and fittings shall conform to the requirements of ASTM F477. Rubber rings shall be stored out of direct sun light, clearly labeled with the material type, and protected in a manner to prevent deterioration.

E. Service Saddles

Service saddles for 1-inch and 2-inch diameter outlets shall be designed for use on C900 PVC pipe and shall conform to the requirements of Section 15057, Copper Pipe and Fittings. The allowable upper pipeline diameter limit for use of service saddles shall be pipe nominally sized 12-inches in diameter. For outlets of larger than 2-inch diameter and for all outlets on larger diameter pipelines, ductile iron tees with flanged outlets shall be used. Refer to the EVWD Standard Drawings.

3-05 BUTTERFLY VALVES, 12-inch and Larger

Butterfly valves shall be short body, flanged type, conforming to AWWA C504, Class 150B. Wafer style valves shall not be used.

Unless otherwise noted, minimum working differential pressure across the valve disc shall be 150 psi.

Valve ends shall be as shown on the drawings and in all cases shall match the class rating of the valve. For example, Class 150 valves shall have 150-lb flanges and Class 250 valves shall have 250-lb flanges. Flanged ends shall be Class 125 drill pattern, ANSI B-16.1 unless otherwise specified. Note that all butterfly valves 12-inch in diameter and larger are required to have flanged ends to meet the requirements for valve leakage testing.

Valve shafts shall be Type 304 or 316 stainless steel for Class 150 valves and 17-4 PH stainless steel for Class 250 valves. Valve shafts may be stub shaft or one-piece units extending completely through the valve disc.

Materials of construction shall be as follows:

Component	Material	Specification
Body	Ductile Iron	ASTM A536, Grade 65-45-12
Valve Shaft (CL 150)	Stainless Steel	Type 304 or Type 316
Valve Shaft (CL 250)	Stainless Steel	Type 17-4
Exposed body cap screws, bolts & nuts (including squeeze-pins)	Stainless Steel	ASTM A276, Type 316
Discs	Ductile Iron Stainless Steel	ASTM A536, Grade 65-45 Type 316
Valve Seat	EPDM Rubber	ASTM D412
O-Rings	Synthetic Rubber	ASTM D2000

The rubber seat shall be made from peroxide-cured EPDM rubber and shall be fastened integrally within the valve body. Rubber seats fastened to the disc by any means shall not be allowed.

Valves shall be Mueller Lineseal, Pratt Groundhog or approved equal.

3-06 RESILIENT-SEATED GATE VALVES, 3-inch through 12-inch

Resilient seated wedge-type, gate valves shall conform to AWWA C509 and the following requirements.

1. Valves shall have a wedge-type resilient seat with the gate fully encapsulated in peroxide-cured EPDM rubber.

2. Valves shall be designed for a minimum working pressure of 200 psi. See Section 15112, Backflow Preventers, for resilient seated gate valves on backflow prevention assemblies.
3. Valves shall have non-rising stems fabricated of Type 304 or 316 stainless steel. As an alternate, stem material may be high strength bronze alloy. Stem nuts shall be independent of the gate and shall be made of bronze.

Materials of construction shall be as follows:

Component	Material	Specification
Body, Operating Nut, Bonnet, Seal Plate	Ductile Iron	ASTM A536, Grade 65-45-12
Gate	Ductile Iron	ASTM A536, Grade 65-45-12
Stem	Stainless Steel or high-strength, low zinc Bronze	AISI 430F; ASTM A582 or Type 316; ASTM B763, CDA 867
Stem Nut	Bronze	ASTM B62
Nuts & Bolts	Stainless Steel	ASTM A193/194, Type 316
Valve Seat	EPDM Rubber	ASTM D412
O-Rings	Synthetic Rubber	ASTM D2000

Low friction, torque reduction thrust bearings shall be provided both above and below the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar.

Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be American AVK, Clow RW, M&H Style 4067, Matco Norca, Mueller A2362, or U.S. Pipe.

3-07 VALVE BOXES

Valve boxes and caps shall be furnished and installed with all buried valves. The valve boxes shall be of the two piece adjustable type with cast iron caps or as directed by the District. The valve boxes shall have walls not less than 10 gauge and the nominal diameter shall not be less than 8 inches. Valve box caps shall have the word "WATER" cast into them.

3-08 FIRE HYDRANTS

Fire hydrants shall be of the break-off traffic type and shall conform to A.W.W.A. C502 with 6 inches flanged inlet and 5-1/2-inch valve opening. Nozzle threads shall be American National Standard. Operating nut shall be 1-1/2-inch National Standard pentagon. The main valve shall be equipped with "O" ring seals and shall open when turned left or counter-clockwise. Fire hydrants shall be painted as specified by the District. Hydrants shall be Mueller or an approved equal and shall be equipped with two 2-1/2-inch hose nozzles and one 4 inch pump

nozzle. The drain plug shall be permanently sealed before installation.

3-09 BLOWOFF

The hydrant head on the 4-inch Blowoff assembly (Std. Dwg. W-103 and W-104) shall be a model J-344 by James Jones Company with a 4-inch inlet and 2-1/2-inch hose connection outlet. The Blowoff assembly shown in Std. Dwg. W-103 and W-104 shall be used at all low points along water mains.

3-10 COMBINATION AIR RELEASE AND VACUUM RELIEF VALVES

A. Valves

1. Valves shall be 1-inch, 2-inch, 3-inch or 4-inch in diameter and shall include:
 - a) A float assembly and large venting orifice to exhaust large quantities of air from pipelines when being filled and to admit large quantities of air when pipelines are being drained. Valves shall have a body with a flanged or threaded top containing the air release orifice. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat. The float shall withstand an external pressure of 1,000 psig without collapsing.
 - b) 1-inch and 2-inch valves and shall include a 3/8-inch threaded outlet with stainless steel plug in the top cover or near the bottom of the valve body. 3-inch and 4-inch valves shall include a 1-inch threaded outlet with stainless steel plug near the bottom of the valve body or on the side of the valve body above the minimum water level.
2. Materials of construction for valves shall be as follows:

Item	Material	Specification
Body and cover	Cast iron or stainless steel with reinforced nylon	ASTM A 126, Class B
Float	Stainless steel or foamed polypropylene	Stainless steel: AISI Type 316, ASTM A 240 or A 276 Foamed Polypropylene: ASTM-1895-89
Guide rod, guide bushings	Stainless steel	AISI Type 316, ASTM A 240 or A 276
Seat	EPDM	---
Valve trim	Stainless steel	AISI Type 316, ASTM A 240 or A 276
Cover bolts	Stainless steel	AISI Type 316, ASTM A 193, GR B8M

3. Valves shall be designed for an operating pressure of 150 psi unless otherwise

specified in the plans or specifications. Valves shall be APCO 140C/150C series, A.R.I. D-040 ST, Crispin UL series, Val-Matic Model 200C series, or for contracts between District and Contractor, approved equal.

B. Valve End Connections

1. Applications: 1-inch and 2-inch valves shall have threaded ends at the bottom of the body. 3-inch and 4-inch valves shall have flanged ends.
2. Threaded Connections: Threaded ends shall comply with ANSI B1.20.1.
3. Flanged Connections: Flanges for Class 150 valves shall comply with ANSI B16.1, Class 125. Flanges for Class 300 valves shall comply with ANSI B16.1, Class 250.

C. Bolts and Nuts for Flanged Valves

1. Bolts and nuts for flanged valves and flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.
2. Washers shall be provided for each nut, shall be of the same material as the nut, and shall be installed adjacent to the nut, between the nut and the flange.
3. The length of each bolt or stud shall be such that between 1/4-inch and 1/2-inch will project through the nut when drawn tight.

D. Vented Cover

1. 1-inch and 2-inch valves shall be enclosed inside a removable vented cover as shown in the IRWD Standard Drawings. Vented covers shall be manufactured of linear-low-density polyethylene (LLDPE) as made by Armorcast Products or by Pipeline Products, Inc. and the integral color shall be sandstone.
2. 3-inch and 4-inch valves shall be enclosed inside a removable, cylindrically-shaped, vented cover fabricated of welded steel pipe, hot dip galvanized after fabrication and painted in accordance with Section 09900, Painting and Coating.

3-11 FLEXIBLE COUPLINGS AND COUPLING ADAPTORS

A. Flexible Pipe Couplings for Steel Pipe

1. General: Steel couplings shall have center sleeves made of steel conforming to ASTM A36, A-53 (Type E or S), or A-512 having a minimum yield strength of 30,000 psi. Follower rings shall be malleable iron (ASTM A47, Grade 32510), ductile iron (ASTM A536), or steel (ASTM A108, Grade 1018, or ASTM A510, Grades 1018 or 1021). Follower ring material shall match that of the pipe being joined. For example, steel follower rings shall be used on steel pipe and malleable iron rings shall be used on ductile iron pipe. Minimum center sleeve lengths shall be per the table below.

Minimum Center Sleeve Length (inches)	Pipe Sizes (inches)
5	1-3
7	4
10	6-24
Submit for Approval	Larger than 24

2. **Sleeve Bolts:** Sleeve bolts shall have a minimum yield strength of 40,000 psi, an ultimate strength of 60,000 psi, and shall be fabricated of Type 316 stainless steel conforming to ASTM A193 (Grade B8M) for bolts and ASTM A194 (Grade B8M) for nuts, and shall conform to AWWA C111.
3. **Manufacturers:** Flexible pipe couplings for steel pipe shall be steel, and shall be Baker Series 200, Dresser, Ford, Romac, or Smith-Blair Type 411.

B. Flexible Pipe Couplings for Asbestos-Cement Pipe

1. **General:** Flexible pipe couplings for asbestos-cement pipe shall be ductile iron, with long-style center sleeves a minimum of 7-inches in length and shall have corrosion resistant Type 316 stainless steel nuts, bolts and washers. Center sleeve and follower rings shall be epoxy coated and holiday free.
2. **Sleeve Bolts:** Sleeve bolts shall be corrosion resistant type 316 stainless steel with a minimum yield strength of 45,000 psi and shall conform to ASTM A193 and AWWA C111.
3. **Manufacturers:** Flexible pipe couplings for asbestos-cement pipe shall be Baker Series 228, Dresser Style 40, Ford Style FRR, Romac Style 501, or Smith-Blair Type 442.

C. Flexible Couplings for Ductile Iron Pipe

1. **General:** Ductile iron pipe couplings shall have center sleeves of ASTM A126 Class B ductile iron with a minimum yield strength of 30,000 psi. Follower rings shall be malleable iron ASTM A47 Grade 32510 or ductile iron ASTM A536. Minimum center sleeve length shall be 7-inches for pipe sizes up to 6-inches and shall be a minimum of 10-inches for larger pipe diameters.
2. **Sleeve Bolts:** Sleeve bolts shall be corrosion resistant type 316 stainless steel with a minimum yield strength of 45,000 psi and shall conform to ASTM A193 and AWWA C111.
3. **Manufacturers:** Flexible couplings for ductile iron pipe shall be ductile iron: Baker Series 228, Dresser Style 153, Ford Style FCI, Romac Style 501, or Smith- Blair Type 442.

D. Transition Couplings

1. **Steel Pipe and Concrete Cylinder Pipe:** Transition couplings for connecting steel pipe and concrete cylinder pipe having different outside diameters shall be steel: Baker Series 212 or 240, Dresser Style 62 or 162, or Smith-Blair Type 413.

2. Ductile Iron Pipe, PVC Pipe, and Asbestos Cement Pipe: Transition couplings for connecting ductile iron pipe, PVC pipe, and asbestos cement pipe having different outside diameters shall be ductile iron, and shall be Baker Series 236, Dresser, Ford Style FC2A, Smith-Blair Type 441, or Romac.
3. Sleeve Bolts: Sleeve bolts shall have a minimum yield strength of 40,000 psi, an ultimate strength of 60,000 psi, shall be Type 316 stainless steel conforming to ASTM A193 (Grade B8M) for bolts and ASTM A194 (Grade B8M) for nuts, and shall conform to AWWA C111.

E. Flanged Coupling Adapters

1. Flanged coupling adapters may be used, where detailed on the approved plans, to install valves, meters, and other types of flanged fittings to plain end pipe of diameter 10-inches and smaller. Flanged coupling adapters shall be Baker Series 601 or 604, Dresser Style 127, Ford Style FFCA, or Smith-Blair Type 913.

F. Expansion Joints

1. General: Expansion joints shall have body, flanges, and slip pipe of carbon steel. Packing shall consist of a minimum of four rubber rings, each separated by jute packing. For installation on steel pipelines, expansion joint shall have plain ends and be beveled for welding. For installation in ductile iron pipelines, expansion joint shall have plain ends. Slip pipe shall have a machined surface, and body shall be equipped with pipe stops. Where called for on the plans, limit or stop rings and limit rods shall be provided to prevent the slip pipe from pulling out of the joint.
2. Limit Rods and Body Studs, Bolts and Nuts: Limit rods and body studs, bolts, and nuts shall be Type 316 stainless steel conforming to ASTM A193 (Grade B8M) for rods and bolts, and ASTM A194 (Grade B8M) for nuts.
3. Manufacturers: Expansion joints shall be Baker Series 403 or 404 or Smith-Blair Type 611 or 612.

G. Sleeve Bolts and Nuts for Flanges

1. Stainless Steel Bolts: Bolts and nuts for buried and submerged flanges, flanges in underground vaults and structures, and flanges located outdoors above ground shall be Type 316 stainless steel conforming to ASTM A193 (Grade B8M) for bolts and ASTM A194 (Grade B8M) for nuts.
2. Washers: Type 316 stainless steel washers shall be provided for each nut. Washers shall be of the same material as the nuts.

3-12 COPPER WATER SERVICE LINES

1. Copper Pipe and Tubing

Copper piping shall conform to ASTM B88. Copper pipe and tubing shall be cylindrical, of uniform wall thickness, and shall be free from any cracks, seams, or other defects. Piping located above floors or suspended from ceilings shall be Type L. Piping buried or

located beneath floor slabs shall be Type K. Copper pipe shall be as manufactured by Cambridge-Lee Industries, Inc., Cerro Copper Products Company, Halstead Industries, Inc., IUSA/Reading, or Mueller Manufacturing Entities c/o Mueller Industries, Inc. No coiled copper tubing shall be used in sizes 1-1/2" and larger.

2. Copper Fittings

Copper fittings shall be copper conforming to ASTM B75 and ANSI B16.22, with solder end joints. Fittings 3/8-inch and smaller may have flared end connections or compression joint connections.

3. Solder

Solder shall be tin-silver solder conforming to ASTM B32, latest revision, Grade Sn94, Sn95 or Sn96. Cored solder shall not be used. Solder and flux used in joints of potable waterlines shall contain no more than 0.2 percent lead.

4. Brass Pipe and Nipples

Short threaded nipples and brass pipe shall conform to ASTM B43, regular wall thickness, except that nipples and pipe of sizes 1-inch and smaller shall be extra strong. Threads shall conform to ANSI B1.20.1.

5. Brass Appurtenances

1. General: All items specified herein shall be manufactured of brass conforming to AWWA C800 and shall meet NSF 61 requirements where the product is used on potable water.
2. Service Saddles: Service saddle bodies shall be manufactured of brass, stainless steel or nylon-coated malleable iron as called for in the IRWD Standard Drawings for the various types of pipe connections. Saddles shall be tapped with a female iron pipe thread outlet. The seal with the outer wall of the pipe shall be effected with either a rubber gasket or an O-ring, except for the stainless steel full-circle style repair clamp connection, which shall have a full-circle rubber gasket. Service saddles shall be as manufactured by A.Y. McDonald, Cambridge Brass, Ford Meter Box, Jones, Mueller, Romac, or Smith-Blair.
 - a) Asbestos-Cement or Ductile Iron Pipe: Service saddles shall be double strap type for all pipe sizes. The straps shall be flat and shall be manufactured of 316 stainless steel. Refer to IRWD Standard Drawings for details.
 - b) C900 PVC: Service saddles shall be manufactured of brass and shall be cast in two sections for pipe up to 8-inches in diameter. Service saddles for use on 10-inch and 12-inch diameter pipe shall have a brass top section and flat 316 stainless steel straps on the bottom of the saddle. Each saddle shall accurately fit the contour of the pipe O.D. without causing distortion of the pipe. The sections shall be securely held in place with type 316 stainless steel hex-head screws or bolts. The casting sections shall be tapped to receive the screws or bolts.
3. Corporation Stops: Corporation stops shall be manufactured of brass. The inlet fitting shall be a male iron pipe thread when used with saddle and the outlet connection shall be a compression type or iron-pipe thread. Corporation stops shall be "ball style" as

manufactured by A.Y. McDonald, Cambridge Brass, Ford Meter Box, Jones, or Mueller.

4. Angle Meter Stops: Angle meter stops shall be of the "ball valve" style and shall be manufactured of brass. The inlet connection shall be an iron-pipe thread and the outlet fitting shall be a meter flange or meter coupling. The inlet and outlet shall form an angle of 90 degrees on a vertical plane through the centerline of the meter stop. A rectangular lug and lock wing shall be provided on the top of the fitting to operate the shutoff mechanism.

Two-inch angle meter stops shall be with "slotted" holes for 1 1/2-inch or 2-inch meters. Angle meter stops shall be of the "ball valve" style and shall be as manufactured by A.Y. McDonald, Cambridge Brass, Ford Meter Box, Jones, or Mueller.

5. Ball Valves for Flush-outs: Ball valves shall be in accordance with Section 15100, Manual Valves or Ford Meter Box BLA18-777-TA-NL. Ford Meter Box valves shall include a PVC threaded cap to protect the male threads on the outlet of the valve. Ball valves for flush-outs shall be installed in accordance with the EVWD Standard Drawings.
6. Customer Service Valve: Customer service valves shall be "ball valve" style manufactured of brass with lever-type turn handle. The inlet connection shall be a meter flange or a meter coupling and the outlet female iron pipe thread. Customer service valves shall be of the insulating style as manufactured by Mueller Corporation. Customer service valves shall be purchased from the District.

6. Flanges, Gaskets, Bolts and Nuts

1. Flanges for Valves and Fittings: Copper pipe shall be connected to flanged valves and fittings with bronze companion flanges conforming to ANSI B16.24, Class 125 (150 lb. Rating) to match the connecting flange. Solder end companion flanges shall be used for copper and threaded companion flanges shall be used for brass, or stainless steel pipe connections.
2. Gaskets: Gaskets for flanged-end fittings shall be made of synthetic rubber binder and shall be full-face, 1/8-inch thick John Crane Co. "Cranite", or Johns- Manville.
3. Flanged Connections: All flanged connections shall be made using, Type 316 stainless-steel bolts and nuts conforming to ASTM A193, Grade B8M, for bolts and ASTM A194, Grade 8M, for nuts. Washers shall be provided for each nut. Washers shall be of the same material as the nuts.
4. Flange Insulating Kits: Flange insulation kits, suitable for the design pressure of the pipeline, shall be provided where shown on the drawings and/or wherever pipelines of dissimilar metals are joined together. Insulation kits and materials shall be as specified in Section 16640, Cathodic Protection and Joint Bonding.

7. Unions

Unions for copper piping systems (non-buried applications) shall conform to the following. Unions shall be the same size as the pipe, and shall be of the three part type, with silver

soldered "sweat" hub-end connections. Unions shall be brass conforming to AWWA C800. Unions shall be A. Y. McDonald, Ford Meter Box, Jones, Lee Brass, or Mueller.

3-13 WATER SAMPLING STATION

1. General: Water quality sample station shall be installed as called for on the drawings and in accordance with EVWD Standard Drawing No, W-122 and as specified herein.
2. Materials: Water quality sample station shall include a 1" brass water flow pipe, a ½" brass drain pipe, a 1" brass flushing valve and elbow, a brass sampling bib and shall be enclosed in a lockable, non-removable housing. When opened, the station shall require no key for operation, and the water will flow in an all brass waterway. All working parts shall be of brass and shall be removed from above ground with no digging. A copper vent tube shall enable each sample station to be pumped free of standing water to prevent freezing and minimize bacteria growth.
3. Service Lateral: Each water quality sample station shall be connected to the water main with 1" water service lateral per EVWD Standard Drawing No. W-101.

3-14 METERS

Unless otherwise specified, all meters will be provided by the District at the Applicants expense. All water service meters shall be in accordance with A.W.W.A. C708 Standard for Cold-Water Meters Multi-Jet Type for Customer Service. An affidavit of compliance shall be submitted stating that all meters furnished comply with all applicable requirements of A.W.W.A. C708. Size and quantity shall be as shown on the plans or directed by the Engineer. The main casing shall be of a copper alloy as specified in A.W.W.A. C708.

Casing spuds for all meters 5/8 thru 2 inch shall have external ANS pipe threads. Registers shall be straight reading and shall read in cubic feet. The registers shall be the dry type. Meters shall be Precision Meters or approved equal. A workmanship and materials warranty shall be furnished requiring the manufacturer to replace without charge, those parts in which defects have developed within 15 years of installation and acceptance.

3-15 METER BOXES

Meter boxes and covers shall be constructed of Solid Fiberglass Reinforced Polymer Concrete (RPC) material and "Concrete Gray" in color as manufactured by Armorcast Products Company. Size shall be as appropriate to accommodate the size and number of meters and shutoff valves to be installed within each.

3-16 CONNECTION TO EXISTING SYSTEM

Connections to the existing water system shall be accommodated through the use of a cut-in tee and valve. Connection to the existing system by means of "Hot-Tapping" may be allowed at the discretion of the District Engineer. All materials necessary to make

connections between proposed and existing water systems per details shown on the Plans shall be furnished by the Contractor and shall be of the size and class shown on the accompanying Plans. Items indicated to be salvaged on the Plans but not used on this project are the property of the District.

SECTION 4

METHODS OF CONSTRUCTION FOR WATER

4-01 EXCAVATION, TRENCHING AND BACKFILL

A. General

The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths and alignment indicated on the construction drawings or as otherwise specified. During Excavation, material suitable for backfilling shall be piled in an orderly manner, a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed and wasted by the Contractor at the direction of the District Engineer.

Suitable shoring, timbering or sheeting shall be provided by the Contractor where necessary to support the sides of the trench prior to and during the installation of the pipe. The shoring methods and procedure shall be consistent with safety and shall be removed as the trench is being backfilled.

B. Trench Excavation

The trench shall be excavated to a width not less than twelve (12") inches nor greater than sixteen (16") inches wider than the outside diameter of the pipe barrel measured at a point twelve (12") inches above the top of the pipe. The trench shall be excavated to the depth necessary to accommodate the placement of six (6") inches of pipe bedding as defined below. The width of the trench above that level may be as wide as necessary for sheeting and bracing and the proper performance of the work.

Except where rock or unsuitable materials is encountered, care shall be taken not to excavate below the depths indicated on the construction drawings. Where the trench bottom requires the use of imported material under the pipe because of soft, wet, spongy or unstable conditions in the trench, a minimum thickness of twelve (12) inches of crushed rock bedding shall be placed below grade of pipe invert for the full width of the trench.

Minimum cover over the pipe in areas where grade is not shown on the plans shall be forty-two (42) inches. Depth of cover shall be measured from the established street grade or the surface of the permanent improvement to the top of the pipe barrel. In the case of lines outside of the existing or proposed street right-of-way, additional cover may be average natural ground surface. Any deviation shall be subject to approval by the District.

In accordance with the requirements of Section 6705 of the California Labor Code, the Contractor, prior to beginning any trench or structure excavation in excess of 5 feet deep, shall be in receipt of the District's written acceptance of the Contractor's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other

provisions for worker protection against the hazard of caving ground during the excavation. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative systems plans shall be prepared by a civil or structural engineer licensed in the State of California.

C. Pipe Bedding

Prior to installation of water pipe, six (6") inches of sand bedding conforming to Greenbook Section 200-1.5, Table 200-1.5.5 shall be placed in the trench bottom as shown on EVWD Standard Drawing No. W-121. Bell holes and depressions for joints shall be dug after the bedding has been placed and graded and shall be only of such length, depth and width as necessary for properly making the particular type of joint.

D. Backfill

1. General - Backfilling of the trench around the pipe and excavation around appurtenances shall follow the installation as closely as possible. Backfill shall be accomplished in two stages: (a.) Pipe zone backfill from bedding material to twelve (12") inches over the pipe; (b.) Trench zone backfill from twelve (12") inches over the pipe to the Paving Sub-Base.
 - a) Pipe Zone Backfill: After the pipe has been bedded, pipe zone material shall be placed simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Material shall be carefully placed around the pipe so that the pipe barrel is completely supported and that no voids or un-compacted areas are left beneath the pipe. Particular care shall be taken in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling. Material placed within the pipe zone shall be compacted by hand tamping only. The backfill material shall be approved by the District Engineer and shall be granular material with a sand equivalent of 30.
 - b) Trench Zone Backfill: Backfill material shall be carefully deposited onto the backfill previously placed in the pipe zone. Free fall of the material shall not be permitted until at least 2 feet of cover is provided over the top of the pipe. Sharp, heavy pieces of material shall not be dropped directly onto the pipe or the tamped material around the pipe. Backfill material shall be approved by the District Engineer and shall contain no rock larger than six (6") inches. Backfill shall be placed in maximum lifts of two (2') feet and shall be compacted to a minimum density of ninety (90) percent of its maximum density as determined in accordance with ASTM D 1557.

E. Pavement Replacement

1. General - When it is necessary to break pavement to order to lay the pipe lines shown on the construction drawings, the existing pavement shall be cut vertically as nearly as possible to a straight line by an approved method. The pavement so removed shall be hauled away as directed by the District and shall be replaced with like material. All pavement removal and replacement shall conform to the standards and

specifications of the governing body having jurisdiction and shall meet with their approval. The Contractor shall be responsible for replacing all necessary pavement.

4-02 HAULING AND UNLOADING PIPE

During loading, transportation and unloading, every precaution shall be taken to prevent injury to the pipe, its lining and its coating. No pipe shall be dropped from cars or trucks nor allowed to roll down skids without proper restraining ropes. Each pipe shall rest upon suitable pads, strips or blocks during transportation and while awaiting installation in the field, and shall be securely wedged or tied in place. Padding shall be used on all car stakes, skids and other material to prevent damage of the coating during transportation and handling.

Where necessary to move the pipe longitudinally along the trench, it will be done in such a manner as not to injure the pipe or its coating. Pipe shall not be rolled or dragged on the ground.

Where pipe is placed in stock piles, it shall be neatly piled and blocked with strips between tiers.

4-03 PROTECTION OF WORK AND MATERIALS

The Contractor shall at all times take care to protect and preserve all materials to be used in the laying of the pipe. The pipe shall be handled in such a manner as not to injure its shape. All pipe and materials which, in the opinion of the District, have been damaged shall be replaced by the Contractor at his own expense.

The Contractor shall be responsible for the safe storage of all material furnished by him until it has been incorporated in the completed project. All material damaged or broken by the Contractor, shall be replaced in exact type and kind by the Contractor at his expense. All materials received by the Contractor and not used shall be removed by the Contractor at his expense.

4-04 HANDLING OF PIPE AND ACCESSORIES

Pipe and accessories shall be loaded at the point of delivery, hauled to, and distributed at the site of the project by the Contractor at his expense. They shall at all times be handled with care to avoid damage. Whether moved by hand, skyways or hoists, material shall not be dropped or bumped against pipe or accessories already on the ground or against any other object on the ground.

In distributing material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pipe shall be handled in such a manner as to avoid damage to machined or special ends. When such damage cannot be repaired to the District's satisfaction they shall be replaced by the Contractor at his expense. The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times.

All pipe, fittings and accessories shall be carefully lowered into the trench in a

workmanlike manner, using proper tools and equipment. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

4-05 PIPE LAYING

All foreign matter and dirt shall be removed from the interior of the pipe prior to its installation. Before lowering, the pipe shall be inspected for defects. Any defective, damaged, or unsound pipe shall be rejected. The entire joint including coupling, machined sections of the pipe and the rubber gasket or ring shall be thoroughly cleaned at the time the joint is made. The entire procedure and method of installation of the pipe and making joints shall be done in a workmanlike manner and shall be in strict accordance with the pipe manufacturer's direction and recommendations.

All pipe shall be laid according to the size, class, location and grade shown on the Plan. The faces of all spigot ends and all shoulders in the hubs or sockets must be true and brought into firm contact. Rubber ring installation shall be checked with suitable gauges to insure that they are located in the proper position relative to the pipe ends.

When pipe laying is not in progress the unfinished end of the pipe shall be securely closed with a suitable water tight plug or cover to prevent the entrance of animals or foreign matter into the line.

The Contractor shall take all necessary care and precautions to prevent the pipe from floating due to water entering the trench from any source. The Contractor shall be responsible for damage caused by floating pipe and shall, at his sole expense, restore and replace the pipe to its proper condition, alignment and grade.

Where pipe is laid on a curve or at horizontal or vertical angles in the trench, the maximum deflection at the joint shall not exceed sixty (60) percent of the limitations specified by the pipe manufacturer and each joint shall be adequately blocked to take the thrust until properly backfilled.

Location tape shall be installed over all pipelines. The tape shall be securely attached to each valve box and shall be continuous between adjacent valves. The tape shall be installed 12" below the finish grade, and in the case of two pipes in a single trench the tape shall be installed at midpoint between the pipes.

4-06 INSTALLATION OF CEMENT MORTAR LINED AND COATED STEEL PIPE

All welding shall be in accordance with the American Water Works Association C206 "Standards for Field Welding of Steel Water Pipe.

Fittings shall be installed at locations shown on the Plans shall correspond to the sizes and types indicated on the Plans. Shop fabricated fittings shall be furnished unless field fabricated fittings are designated on the Plans.

Steel pipe joints shall be thoroughly cleaned and coated with cement mortar to a minimum thickness equal to the thickness of the cement mortar to a minimum coating on the pipe. For all sizes of steel pipe, both the inside and outside of joints shall be coated.

The field joint procedure shall be as described in the Appendix shown in A.W.W.A. C205, "Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe", and in

accordance with the manufacturer's instructions.

4-07 INSTALLATION OF DUCTILE IRON PIPE

The ductile iron water mains shall be laid and the work incidental thereto performed in accordance with applicable requirements of A.W.W.A. C600- "Standards for Installation of Cast Iron Water Mains."

All pipe shall be carefully inspected for defects before installation. Such inspection shall include light tapping with a hammer while the pipe is suspended in the air. No pipe or fitting which is cracked or which shows defects excluded by the Specifications for such fittings shall be used. Any injuries to the protective coating of the pipe or fittings shall be carefully repaired by the Contractor with coat tar pitch varnish. The pipes, valves, and fittings shall be carefully cleaned immediately before installation. Every open end of a pipe shall be carefully plugged or capped before leaving the work.

4-08 INSTALLATION OF C900 PVC WATER PIPE

The ductile iron water mains shall be laid and the work incidental thereto performed in accordance with applicable requirements of A.W.W.A. C900 and AWWA C905 - "Standards for Installation of PVC Water Mains."

4-09 FIRE HYDRANT ASSEMBLY INSTALLATION

Fire hydrants shall be installed by the Contractor at the locations shown on the accompanying Plans in accordance with details show on Std. Dwg. W-113 herein, and positioned to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians. The size and type of hydrant shall correspond to the designation shown on the Plans. The entire hydrant assembly shall be plumb. Nozzles shall be at right angles to the street or as directed by the District. The hydrant shall be located so that the centerline of the riser or barrel is approximately twenty-four (24) inches in back of the curb face or face of berm or the edge of the street pavement unless otherwise directed.

The Contractor shall provide and install all necessary fire hydrant bury extensions to permit installation of the hydrant assembly to proper grade. The Contractor shall be responsible for determining proper grade.

The Contractor shall make certain that the automatic drain openings of the fire hydrant are satisfactorily plugged before installation.

Upon completion of the water main installation and after the field tests have been performed, each fire hydrant shall be operated by the Contractor in the presence of the District representative. Operation shall consist of opening the fire hydrant assembly and allowing water to flow freely from one or more of its outlets. Upon completion of this sequence, the fire hydrants shall be turned off and all protective caps properly placed on each outlet.

4-10 VALVE INSTALLATION

Valves shall be installed at the locations shown on the Plans and shall correspond to the size and types of ends shown on the plans. All valves shall be equipped with a valve box

and cap.

The cutting of pipe for inserting into the bells of valves shall be done in a neat and workmanlike manner without damage to the pipe, its coating or lining and in accordance with the manufacturer's instructions.

Except as directed by the District, the Contractor shall not operate gate valves without a District representative present. During the course of water main installation, all valves shall be left completely open or completely closed unless otherwise authorized by the District. Upon completion of the water mains and all appurtenances, all valves shall be operated through a complete open and closed cycle by the Contractor in the presence of the District representative. After completion of this operational cycle, all valves shall be left in an OPEN position unless directed otherwise by the District.

4-11 VALVE BOX AND CAPS

Valve boxes and caps to be installed in proposed pavement areas of presently unpaved street rights-of-way shall be installed ten (10) inches below finished grade of street or such greater depth as determined by the District. The Contractor shall be responsible for future location of all valve boxes and caps until completion of paving. At least two properly designed witness markers shall be provided and installed by the Contractor to aid future location of valve boxes and caps.

When installed in paved areas, the valve cap shall be installed with its top one-quarter (1/4) inch above finished grade, and feathered into the existing pavement.

4-12 BLOW-OFF ASSEMBLY INSTALLATION

Blow-offs shall be installed by the Contractor at the locations shown and in accordance with the details shown on EVWD Standard Drawing No. W-103. The entire assembly shall be plumb with nozzles at right angles to the street or as directed by the District.

Blow-offs shall be located to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians.

Upon completion of the water main and system installation, each Blow-off shall be operated by the contractor in the presence of the District representative. Operation shall consist of opening the hydrant head on the assembly and allowing water to flow freely from its outlet. Upon completion of this sequence, the Blow-off assembly shall be turned off and all protection caps properly placed on the outlet.

4-13 AIR RELEASE AND AIR VACUUM ASSEMBLY

Air and vacuum assemblies shall be installed at the locations indicated on the Plans at sites adjacent to the roadway or on back lot lines as selected by the District. They shall be completely accessible and protected from possible damage from vehicles or equipment. The assemblies shall be installed in accordance with details shown on EVWD Standard Drawing No. W-105 herein, in a workmanlike manner and in accordance with accepted water works standards. Pipe joints shall be assembled in a proper manner to assure that they are free of leaks.

4-14 WATER SERVICE INSTALLATION

Service connections shall be installed at the locations designated by the District and per details shown on the Plans and in accordance with details show on EVWD Standard Drawing No. W-101 and W-102 herein. Service stubs shall be installed in a like manner and in accordance with accepted water works standards, with a minimum cover of thirty (30) inches.

4-15 CONCRETE ENCASEMENTS

Concrete encasement shall be installed in a manner to completely surround the pipe barrel at all water course crossings to provide protection from flood flows and eliminate possible water infiltration. The entire procedure shall be in accordance with the pipe manufacturer's recommendations as approved by the District.

4-16 THRUST BLOCKS

Concrete thrust blocks shall be installed at all dead ends, tees, elbows, bends, crosses, blow-offs, drains and fire hydrants shown on the Plans. The thrust blocks shall be adequate in size to provide for a test pressure on the size of pipe under consideration per EVWD Standard Drawing No. W-108.

Thrust blocks shall be constructed of concrete between the fitting of pipe and the trench wall. The concrete shall be placed so that it extends to the trench wall in a manner that enables the entire bearing area to be in contact with undisturbed freshly cut material.

Concrete shall be kept behind the bell of the fitting and shall not be permitted to run against the pipe. Concrete shall be kept clear of all bolts on flanged fittings to enable proper future removal of all such bolts.

4-17 DISINFECTION

A. Pipelines

1. General: Before being placed into service, all pipelines and appurtenances shall be chlorinated in accordance with AWWA C651 and as described herein. Pipelines with a diameter of 12-inches or less shall be disinfected by either direct chlorine solution injection or by use of calcium hypochlorite tablets. Pipelines with a diameter larger than 12-inches shall be disinfected by direct chlorine solution injection. Steel pipelines shall be disinfected by continuous feed chlorine solution injection. Bacteriological testing after disinfection shall be performed by the District.
2. Chlorination Contractor: Chlorination shall be performed by a certified chlorination and testing Contractor. Chlorination shall be in accordance with the instructions of the chlorinator manufacturer and be performed by a Class A or C-34 licensed contractor.
3. Services: Every service connection served by a main being disinfected shall be tightly shutoff at the curb stop before water is applied to the main. Care shall be taken to expel all air from the main and services during the filling operation.

4. Pipeline Flushing: Before chlorinating pipeline, flush pipes with water to remove dirt and debris. Maintain a flushing velocity of at least 3 feet per second. Flush pipes for a minimum of the time period calculated from the formula:

$$T = \frac{2}{3}L \text{ in which:}$$

T = flushing time in seconds

L = pipe length in feet

If a velocity of 3 feet per second cannot be achieved, other methods of cleaning as recommended by AWWA C651 may be selected by the District at no additional cost.

5. Continuous Feed: Chlorine Solution Injection Method

- a) Chlorine solution shall be applied at the beginning of the section to be chlorinated and shall be injected through a corporation stop, a hydrant, or other approved connection to ensure treatment of the entire system being disinfected. All required corporation stops and other plumbing materials necessary for chlorination or flushing of the main shall be installed by the Contractor.
- b) Potable water shall be introduced into the pipeline at a constant measured rate. Chlorine solution shall be injected into the potable feed water at a measured rate. The two rates shall be proportioned so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 50 mg/L to 100 mg/L, with a chlorine residual of 25 mg/L after 24 hours in the pipe. The concentration at points downstream shall be checked periodically during the filling to confirm that sufficient chlorine is being added.

6. Disinfection by Calcium Hypochlorite Tablets: The use of 5-g calcium hypochlorite tablets will be permitted in pipe sizes 4- through 16-inches. The tablets shall be attached by means of an approved adhesive to the inside top of the lengths of pipe as they are being laid. The amount of adhesive shall be limited to the smallest practicable amount applied to one side of the tablet only.

The following table shows the number of tablets to be used per length of pipe of various sizes to provide the required chlorine residual:

Inside Diameter of Pipe (Inches)	No. of 5g. Hypochlorite Tablets Per Length of Pipe, in feet		
	18	20	40
4	1	1	1
6	1	1	2
8	2	2	4
10	3	3	5
12	4	4	7
16	6	7	13

When the installation is complete, the main shall be filled with water at a rate such that water within the main will flow at a velocity no greater than 1 ft/s. This water shall remain in the pipe for no less than 24 hours.

7. Disinfection of Valves and Appurtenances: During the period that the chlorine solution is in the section of pipeline, valves shall be opened and closed to obtain a chlorine residual at hydrants and other pipeline appurtenances. Care shall be taken to ensure that no chlorinated water enters any active pipeline.
8. Confirmation of Residual: After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours, samples shall be taken at air valves and other points of access to confirm that a chlorine residual of 25 mg/L minimum exists along the pipeline.
9. Water Quality Samples and Testing: The contractor shall provide adequate and convenient means for the District Representative to collect an appropriate number of water samples for each segment of pipeline tested. A bacteriologic and physical quality test will be performed by the District to demonstrate the absence of coliform organisms in each separate section of the pipeline after chlorination and refilling.
10. Pipeline Flushing: After confirming the chlorine residual, excess chlorine solution shall be flushed from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/L of the replacement water.
11. Bacteriological Tests: On two consecutive days, bacteriological samples shall be taken by the District for examination. Samples shall be tested by the District for coliform bacteria and heterotrophic plate count. All coliform test results must be negative and heterotrophic plate counts must be less than 500 colonies/mL prior to placing the water line into service.
12. Repetition of Procedure: If the initial or second chlorination fails to produce required residuals and bacteriologic results, chlorination and testing shall be repeated until two consecutive satisfactory results are obtained. All costs incurred for testing shall be borne by the contractor.
13. Test Facility Removal: After satisfactory disinfection, all temporary disinfection and test facilities shall be removed and restored to the satisfaction of the District Representative.

B. Disposal of Chlorinated Water

1. Dechlorination Prior to Disposal: Dechlorination shall be performed by a certified chlorination and testing company. Dechlorinated water shall have a total chlorine residual concentration of less than 0.1 mg/L.

C. Connections to Existing System

1. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough

flushing shall be started as soon as the connection is completed and shall be continued until all discolored water is eliminated.

4-18 FIELD TESTING

A. General

After the pipe has been laid, backfilled and compacted, all laid pipe shall be given a pressure and leakage test. The test section should be tested with proper bulkheads rather than against a "closed" valve to preclude the problems associated with leaking valves. In no case shall a section of pipe which is connected to a potable system, be pressurized until that entire section has been disinfected and satisfactory bacteriological test results have been received by the District.

The maximum test section length for pipe of 12 inches in diameter or smaller shall be 3,500 feet and for pipe larger than 12 inches in diameter the maximum test section length shall be 1 mile. Test bulkheads shall be provided where the distance between valves exceeds these limits.

B. Hydrostatic Testing

1. Filling Rate: The pipeline shall be filled at a rate such that the average velocity of flow is no greater than 1 fps. At no time shall the maximum velocity of flow exceed 2 fps. The following table relates velocity filling rate to an equivalent volume flow rate for pipe diameters 10-inches and under.

Filling Rates in gpm
Equivalent to Filling Velocities of 1 fps, for Pipes Flowing Full

Nominal Size (inches)	Flow Rate Q (gpm)
4	9.8
6	14.7
8	19.6
10	24.5

2. Air Removal: All air should be purged from the pipeline before checking for leaks or performing pressure tests on the system. To accomplish this, if air valves or hydrants or other outlets are not available at high points, taps shall be made to expel the air, and these taps shall be tightly plugged after testing.
3. Pressurization: After the pipeline has been filled and allowed to sit a minimum of 48 hours (72 hours for mortar-lined pipelines), the pressure in the pipeline shall then be pumped up to the specified test pressure. If a large quantity of water is required to increase the pressure during testing, entrapped air, leakage at joints, or a broken pipe may be suspected. If a large quantity of water is required to increase the pressure during the test, the test shall be discontinued until the source of issue is identified and corrected.

4. Field Test Pressure: Unless otherwise specified, the pipeline shall be subjected to a field hydrostatic pressure of 200 psi for Class 150 and Class 200 PVC pipe, and 125% of design pressure for steel pipe, but not to exceed 200 psi.

C. Allowable Leakage

1. Pipelines of Diameter 10-inches and Under:

- a) When the test pressure has been reached, pumping shall be discontinued until the pressure in the line has dropped 5 psi, at which time the pressure shall again be pumped up to the specified test pressure. This procedure shall be repeated until four hours have elapsed from the time the specified test pressure was first applied. At the end of the four-hour period, the pressure shall be pumped up to the test pressure for the last time.
- b) The leakage shall be considered as the total amount of water pumped into the pipeline during the four-hour period, including the amount required in reaching the test pressure for the final time. Leakage shall not exceed the rate of 24 gallons per inch of diameter per mile of pipe per 24 hours for Class 150 pipe, and 30 gallons per inch of diameter per mile of pipe per 24 hours for Class 200 pipe. The following table indicates the leakage allowance for various sizes of pipe for Class 150 and Class 200 pipe and is equal to the number of gallons per the four- hour test per 1,000 feet of pipe being testing:

LEAKAGE ALLOWANCE

Pipe Size (Inches)	Test Pressure (psi)		Allowable Leakage Gallons per four hours per 1,000 feet of pipe	
	Class 150	Class 200	Class 150	Class 200
4	200	200	1.5	1.7
6	200	200	2.3	2.6
8	200	200	3.0	3.4
10	200	200	3.8	4.3

- c) One to three days shall be allowed for the filled pipeline to soak and to release entrapped air. The test pressure shall be applied with a positive displacement pump. A snubber and dampener shall be provided between the pump and the pipeline to reduce instantaneous pressure
 - d) Note the allowable leakage rate for pipeline sections with flanged, welded, and/or grooved-end joints shall be zero.
2. Pipelines of Diameter 12-inches and Larger:
- a) The test pressure shall be maintained for a four (4) hour duration by restoring it whenever it falls an amount of 5 psi.
 - b) The amount of water used to maintain the test pressure during the test period

shall be considered the leakage. The allowable leakage shall be determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

Where L= the allowable leakage in gallons per hour,

N = is the number of rubber-gasketed pipe joints in the test section

D = is the inside pipe test diameter in inches,

P = the pipe test pressure (psig) which is defined as the average of the highest and lowest test pressures in the pipe section being tested.

3. Repetition of Test

If the actual leakage exceeds the allowable, the faulty work shall be located and corrected and the test repeated. The work shall be restored, and all damage resulting from leaks repaired. All visible leakage shall be eliminated.

4. Bulkhead and Test Facility Removal

After a satisfactory test, water shall be drained, test bulkheads and other test facilities removed, and pipe coatings restored.

D. Compaction Tests

Compaction tests of the trench backfill is required approximately every 250 feet, or more often if tests indicate the need, along the alignment of the main pipeline. In addition, approximately 20 percent of all laterals within the street right-of-way shall be tested. Location of tests will be determined by the District Engineer. Additional tests may be required at the District's discretion. The tests shall be made at varying depth. Compaction tests which meet the specified requirements shall be made at the District's expense through an approved soil testing laboratory. All compaction tests which do not meet the specified requirements shall be at the Contractor's expense without any compensation therefore. Any additional requirements of governing bodies having jurisdiction must be met. If the work is done under a permit, the Contractor shall obtain written confirmation that the work is acceptable to the governing body having jurisdiction.

4-19 JACKED STEEL CASING

1. Steel Casing

A. Materials: Steel casing shall be ASTM A283, Grade C, ASTM A570 Grade 30, 33, and ASTM A36 unless noted otherwise. The minimum inside diameter and wall thickness of the casing shall be as follows, or shall be as shown on the drawings. Greater casing thickness and diameter may be used as convenient for the method of work and loadings involved, as suitable for the site and as limited by possible interferences, but at no additional cost to District.

The Contractor shall choose a size of casing at or above the minimum specified, in order that the jacking may be done with a sufficient degree of accuracy to permit

installation of the carrier pipe to the grades shown on the plans and to properly accommodate the largest dimension of the carrier pipe.

- B. Joints & Welding: Casing sections shall be joined by full circumference welding. Field welds shall be full-penetration bevel welds in accordance with the standards of quality as set forth in the specifications of the American Welding Society. All welding shall be performed by skilled welders qualified under the provisions of ANSI/AWS D1.1. Welder qualifications shall be certified by an independent local, approved testing agency not more than 6 months prior to commencing work. Prepare ends of casings for proper bevel weld by providing a 45-degree bevel on the end of one of the two casing pieces being joined.
- C. Wall Thickness: Minimum size and thickness of casing pipes for insertion of various sizes of carrier pipes shall be as shown in the EVWD Standard Drawings unless a larger or heavier wall casing pipe is required by the agency having jurisdiction over the road or railroad crossing or the contractor requests use of a thicker wall pipe.

2. Casing Seals

Casing seals shall be 1/8-inch-thick synthetic, rubber, designed to fit snugly around pipe and casing. Casing seals may be one piece with no field seams or the wrap-around style to facilitate installation after the casing and carrier pipe are already installed. Seamless style is preferred. Bands and hardware for attachment to pipe and casing OD shall be stainless steel.

3. Grout

- 1. Exterior of Casing: Grout shall consist of an 8 sack sand slurry.
- 2. Interior of Casing (between carrier pipe and casing): Grout shall consist of cellular concrete as manufactured by Cell-Crete Corporation. The cellular concrete shall have minimum compressive strength of 100 psi.

4. Grout Connections

The contractor shall provide 1-inch diameter threaded steel half-couplings on the inside of the casing pipe at the locations, spacing and orientation called for in the Standard Drawings. Unless noted otherwise in the plans or specifications, grout connections on the casing pipe shall be provided near the top of the casing. Longitudinal spacing between grout connections along the axis of the casing pipe shall be 60 inches. This spacing may be decreased to provide more frequent grouting, but in no case shall the spacing shown on the drawings or specifications be exceeded.

SECTION 5

MATERIALS FOR SEWER

5-01 GENERAL

The reference to specifications for the various materials shall include, in addition to the basic specifications referred to, all applicable amendments to the specifications and all emergency alternate specifications which have been promulgated and are in effect. Whenever a material, article, or piece of equipment is identified on the plans or in the specifications by reference to manufacturers' or vendors' names, trade names, catalogue numbers, etc., it is intended generally to establish a standard; and, any material, article, or equipment of other manufacturers and vendors which will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or equipment so proposed, is in the opinion of the District, of equal substance and function. It shall not be purchased or installed without the District's written approval.

5-02 VITRIFIED CLAY PIPE (VCP)

A. Pipe

1. General: All VCP and fittings shall be extra strength, and shall comply with ASTM C700. Pipe and fittings shall be of the best quality; vitrified; homogenous in structure; thoroughly burned through their entire thickness; impervious to moisture; sound; and free from cracks, checks, blister, broken extremities, or other imperfections. Pipe ends shall be square with the longitudinal axis, and sockets shall be true, circular, and concentric with the barrel of the pipe. The thickness of the shell, the depth of the socket, and the dimension of the annular space shall be within the limits of permissible variation to dimension standards of the specifications of ASTM C700, for the size of pipe indicated on the plans.
2. Pipe Marking: All pipe or fittings shall be clearly marked with the name of the manufacturer or with a trademark and with the size and strength of the pipe as shown on the plans and as herein specified.
3. Testing: Before being used in any work under these specifications, pipe shall be subjected to and shall meet the requirements of the following hydrostatic pressure test and loading test; these tests shall be witnessed by a reputable testing laboratory approved by the District. Pipe selected for testing shall be delivered to the place and at the time designated by the testing laboratory. All costs of furnishing, transporting, and handling the pipe for testing and conducting the tests shall be borne by the Contractor.

Where specifically approved by District, a certified statement from the pipe manufacturer, in lieu of witnessing by a testing laboratory may be furnished stating that all prescribed tests have been made and the pipe to be used

on the project has met all requirements of the specifications.

The testing laboratory shall select, at random, for testing as herein specified, no less than 1% of the number of pipe sections in each size of pipe furnished.

The specimens selected for testing shall be sound pipe having dimensions consistent with these specifications. The lot or lots from which the tests samples are taken shall be sufficient to fill the entire order for that size of pipe used in the work under the contract and, if they pass the tests, shall be so designated and marked.

All pipe shall be subject to inspection at the factory, trench, or other point of delivery by the District Representative. The purpose of the inspection shall be to cull and reject any pipe that, independent of the physical tests herein specified, fails to conform to the requirements of these specifications or that may have been damaged during transportation or in subsequent handling.

In lieu of the standard ASTM absorption test, the ASTM C301 hydrostatic pressure test shall be substituted. The hydrostatic pressure test shall precede the loading test by not less than one hour or more than three hours and shall be applied to all the specimens received for test in each size of pipe.

The loading test shall be the 3-edge bearing test. The loading tests shall conform to the applicable provisions of ASTM C301 and shall be applied to all specimens selected for testing, except that loading to test ultimate strength will not be required.

If all of the minimum designated percentage or number of the specimens tested meet the requirements of the test, then all of the pipe in the lot, shipment, or delivery corresponding to the sizes and classes so tested shall be considered as complying with the test. If, however, 10% or more of the specimens tested fail to meet the requirements of the test or if more than one specimen fails to meet the requirements of the test when the number to be tested is less than ten, then a second selection of pipe shall be made for that test. The number of specimens to be tested in the second selection of pipe shall be five for each specimen of the first selection that failed to meet the requirements.

If 90% or more of the specimens tested, including those first tested, meet the requirements of the test, all the pipe in the lot, shipment, or delivery corresponding to the sizes and classes so tested shall be considered as complying with that test, otherwise all pipe of these sizes and classes shall be rejected.

4. Causes for Rejection: The following imperfections in a pipe or special fitting shall be considered injurious and cause for rejection without consideration of the test results specified above.

- a) A single crack in the barrel of the pipe will cause rejection.
 - b) Surface imperfections, such as lumps, blisters, pits or flakes, on the interior surface of a pipe or fitting shall cause rejection.
 - c) When the bore or socket of the pipe varies from a true circle more than 3% of its nominal diameter, it shall be rejected.
 - d) The pipe or fitting shall be rejected if it is designated to be straight and it deviates from a straight line more than 1/16-inch per lineal foot. The deviation shall be measured from a straight edge at a point midway between the ends of the pipe.
 - e) A joint of pipe with a piece broken from either the socket or spigot end shall be rejected.
 - f) Pipe joints that have tramp clays, grog or other foreign matter flushed permanently to the exterior or interior surface of the pipe or fittings shall be rejected.
5. Joints: Unless otherwise specified, all VCP pipe and fittings joints shall be of the bell and spigot compression type, complying with ASTM C425. Joints shall be equal to "Speed Seal" manufactured by Gladding McBean division of Pacific Coast Building Projects, or polyurethane compression joints as manufactured by Mission Clay Products (MCP Industries, Inc.) for contracts between District and Contractor, approved equal. The compression joint on the spigot and bell ends of the pipe shall be factory made of plastisol, polyurethane elastomer, or other approved resilient element bonded onto the outside of the spigot and the inside of the bell to the pipe and molded and cured to a uniform hardness and compressibility to form a tight compression coupling when assembled.
- Where pipe from different manufacturers is to be jointed together, an adapter pipe with the proper matching joint on each end for the respective manufacturer shall be used. Hot poured joints or concrete encasement of plain end joints shall not be permitted.
6. Branches: Branches of the type shown on the plans shall be furnished with connections of the sizes specified and shall be securely and completely fastened to the barrel of the pipe in the process of manufacture. Tee branches shall have their axis perpendicular to the longitudinal axis of the pipe. Wye branches shall have their axis approximately 45 degrees (unless otherwise specified on the plans) to the longitudinal axis of the pipe, measured from the socket end. All branches shall terminate in sockets and the barrel of the branch shall be of sufficient length to permit making a proper joint.
7. Stoppers: The stoppers for all pipe 8-inches in diameter and smaller, in which a sealing component for a flexible compression-type joint is cast, shall be neoprene, polyethylene, or polyurethane. Stoppers in all other cases shall be discs of the same material as the pipe, equal in diameter to

the outside of the pipe barrel, and made and installed as approved by the District Representative.

Neoprene stoppers shall be manufactured from a compound containing not less than 50 percent neoprene by volume, which shall be the sole elastomer. Stoppers shall not be adversely affected when exposed to the chemical and bacteriological environments normally found in wastewater sewers. Neoprene Stoppers shall be of the type manufactured by Mission Clay Products (MCP Industries, Inc.), Gladding McBean, or for contracts between District and Contractor, approved equal.

When installed and braced in place in branch spurs, stoppers shall withstand a hydrostatic pressure test of 10 psi with no leakage. When unbraced, stoppers shall remain in place when subject to a maximum air pressure test of 5 psi.

8. Manufacturers: Vitrified clay pipe shall be manufactured by Gladding McBean, Division of Pacific Coast Building Products, Inc., Pacific Clay Products, Mission Clay Products LLC (MCP Industries, Inc.), or for contracts between District and Contractor, approved equal.

5-03 POLYVINYL CHLORIDE (PVC) SEWER PIPE

A. Pipe and Fittings

1. ASTM Requirements: Pipe, fittings, couplings, and joints shall be in conformance with the size, material and performance requirements of ASTM D 3034, SDR 35, and shall have gasketed joints.

Pipe shall be made of PVC plastic having a cell classification of 12454 as defined in ASTM D 1784. All pipe shall be of solid wall construction with smooth interior and exterior surfaces.

Fittings shall be made of PVC plastic having a cell classification of 12454.

2. Manufacturer's Testing Certification: During production of the pipe, the manufacturer shall perform the specified tests for each pipe marking. A certification by the manufacturer indicating compliance with specification requirements shall be delivered with the pipe. The certification shall include the test result data.
3. Pipe Marking: All pipe, fittings, and couplings shall be clearly marked at an interval not to exceed 5-feet as follows:
 - a) Nominal pipe diameter.
 - b) PVC cell classification.
 - c) Company, plant, shift, ASTM, SDR, and date designation.
 - d) Service designation or legend.

For fittings and couplings, the SDR designation is not required. All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made. Fittings shall be marked with raised molding markings on two sides (diametrically opposite from each other) showing the manufacturer's identification information.

4. Additional Pipe Tests Following Delivery: When pipe is delivered to the jobsite, the District Representative may require additional testing to determine conformance with the requirements of pipe flattening, impact resistance, pipe stiffness, and extrusion quality.

When testing is required, one test pipe shall be selected at random by the District Representative from each 1,200 feet or fraction thereof of each size of pipe delivered to the jobsite, but not less than one test pipe per lot. A lot shall be defined as pipe having the same identification marking. The length of specimen for each selected pipe shall be a minimum of 8-feet.

5. Pipe Retest: Pipe which is not installed within 120 days of the latest test shall not be used without prior approval from the District Representative.
6. Pipe Manufacturers: Pipe shall be as manufactured by Certainteed Corporation, Diamond Plastics Corporation, J-M Manufacturing Company, Inc. and PW Eagle, Inc. (dba JM Eagle™), North American Specialty Products, or Vinyltech Corporation.
7. Fitting and Coupling End Configurations: The socket and spigot configurations for fittings and couplings shall be compatible with those used for the pipe.
8. Fittings Manufacturers: Fittings shall be as manufactured by GPK Products, Inc., Harco Fittings, Inc. (dba Harrington Corporation and HARCO), J-M Manufacturing Company, Inc. and PW Eagle, Inc. (dba JM Eagle™), Multi Fittings Corporation, Plastic Trends, Inc., or Tigre PVC Fittings.

B. Gaskets for PVC Pipe

1. General: Unless otherwise specified, gaskets shall be manufactured from a synthetic elastomer, and shall be extruded or molded and cured in such a manner as to be dense, homogeneous and of smooth surface, free of pitting, blisters, porosity, and other imperfections. The compound shall contain not less than 50 percent by volume of first-grade synthetic rubber. The remainder of the compound shall consist of pulverized fillers free of rubber substitutes, reclaimed rubber, and deleterious substances.

The tolerance for any diameter measured at any cross section shall be $\pm 1/32$ -inch (.8mm).

2. Gasket Material Requirements: When required by the District

Representative, the Contractor shall furnish test samples of gaskets from each batch used in the work.

3. Splices: No more than one splice will be permitted in a gasket. A splice shall be made by applying a suitable cement to the ends and vulcanizing the splice in a full mold. The splice shall show no separation when subjected to the following tests:
 - a) Elongation Test: The part of the gasket which includes the splice shall withstand 100% elongation with no visible separation of the splice. While in the stretched position, the gasket shall be rotated in the spliced area minimum of 180 degrees in each direction in order to inspect for separation.
 - b) Bend Test: The portion of the unstretched gasket containing the splice shall be wrapped a minimum of 180 degrees and a maximum of 270 degrees around a rod of a diameter equal to the cross section diameter of the gasket.

5-04 DUCTILE IRON PIPE

Ductile iron pipe shall comply with the provisions of Section 207-9 of the "Standard Specifications for Public Works Construction", latest edition. All pipe and fittings shall be coated inside and outside per ANSI Standard A21.6 – (latest edition) unless otherwise noted. Ductile iron pipe shall be compression (slip) joint, conforming with ANSI A21.11 and A21.51, latest, and shall be standard thickness class 52. All ductile iron pipe shall be provided with an 8 mil polyethylene encasement the entire length of the pipeline.

5-05 WYES AND TEES

All sewer lateral connections shall be made with use of a Wye or Tee fitting. New sewer laterals to be installed on existing sewer mains shall be accommodated by a cut-in wye or tee unless otherwise approved by the District Engineer. Where allowed by the District Engineer, a saddle of proper type and size for the sewer main may be used. The saddles for VCP and PVC pipe shall be provided with a groove to accommodate a rubber O-ring gasket cemented in place so as to be an integral part of the saddle. The saddle shall be provided with a stainless steel band and hardware for firmly attaching to sewer main.

5-06 MANHOLE FRAME AND COVER

Manhole frames and covers for District sewers shall be furnished in accordance with EVWD Standard Drawing No. S-106, and shall be furnished with a 36-inch diameter over-all base, a 24-inch clear opening, a 5-inch frame height, a diamond pattern cover with letter designations "SEWER" and "EVWD", weighing no less than 385 pounds in place and shall be designed for H-20 highway wheel loading. The seat shall be beveled of the non-rocking type with covers and frames machined and matched to fit snugly. All castings shall be dipped twice in a preparation of asphalt

or coal tar and oil applied at a temperature of not less than 290 degrees F nor more than 310 degrees F and in such a manner as to form a firm and tenacious coating.

Covers and frames shall be Alhambra Foundry No. A-1590, or approved equal, subject to the above specifications, the Plate and the approval of the District.

5-07 PRECAST MANHOLES

Precast concrete manhole components shall be in accordance with ASTM C 478 and the EVWD Standard Drawings. Manhole components shall be designed for H-20 highway wheel loading and specific site conditions. Manhole shaft shall be fabricated only from precast shaft sections, eccentric cones and grade rings.

Manhole bases may be either precast or cast-in-place, as appropriate for the application, with a recess shaped to match the first precast shaft section. The manhole base shall extend 9-inches below the bottom of the lowest pipe and 6-inches above the top of the largest pipe.

SECTION 6
METHODS OF CONSTRUCTION FOR SEWER

6-01 EXCAVATION, TRENCHING AND BACKFILL

A. General

The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths and alignment indicated on the construction drawings or as otherwise specified. During Excavation, material suitable for backfilling shall be piled in an orderly manner, a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed and wasted by the Contractor at the direction of the District Engineer.

Suitable shoring, timbering or sheeting shall be provided by the Contractor where necessary to support the sides of the trench prior to and during the installation of the pipe. The shoring methods and procedure shall be consistent with safety and shall be removed as the trench is being backfilled.

B. Trench Excavations

The trench shall be excavated to a width not less than twelve (12") inches nor greater than sixteen (16") inches wider than the outside diameter of the pipe barrel measured at a point twelve (12") inches above the top of the pipe. The trench shall be excavated to the depth necessary to accommodate the placement of six (6") inches of pipe bedding as defined below. The width of the trench above that level may be as wide as necessary for sheeting and bracing and the proper performance of the work.

Except where rock or unsuitable materials is encountered, care shall be taken not to excavate below the depths indicated on the construction drawings. Where the trench bottom requires the use of imported material under the pipe because of soft, wet, spongy or unstable conditions in the trench, a minimum thickness of twelve (12) inches of crushed rock bedding shall be placed below grade of pipe invert for the full width of the trench.

In accordance with the requirements of Section 6705 of the California Labor Code, the Contractor, prior to beginning any trench or structure excavation in excess of 5 feet deep, shall be in receipt of the District's written acceptance of the Contractor's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative systems plans shall be prepared by a civil or structural engineer licensed in the State of California.

C. Excavation for Appurtenances

Excavation for manholes and similar structures shall be sufficient to leave at

least twelve (12) inches clear between their outer surfaces and embankment or timber which may be used to hold and protect the banks. Excavations for other structures shall be made to the grades shown on the construction drawings and all work shall be done in a workmanlike manner.

D. Pipe Bedding

Prior to installation of sewer pipe, ¾" crushed stone per Greenbook Section 200-1.2 shall be placed in the trench bottom as shown on EVWD Standard Drawing No. S-114. Bell holes and depressions for joints shall be dug after the bedding has been placed and graded and shall be only of such length, depth and width as necessary for properly making the particular type of joint.

E. Backfill

5. General - Backfilling of the trench around the pipe and excavation around appurtenances shall follow the installation as closely as possible. Backfill shall be accomplished in two stages: (a.) Pipe zone backfill from bedding material to twelve (12") inches over the pipe; (b.) Trench zone backfill from twelve (12") inches over the pipe to the Paving Sub-Base.

c) Pipe Zone Backfill: After the pipe has been bedded, pipe zone material shall be placed simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Material shall be carefully placed around the pipe so that the pipe barrel is completely supported and that no voids or un-compacted areas are left beneath the pipe. Particular care shall be taken in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling. Material placed within the pipe zone shall be compacted by hand tamping only. The backfill material shall be approved by the District Engineer and shall contain no rock larger than one and one-half (1-1/2") inch for VCP or three-quarter (3/4") inch for PVC Pipe.

d) Trench Zone Backfill: Backfill material shall be carefully deposited onto the backfill previously placed in the pipe zone. Free fall of the material shall not be permitted until at least 2 feet of cover is provided over the top of the pipe. Sharp, heavy pieces of material shall not be dropped directly onto the pipe or the tamped material around the pipe. Backfill material shall be approved by the District Engineer and shall contain no rock larger than six (6") inches. Backfill shall be placed in maximum lifts of two (2') feet and shall be compacted to a minimum density of ninety (90) percent of its maximum density as determined in accordance with ASTM D 1557.

F. Pavement Replacement

2. General - When it is necessary to break pavement to order to lay the pipe lines shown on the construction drawings, the existing pavement shall be cut vertically as nearly as possible to a straight line by an approved method. The pavement so removed shall be hauled away as directed by the District and shall be replaced with like material. All pavement removal and replacement shall conform to the standards and specifications of the governing body having jurisdiction and shall meet with their approval. The Contractor shall be responsible for replacing all necessary pavement.

6-02 PIPE LAYING

1. All foreign matter and dirt shall be removed from the interior of the pipe prior to its installation. Before lowering, the pipe shall be inspected for defects. Any defective, damaged or unsound pipe shall be rejected. The entire joint including coupling, ends of the pipe and the rubber gasket or ring shall be thoroughly cleaned at the time the joint is made. The entire procedure and method of installation of the pipe and making joints shall be done in a workmanlike manner and shall be in strict accordance with the pipe manufacturers direction and recommendations.
2. The bottom of the trench shall be shaped to give substantially uniform support to each pipe. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe pointing in the direction of the flow. The faces of all spigot ends and all shoulders in the hubs or sockets must be true and brought into firm contact. Rubber ring locations shall be checked with suitable gauges to insure that they are located in the proper position relative to the pipe ends.
3. Each pipe shall be laid true to line and grade in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line. As the work progresses, the interior of the sewer shall be cleared of all dirt and superfluous materials of every description.
4. If the maximum width of the trench at the top of the pipe, specified in EXCAVATION, TRENCHING AND BACKFILL, is exceeded for any other reason than by order of the District Engineer, the Contractor shall install, at his own expense, such concrete, cradling, pipe encasement, or other bedding as may be required by the District Engineer to support the added load the backfill. Trenches shall be kept free from water until the pipe jointing has been completed, and pipe shall not be laid when the condition of the trench or the weather is unsuitable for such work. The Contractor shall take all necessary care and precautions to prevent the pipe from floating due to water entering the trench from any source. The Contractor shall be responsible for damage caused by floating pipe, and shall at his sole expense, restore and replace the pipe to its proper condition, alignment and grade. At times when work is not in progress, unfinished ends of pipe and fittings shall be securely closed to the satisfaction of the District Engineer so that no trench water, earth or other substance will enter the pipe or fittings.

5. Where pipe is laid on a curve or at horizontal or vertical angles in the trench, the maximum deflection at the joint shall not exceed sixty (60) percent of the limitations specified by the pipe manufacturer and each joint shall be adequately blocked to take the thrust until properly backfilled.
6. Whenever pipe is required to be cut, it shall be done in a neat and workmanlike manner and the cut shall be made at a right angle to the longitudinal axis of the pipe. All burrs shall be removed prior to the assembly of the pipe.
7. Connections to manholes or other rigid structures shall be accomplished by the use of two – One (1') foot long pipe sections at each side of the manhole or structure.

6-03 PIPE JOINTING

A. Vitrified Clay Pipe

Joints in the bell-and-spigot pipe shall be made by lubricating the resilient material on both the bell-and-spigot ends with a soap solution approved the manufacturer. Position the spigot inside the bell of the next length and properly align the two sections in the trench. Put the joint home by hand or by means of a bar lever, with wooden blocking to protect the bell end from damage, until the joint is obtained.

Joints in plain-end pipe shall consist of three parts; a circular rubber sleeve, stainless steel compression bands with a bolt and nut mechanism for tensioning bands, and a sheer ring to insure proper alignment of the pipe joints. The bolt and nut mechanism to tension bands shall be tightened by a torque wrench, furnished by and preset to the manufacturer's specifications. Prior to tensioning, a lubricant approved by the manufacturer shall be applied to the rubber under the area of the bands.

B. Polyvinyl Chloride (PVC) Pipe

Joints in PVC elastomeric joints shall be made by making certain the bell and rubber rings are clean with no foreign material that could interfere with the proper assembly of the joint. Wipe the spigot end of the pipe with a clean, dry cloth around the entire circumference from the end to one inch beyond the reference mark. Lubricate the spigot end of the pipe, using only lubricant recommended or supplied by the pipe manufacturer. The lubricant shall be applied to a consistency and manner in accordance with the pipe manufacturers recommendation. The spigot end of the pipe is then inserted into the bell so that it is in contact with the rubber ring, keeping the pipe lengths in proper alignment. Brace the bell while the spigot end is pushed in under the rubber ring, so that previously completed joints will not be closed up. Push the spigot end in until the reference mark on the spigot end is flush with the end of the bell. This pipe shall be assembled by hand and/or bar and block and shall not be stabbed.

C. Ductile Iron Pipe

1. Bell-and-Spigot - Before jointing, the outside of the spigot and the inside of the bell shall be free from lumps, blisters, oil, grease and excess coating material, and shall be wire brushed and wiped clean and dry. Join as described above for PVC pipe.
2. Mechanical - Before jointing, the socket and plain end of the pipe shall be brushed and wiped clean of dirt, oil, grease and scale. The socket and end shall be washed with soapy water, then after the gland and gasket have been slipped on, the gasket shall be painted with soapy water. The gasket shall then be pushed into position and seated with the fingers after which the gland shall be positioned and all bolts tightened by hand before using the wrench.

6-04 WYES AND TEES

Commercially manufactured wyes or tees shall be installed where indicated on the plans and/or at such other locations required by the District Engineer. All wye branches not joined to house connections shall be installed with a suitable stopper of the size of the wye branch. The wye branches, unless otherwise specified, shall be inclined upward at an angle not greater than 45 degrees from a horizontal line. No wye branch shall be placed closer than five (5) feet to the centerline of any structure.

6-05 CHIMNEY PIPES

Chimney pipes shall be constructed as shown and at the locations designed on the plans. Chimney pipes shall be installed where the depth of the sewer main is twelve (12) feet or more, or as designated by the District Engineer.

6-06 LATERAL CONNECTIONS

The term "lateral connection" as used in these specifications or on the plans is used to designate branch or lateral sewers, laid from a main sewer to points at the property lines, or other locations as shown on the plans, from which sewer service can be obtained by proper extension.

The lateral connection shall be constructed in accordance with details herein on an unyielding foundation, with joints closely and accurately fitted, true to line, and on a straight grade from the bend joining the main sewer to their upper ends, unless otherwise indicated on the plans. House connections shall not be laid on a slope greater than 45 degrees from a horizontal line unless approved by the District Engineer.

6-07 MANHOLE

A. General

Manhole invert channels shall be smooth and semicircular in shape, conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base, may be half tile laid in concrete, or may be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than one (1) inch per foot or more than two (2) inches per foot. Edge of channel shall be rounded and smooth.

Manhole frames and covers shall be installed in accordance with EVWD Standard Drawing No. S-104. Top of manhole frames and covers shall be installed six (6) inches below finish grade in new tract developments. After paving, frames and covers shall be adjusted to top of pavement. Manhole frames and covers in existing street pavement shall be constructed to top of pavement.

B. Precast Manholes

Precast Manholes shall be installed per EVWD Standard Drawing No. S-104 and in accordance with the manufacturer's specifications. The inside joints shall be neatly struck and pointed with mortar not to exceed 3/8" in thickness. As an alternate to applying mortar to the inside joints, a flexible plastic gasket as manufactured by Henry Company, or approved equal, may be used. An eccentric cone shall be used with the straight wall downstream except at permanent sewer dead ends where the straight wall shall be upstream. All junction manholes shall have concentric cones. All manholes shall have three (3) inch and six (6) inch grade rings with a minimum height of twelve (12) inches, and a maximum height of twenty-four (24) inches, below the manhole frame.

C. Drop Manholes

Drop Manholes shall be constructed as shown on EVWD Standard Drawing No. S-105 and may only be used with approval of the District Engineer.

D. Remodeling Existing Manholes

Pipe connections to existing manholes or existing stubs shall be made in such manner than the finished work will conform as nearly as practicable to the

essential applicable requirements specified for new manholes, including all necessary brick work, concrete work, cutting and reshaping of inverts to provide proper channels for flow.

6-08 DEAD ENDS

Dead Ends may be constructed as shown on EVWD Standard Drawing NO. S-107 at locations approved by the District Engineer. The top of Dead End frames and covers shall be installed six (6) inches below finish grade in new tract developments. After paving, the top of dead end frames and covers shall be raised flush with final pavement surface.

6-09 FIELD TESTS

A. General

The completed sewers, including laterals and manholes, shall be watertight, clean, of uniform grade and free from obstructions or offsets which could interfere with the functional design of the system. Except as indicated below, the Contractor shall furnish all materials, equipment and services required for all testing. Compaction tests shall be completed to confirm satisfactory densification of backfill prior to tests for displacement, leakage or deflection of sewer pipe. Any backfill re-compaction effort or sewer pipe repair done after testing will require retests for compaction, displacement, leakage and deflection. Tests shall be made in the presence of the District's authorized representative and shall be performed prior to the sewers being placed in service. All sewers will require testing unless otherwise directed by the District.

B. Test for Displacement of Sewers

Sewer main will be checked by the District Engineer to determine whether any displacement of the pipe has occurred after the trench has been completely backfilled and compacted as specified. The test will be as follows: A light will be flashed between manholes, or if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight. After the sewer mains have been visually inspected, the contractor shall pass their cleaning equipment through the sewer mains to check for obstructions. If the illuminated interior of the pipeline shows poor alignment, displaced pipe, or the cleaning equipment will not pass through the sewer mains freely, the defects designated by the District shall be remedied by the Contractor at his expense to the satisfaction of the District.

C. Test For Leakage

1. General: Water tightness of sewers and manholes shall be determined by one of the following two methods:

- a) Exfiltration Testing
- b) Low Pressure Air Testing

2. Exfiltration Test: Each section of sanitary sewer shall be tested from manhole to manhole or dead-end. The tests shall be made by closing the lower end of the sewer to be tested and the inlet of the upper structure with plugs and filling the pipe and structure with water to a point four (4) feet above the invert of the open sewer in the upper manhole or dead-end. Where the difference in elevation of inverts of the lower and upper structures is more than 20 feet, an air test shall be used.

Prior to the actual test, the sewer and manhole to be tested shall be allowed to saturate at the test head for a period to be determined by the District Engineer. the allowable leakage shall be 200 gallons per day per inch of inside diameter per mile of sewer. If the leakage disclosed by the test is greater than that allowed by the formula, the sewer main shall be repaired and if necessary, re-laid until the joints shall hold satisfactorily under this test.

All sewer mains will require testing unless otherwise directed by the District Engineer. The Contractor shall, at his own expense, furnish all materials and labor for making said tests, and the tests shall be made only in the presence of the District Engineer or his authorized representative.

3. Hydrostatic Test – Manholes: When the air pressure test is used for testing of the pipe and where required by the District Engineer, manholes shall be water tested separately. The inlet and outlet of the manhole shall be plugged and the cylindrical section of the manhole filled with water. The maximum allowable leakage rate per foot of depth tested shall be one (1) gallon per hours. The test shall run a minimum of thirty (30) minutes.
4. Air Test: Length of line tested at one time shall be limited to the length between adjacent structures. Pressurize the test section to 4.0 psi and hold at 4.0 psi for not less than two minutes. Add air if necessary, to keep the pressure at 4.0 psi. Disconnect air supply. When pressure decreases to 3.5 psi, start stopwatch. Determine the time in seconds that is required for the internal pressure to reach 2.5 psi. This time interval shall be greater than time given in the following table. The section of pipe shall not have passed if the time is less than shown.

Minimum Air Test Time

Sewer Diameter	Minimum Time (min & sec) for 1.0 PSIG Pressure Drop for Length (Feet) of Sewer Shown
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(in.)	<u>100</u>	<u>150</u>	<u>200</u>	<u>250</u>	<u>300</u>	<u>350</u>	<u>400</u>	<u>450</u>
4	0:18	0:27	0:36	0:45	0:53	1:02	1:11	1:20
6	0:40	1:00	1:20	1:40	2:00	2:20	2:40	3:00
8	1:11	1:47	2:22	2:58	3:34	4:09	4:44	5:20
10	1:51	2:47	3:42	4:38	4:43	5:11	5:56	6:40
12	2:40	4:00	5:20	5:40	5:40	6:14	7:07	8:00
15	4:10	6:15	7:05	7:05	7:05	7:18	8:20	9:23
18	6:00	8:30	8:30	8:30	8:30	8:30	9:37	10:49
21	8:11	9:55	9:55	9:55	9:55	10:24	11:54	13:23
24	10:41	11:20	11:20	11:20	11:20	12:28	14:14	16:00

When the prevailing ground water is above the sewer being tested, air pressure shall be increased 0.43 psi for each foot the water table is above the flow line of the sewer.

If the time for the pressure to drop 1.0 psi is not more than 125 percent of the time given in the table, the line shall immediately be re-pressurized to 4.0 psi and the test repeated.

If the test is not passed, the leak shall be found and repaired to the satisfaction of the District Engineer.

House sewers shall be considered part of the main sewer to which they are connected and no adjustment of test time shall be allowed to compensate, i.e. the length of four (4) and six (6) inch house sewers or laterals which are tested as part of the main sewer shall be ignored for determining minimum time.

The pressure gauge used shall be supplied by the Contractor; shall have minimum divisions of 0.10 psi, and shall have an accuracy of 0.04 psi. Accuracy and calibration of the gauge shall be certified by a reliable testing firm at six- month intervals, or when requested by the District Engineer.

When the air pressure test is used for testing of the pipe, the manholes shall be hydrostatically tested in accordance with 3-11-c (4).

D. Mandrel Test of PVC Pipe

Following the placement and densification of backfill and prior to the placing of permanent pavement, all main line PVC pipe shall be cleaned and then mandrelled. A rigid mandrel, with a circular cross section and a minimum of nine (9) longitudinal bars, having a minimum length of the circular portion equal to the nominal diameter of the pipe, shall be pulled through the pipe by hand. If the mandrel sticks in the pipe at any point, the pipe shall be replaced and retested. The mandrel diameter shall be at least 95 percent of the specified average inside pipe diameter for PVC solid wall pipe.

E. Compaction Tests

Compaction tests of the trench backfill is required approximately every 300 feet, or more often if tests indicate the need, along the alignment of the main pipeline, and, in addition, of approximately 20 percent of all laterals within the street right-of-way. The tests shall be made at varying depths. Final test results shall be submitted in the form of a test report by an approved soils testing laboratory. Any additional requirements of governing bodies having jurisdiction must be met. If the work is done under a permit, the Contractor shall obtain written confirmation that the work is acceptable to the governing body having jurisdiction.

SECTION 7
CRITERIA FOR SEPARATION OF WATER MAINS
AND SANITARY SEWERS

7-01 GENERAL

The community is vulnerable as stated in the public health considerations of this section. Water mains in close proximity to sanitary sewers are vulnerable to contamination. It is the Contractor's responsibility to maintain proper separation of water mains and sanitary sewers.

This document sets forth the construction criteria for the installation of water mains and sewer lines to prevent contamination of the public water supplies by nearby sanitary sewers. There shall be no deviation from this criteria except upon written approval from the State Health Department. The following criteria must be followed:

7-02 BASIC SEPARATION STANDARDS

The "California Waterworks Standards" sets forth the minimum separation requirements for water mains and sewer lines. These standards, contained in Section 64630, Title 22, California Administrative Code, specify.

- a) Parallel Construction: The horizontal distance between pressure water mains and sewer lines shall be at least 10 feet.
- b) Perpendicular Construction (Crossing): Pressure water mains shall be at least one foot above sanitary sewer lines where these lines must cross.
- c) Separation distances specified in (b) shall be measured from the nearest edges of the facilities.
- d) Common Trench: Water mains and sewer lines must not be installed in the same trench. When water mains and sanitary sewers are not adequately separated the potential for contamination of the water supply increases. Therefore, when adequate physical separation cannot be attained an increase in the factor of safety should be provided by increasing the structural integrity of both the pipe materials and joints.

7-03 EXCEPTIONS TO BASIC SEPARATION STANDARDS

Local conditions, such as available space, limited slope, existing structures, etc. may create a situation where there is no alternative but to install water mains or sewer lines at a distance less than that required by the Basic Separation Standards. In such cases, alternative construction criteria as specified in Section 7-06 should be followed, subject to the special provisions in Section 7-04.

7-04 SPECIAL PROVISIONS

- a) The Basic Separation Standards are applicable under normal conditions for Sewage collection lines and water distribution mains. More stringent requirements may be necessary if conditions, such as, high ground water exist.
- b) Sewer lines shall not be installed within 25 feet horizontally of a low head (5 psi or less pressure) water main.
- c) New water mains and sewers shall be pressure tested where the conduits are located ten feet apart or less.
- d) In the installation of water mains or sewer lines, measures should be taken to prevent or minimize disturbances of the existing line. Disturbance of its supporting base could eventually result in failure or the existing pipeline.
- e) Special consideration shall be given to the selection of pipe materials if corrosive conditions are likely to exist. These conditions may be due to soil type and/or the nature of the fluid conveyed in the conduit, such as a septic sewage which produces corrosive hydrogen sulfide.

7-05 SEWER FORCE MAINS

- a) Sewer force mains shall not be installed within ten feet (horizontally) of water main.
- b) When a sewer force main must cross a water line, the crossing should be as close as practical to the perpendicular. The sewer force main should be at least one foot below the water line.
- c) When a new sewer force main crosses under an existing water main, all portions of the sewer force main within ten feet (horizontally) of the water main shall be enclosed in a continuous sleeve.
- d) When a new water main crosses over an existing sewer force main, the water main shall be constructed of pipe materials with a minimum rated working pressure of 200 psi or equivalent pressure rating.

7-06 ALTERNATE CRITERIA FOR CONSTRUCTION

The construction criteria for sewer lines or water mains where the Basic Separation Standards cannot be attained are shown in EVWD Standard Drawing NO. W-106 & W-107. There are two situations encountered:

Case 1 - - New Sewer Line – new or existing water main.

Case 2 - - New water main – existing sewer line.

For Case 1, the alternate construction criteria apply to the sewer line.

For Case 2, the alternate construction criteria may apply to either or both the water main and sewer line.

The construction criteria should apply to the house laterals that cross above a pressure water main but not to those house laterals that cross below a pressure water

main.

Case 1: New Sewer Being Installed

Zone Special Construction Required for Sewer Pipe

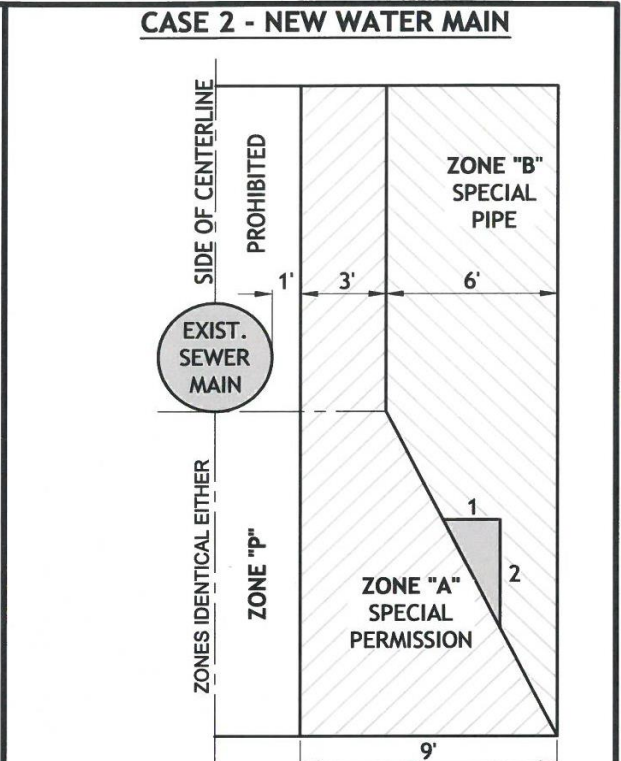
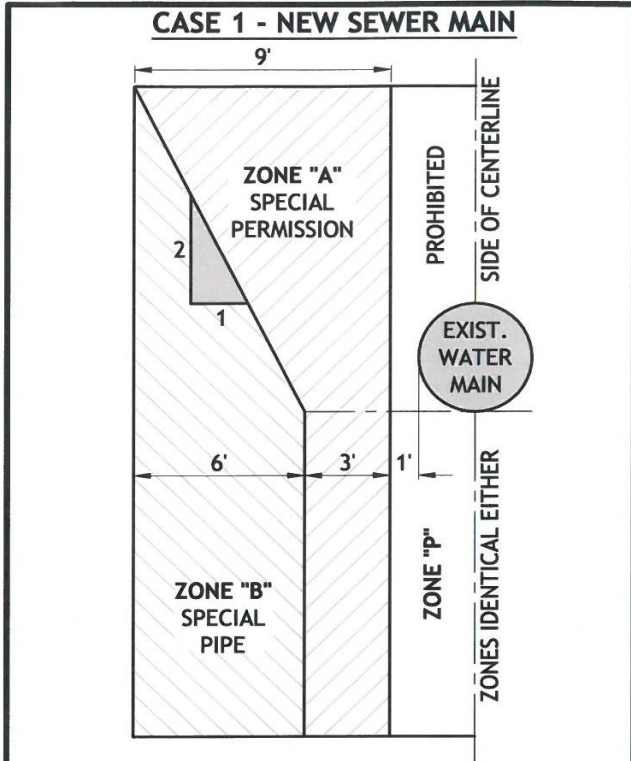
- A. Sewer lines parallel to water mains shall not be permitted in this zone without approval from the responsible health agency and water supplier.
- B. A sewer line placed parallel to a water line shall be constructed of:
 - i. Extra strength vitrified clay pipe with compression joints.
 - ii. Class 4000 Type II, asbestos-cement pipe with rubber gasket joints.
 - iii. Plastic sewer pipe with rubber ring joints (per ASTM D3034) or equivalent.
 - iv. Cast or ductile iron pipe with compression joints.
 - v. Reinforced concrete pressure pipe with compression joints (per AWWA C302-74).
- C. A sewer line crossing a water main shall be constructed of:
 - i. Ductile iron pipe with hot dip bituminous coating and mechanical joints.
 - ii. A continuous section of Class 200 (DR 14 per AWWA C900) plastic pipe or equivalent, centered over the pipe being crossed.
 - iii. A continuous section of reinforced concrete pressure pipe (per AWWA C302-74) centered over the pipe being crossed.
 - iv. Any sewer pipe within a continuous sleeve.
- D. A sewer line crossing a water main shall be constructed of:
 - i. A continuous section of ductile iron pipe with hot dip bituminous coating.
 - ii. A continuous section of Class 200 (DR 14 per AWWA C900) plastic pipe or equivalent, centered on the pipe being crossed.
 - iii. A continuous section of reinforced concrete pressure pipe (per AWWA C302) centered on the pipe being crossed.
 - iv. Any sewer pipe within a continuous sleeve.

Case 2: New Water Mains Being Installed

Zone Special Construction Required for Sewer Pipe

- A. No water mains parallel to sewers shall be constructed without approval from the health agency.
- B. If the sewer paralleling the water main does not meet the Case 1, Zone B, requirements, the water main shall be constructed of:

- i. Ductile iron pipe with hot dip bituminous coating.
 - ii. Dipped and wrapped one-fourth-inch-thick welded steel pipe.
 - iii. Class 200, Type II, asbestos-cement pressure pipe.
 - iv. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
 - v. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300 or C301 or C303).
- C. If the sewer crossing the water main does not meet the Case 1, Zone C, requirements, the water main shall have no joints in Zone C and be constructed of:
- i. Ductile iron pipe with hot dip bituminous coating.
 - ii. Dipped and wrapped one-fourth-inch-thick welded steel pipe.
 - iii. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
 - iv. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300 or C301 or C303).
- D. If the sewer crossing the water main does not meet the requirements for Zone D, Case 1, the water main shall have no joints within four feet from either side of the sewer and shall be constructed of:
- i. Ductile iron pipe with hot dip bituminous coating.
 - ii. Dipped and wrapped one-fourth-inch-thick welded steel pipe.
 - iii. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.
 - iv. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300 or C301 or C303).



SPECIAL CONSTRUCTION REQUIRED FOR NEW SANITARY SERWER MAIN: CASE 1

ZONE "A"

Sanitary sewer mains parallel to water mains shall not be permitted in this zone without prior written approval from the Department and public water system.

ZONE "B"

If the water main paralleling the sanitary sewer main does not meet the Case 2 Zone "B" requirements, the sanitary sewer main should be constructed of one of the following:

1. High-density-polyethylene (HDPE) pipe with fusion welded joints (per AWWA C906-99);
2. Extra strength vitrified clay pipe (VCP) with compression joints;
3. Class 4000, TType II, asbestos-cement (A.C.) pipe with hubber gasket joints;
4. PVC sewer pipe with rubber ring joints (per ASTM D3034) or equivalent;
5. Cast or ductile iron pipe with compression joints; or
6. Reinforced concrete pressure pipe with compression joints (per AWWA C302-95).

SPECIAL CONSTRUCTION REQUIRED FOR NEW WATER MAIN: CASE 2

ZONE "A"

No water mains parallel to sanitary sewer mains shall be constructed without prior written approval from the Department.

ZONE "B"

If the sanitary sewer main paralleling the water main does not meet the Case 1, Zone "B" requirements, the water main should be constructed of one of the following:

1. HDPE pipe with fusion welded joints (per AWWA C906-99);
2. Ductile iron pipe with hot dip bituminous coating;
3. Dipped and wrapped one-fourth inch (1/4") thick welded steel pipe;
4. Class 200, Type II, asbestos-cement (A.C.) pressure pipe;
5. Class 200 pressure rated PVC water pipe (DR 14 per AWWA C900-97) or equivalent; or
6. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-97 or C302-99 or C303-95).

HORIZONTAL PROTECTION ZONES FOR SEWER AND WATER

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EAST VALLEY WATER DISTRICT, ENGINEERING DEPARTMENT

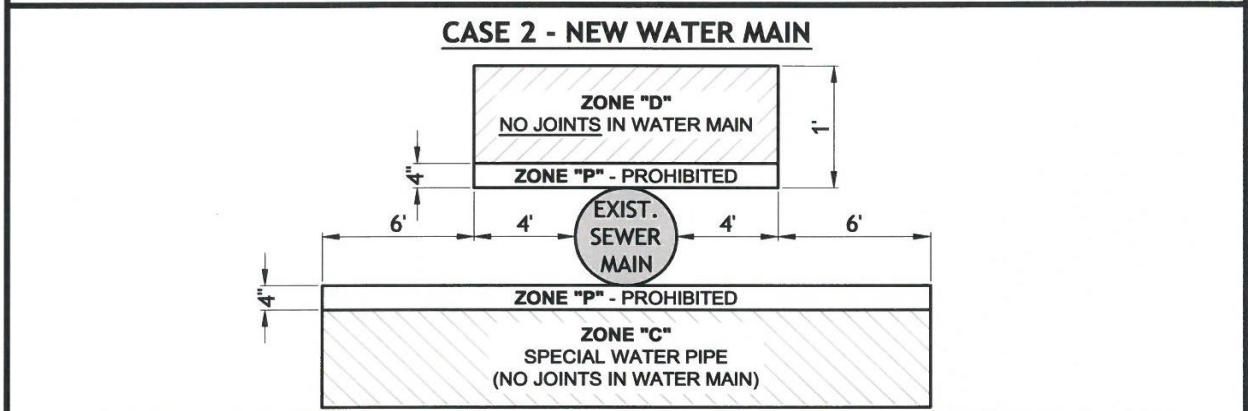
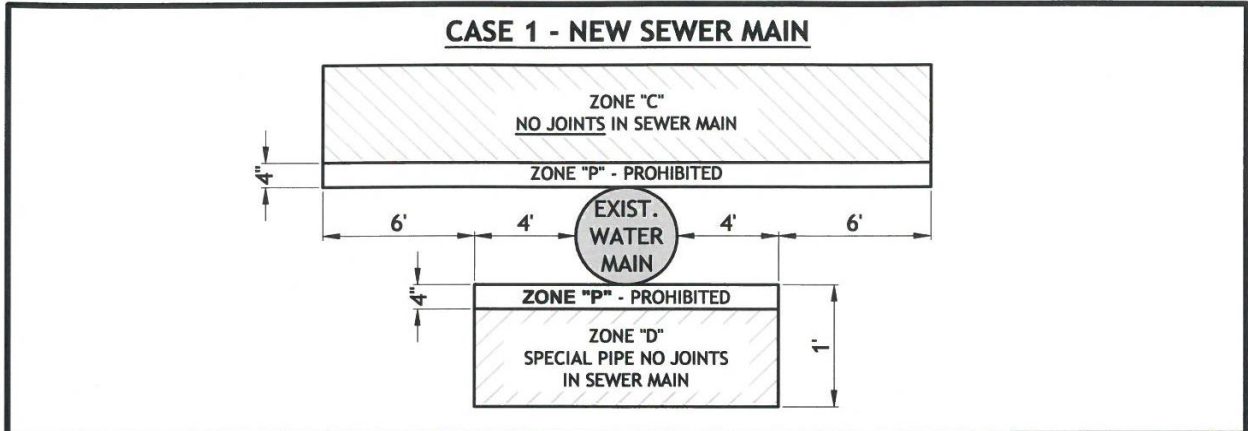
APPROVED BY:

STEVEN NIX, R.C.E. 56810
DIRECTOR of ENGINEERING and OPERATIONS

MARCH 2017
REVISION

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SPECIAL CONSTRUCTION REQUIRED FOR NEW SANITARY SEWER MAIN: CASE 1

ZONE "C"

If the water main crossing above the sanitary sewer main does not meet the Case 2, Zone "C" requirements, the sanitary sewer main should have no joints in Zone "C" and be constructed of one of the following:

1. HDPE pipe with fusion-welded joints (per AWWA C906-99);
2. Ductile iron pipe with hot dip bituminous coating and mechanical joints (gasketed, bolted joints);
3. A continuous section of Class 200 (DR 14 per AWWA C900-97) PVC pipe or equivalent, centered over the pipe crossed;
4. A continuous section of reinforced concrete pressure pipe (per AWWA C302-95) centered over the pipe being crossed; or
5. Any sanitary sewer main within a continuous sleeve.

ZONE "D"

If the water main crossing below the sanitary sewer main does not meet the requirements for Case 2, Zone "D" the sanitary sewer main should have no joints within four (4) feet from either side of the water main and should be constructed of one of the following:

1. A continuous section of ductile iron pipe with hot dip bituminous coating;
2. one of Zone "C" options 1,3,4, or 5 above.

SPECIAL CONSTRUCTION REQUIRED FOR NEW WATER MAIN: CASE 2

ZONE "C"

If the sanitary sewer main crossing above the water main does not meet the Case 1, Zone "C" requirements, the water main should have no joints in Zone "C" and be constructed of one of the following:

1. HDPE pipe with fusion welded joints (per AWWA C906-99);
2. Ductile iron pipe with hot dip bituminous coating;
3. Dipped and wrapped one-fourth inch (1/4") thick welded steel pipe;
4. Class 200, Type II, asbestos-cement (A.C.) pressure pipe;
5. Class 200 pressure rated PVC water pipe (DR 14 per AWWA C900-97) or equivalent; or
6. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-97 or C302-99 or C303-95).

ZONE "D"

If the sanitary sewer main crossing below the water main does not meet the requirements for Zone "D", Case 1, the water main should have no joints within four (4) feet from either side of the sanitary sewer main and should be constructed as for Zone "C".

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VERTICAL PROTECTION ZONES FOR SEWER AND WATER



EAST VALLEY WATER DISTRICT, ENGINEERING DEPARTMENT

APPROVED BY:

STEVEN NIX, R.C.E. 56810
DIRECTOR of ENGINEERING and OPERATIONS

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SECTION 8
GUARANTEE

The Applicant shall be virtue of a bond, satisfactory to the District, guarantee the completed work against repairs caused by defective workmanship or materials furnished and installed for a period of one (1) year from the date of acceptance by the District of the Dedication of the Water System.

The Applicant shall furnish to the District a satisfactory bond in the amount of 100 percent of the total installation cost upon a form furnished by the District to guarantee the fulfillment of such obligation.