

SECTION CS-8.

POTABLE WATER SYSTEMS CONSTRUCTION STANDARDS

CS-8-01. GENERAL: Potable water systems improvements shall be constructed in conformance with the City Standard Specifications and Standard Drawings.

Nothing in the City Standard Specifications shall relieve the Contractor from conforming to the manufacturer's recommendations. If a conflict between the City Standard Specifications and the manufacturer's recommendations arises, the more stringent requirement shall apply.

All testing requirements of the ASTM and AWWA standards and other provisions of these City Standard Specifications for the materials and equipment furnished shall be conducted by the manufacturer or its representative unless otherwise stated. A certificate of compliance conforming to these specifications must be furnished and submitted to the Director of Public Works by the manufacturer through the Contractor. The certification must be approved by the Director of Public Works prior to installation of the materials or equipment. Such certification shall reference and specifically identify the materials and equipment delivered to the job site. All other testing requirements required by these City Standard Specifications shall be performed by the Contractor at its own expense unless otherwise noted.

CS-8-02. WATER MAINS: Pipe materials shall be as specified on the Project Plans and/or Special Provisions and shall conform to the following:

A. DUCTILE IRON PIPE (DIP)

1. Ductile iron pipe for sizes 4-inch through 12-inch shall conform to AWWA C151 for a minimum pressure Class 350 unless otherwise specified. Sizes 18 inches and larger shall conform to AWWA C151 and the pressure class shall be as noted on the Project Plans and or as specified in the Special Provisions.
2. The class or normal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.
3. The interior surface of all ductile iron pipe shall be standard thickness, cement-mortar lined and seal coated in conformance with AWWA C104.
4. The exterior surface of the pipe shall have a standard asphaltic coating.
5. Joints shall be of bell and spigot type conforming to AWWA C111 unless otherwise specified. The lubricant and its application shall be as recommended by the pipe manufacturer and shall not adversely affect the

potable qualities of the water to be transported. Spray on lubricants shall not be permitted.

B. POLYVINYL CHLORIDE PIPE (PVC)

- 1.** Polyvinyl chloride pipe shall be manufactured in accordance with AWWA C900 for polyvinyl chloride (PVC) pressure pipe for water. The pipe shall have cast-iron pipe equivalent outside diameter and shall have a dimension ratio of 18 (Class 150) unless a higher class of pipe is specified on the Project Plans or in the Special Provisions.
 - a.** The pipe shall be blue or white in color.
 - b.** The pipe and gaskets shall be kept clean and protected against sunlight and heat damage. Sun or heat damaged pipe may be rejected at the Inspector's discretion.
 - c.** Pipe manufactured more than 18 months prior to its installation will not be permitted.
 - d.** Rejected pipe shall be immediately removed from the job site.
 - e.** The beveled end of the pipe shall be cut off squarely before insertion into a mechanical joint. The cut end shall be de-burred such that it does not cut the elastomeric gasket when it is slipped over the cut end of the pipe.
- 2.** PIPE JOINTS – The pipe joint for PVC pipe shall be either a PVC coupling sleeve of a corresponding size and pressure class adequate to withstand not less than the pressure class rating of the pipe, employing two elastomeric gasket seals, conforming to ASTM F477, or an integral wall thickened bell end, with an elastomeric gasket seal ring groove and employing an elastomeric gasket seal which conforms to ASTM F477. Lubricant shall be as recommended by the pipe manufacturer and shall not adversely affect the potable qualities of the water to be transported.
- 3.** MARKINGS – The pipe shall be clearly marked in accordance with AWWA C900. Additionally, the pipe shall be manufacturer date coded and the City shall be provided the manufacturer's coding for translation. The pipe shall be installed with the manufacturing label showing on the top.

C. FITTINGS

- 1.** All fittings, including but not limited to bends, tees, crosses, and reducers for use with either ductile iron or polyvinyl chloride pipe shall be ductile iron and shall be restrained in accordance with the requirements of section CS-8-09, "Thrust Restraint" of these specifications. Ductile iron fittings for mechanical

joints shall conform to “compact ductile iron fittings” as specified in AWWA C153 and flange fittings shall conform to AWWA C110.

2. All cross and tee fittings shall have flange ends. All other fittings shall have either flange or mechanical joint ends.
3. All fittings except for tapping sleeves shall be either factory fusion-bonded epoxy lined and coated in accordance with AWWA C116 or cement mortar lined and seal coated in accordance with AWWA C104.
4. All flange bolts, nuts, and washers, installed below grade shall be Type 304 stainless steel.
5. Teflon anti-seize compound shall be used on bolt and tie rod threads.

CS-8-03. GATE VALVES: All valves 4-inch through 12-inch nominal pipe size shall be gate valves and shall be cast iron body, non-rising stem, resilient wedge type as manufactured and tested in accordance with AWWA C509, and shall meet the following requirements.

- A. Valves shall open left (counter clockwise) and be provided with 2-inch square wrench nuts.
- B. Valves shall have a full opening of equal diameter of the connecting pipe.
- C. All internal ferrous metal surfaces shall be fully coated with factory applied epoxy as per AWWA C550. The coating thickness shall be a nominal thickness of 10 mils.
- D. The wedge shall be fully encapsulated with styrene butadiene rubber. There shall be no voids or exposed iron on the cast iron wedge.
- E. The rubber on the wedge guide lugs shall be protected with an acetyl copolymer bearing cap.
- F. The valves shall be rated for 250 psig.
- G. The stem shall be machined from a forged manganese bronze bar stock and shall have a forged thrust collar. Cast stems are not acceptable.
- H. Valves shall have class 125 flange ends in accordance with ANSI B-16.1.
- I. A valve box shall be installed over each valve with an 8 inch diameter riser.
- J. Gate valves shall conform to the Standard Drawings.

CS-8-04 BUTTERFLY VALVES: Valves 18 inches and larger shall be butterfly valves and shall be manufactured in accordance AWWA C504 for Class 150B service and shall comply with the following requirements:

- A.** Valve bodies shall be constructed of cast iron ASTM A-126 Class B and conform to AWWA C504 in terms of laying lengths and minimum body shell thickness.
- B.** Valves shall have class 125 flange ends in accordance with ANSI B-16.1.
- C.** Valve disks shall be made from cast iron ASTM A-126 Class B (18”) or ASTM A-48 Class 40 (24”). Sizes 30-inch and larger shall be ductile iron ASTM A-536 Grade 65-45-12. The disc shall be furnished with a type 316 stainless steel seating edge to mate with the rubber seat on the valve body.
- D.** Valve seats shall be Buna-N rubber located on the valve body. Valve sizes 20 inches and smaller shall have a bonded seat that meets test procedures outlined in ASTM D429 Method B. Sizes 24” and larger shall be retained in the valve body by mechanical means without the use of metal retainers or other devices located in the flow stream.
- E.** Valve shafts shall be type 304 stainless steel, conforming to ASTM A-276. Shaft seals shall be standard self-adjusting chevron “V” type packing. Shaft seals shall be of a design allowing replacement without removing the valve shaft.
- F.** Valve bearings shall be sleeve type, which are corrosion resistant and self-lubricating. The bearing load shall not exceed 1/5 of the compressive strength of the material.
- G.** Valve actuators shall be fully grease packed and have stops in the open/close position. The actuator shall have a mechanical stop which will withstand an input torque of 450 ft. lbs. against the stop. The traveling nut shall engage alignment grooves in the housing.
- H.** The valve interior and exterior surfaces except for seating shall be coated with a nominal thickness of 7-mil factory applied epoxy in accordance with AWWA C550. Rubber lined interiors are not acceptable.
- I.** All valves shall be factory hydrostatic and leak tested. The leak test shall be performed at a differential pressure of 150 psig with the disk in a closed position. In a slightly open position, internal hydrostatic pressure equal to 300 psig shall be applied to the inside of the body for 5 minutes.
- J.** A valve box with an 8-inch diameter riser shall be installed over each valve.
- K.** Butterfly valves shall conform to the Standard Drawings.

CS-8-05 VALVE BOXES: Valve boxes shall be of precast concrete, and shall have a cast iron face and a cast iron traffic lid marked "WATER."

- A. Valve box risers shall be set perpendicular to the axis of the water valve body and centered over the valve operating nut.
- B. Where valves are placed in unimproved easement areas the valve boxes shall be set 3 inches above grade and shall be marked by the installation of a reflectorized "Water Line Warning" marker.
- C. The Water Line Warning marker installation shall conform to the Standard Drawings.

CS-8-06 FIRE HYDRANT ASSEMBLIES: Fire hydrants shall be wet barrel and shall meet the requirements of AWWA Standard C503. Hydrants shall be furnished with a break-off spool. Hydrants shall be Clow or Jones.

- A. The bury shall have an inlet diameter of 6 inches.
- B. Delivery classification shall be two-hose (2½ inch) and one-pumper nozzle (4½ inch), having "National Standard Fire Hose Coupling Screw Threads" in conformity with NFPA 194 and ANSI B26. The operating nuts and nozzle caps shall be National Standard pentagon dimensions, and shall open left (counter clockwise).
- C. Every fire hydrant installation shall have a gate valve installed on the lateral at the main. Only ductile iron pipe with restrained joints shall be used as a service connection between the main and the hydrant.
- D. A blue Type B reflective pavement marker conforming to the requirements of Section 85 of the CALTRANS Standard Specifications for identifying the location of each fire hydrant shall be installed within the improved street in accordance with the Standard Drawings.
- E. The hydrant shall be painted white in the field with rust resistant gloss enamel paint. Glass beads shall be applied liberally to the wet paint surface.

CS-8-07. AIR RELEASE AND BLOW-OFF ASSEMBLY: Attention is directed to the Standard Drawings for the approved design and construction of these assemblies.

CS-8-08. WATER SERVICE LINES: The size and location of water service lines shall be shown on the Project Plans. Materials and installation shall be as follows:

- A. Polyethylene tubing shall be used for service sizes of 1, 1 1/2, & 2 inches.
 - 1. Polyethylene pressure pipe shall meet the standards of AWWA C901, PE3408.

2. The pipe shall have a minimum pressure rating of 200 psi.
 3. One inch pipe shall be manufactured to iron pipe size (IPS) and have an SDR of 7.
 4. Pipes 1½-inch and 2-inch in diameter shall be manufactured to copper tube size.
 5. Installation shall be in accordance with the manufacturer's recommendation.
 6. Splicing of pipe between the main and angle stop shall not be permitted.
- B.** Ductile Iron Pipe (DIP) shall be used for services of 3 inches in size and larger, including lines for all appurtenances. The DIP service pipe shall conform to the provisions of Section CS-8-02, "Water Mains." The 4-inch by 3-inch reducer and 3-inch spool shown on the 3-inch water service Standard Drawing shall be Class 53.
- C.** Service line valves and fittings shall conform to AWWA C800 and the Standard Drawings.
1. Services up to and including 2-inch in diameter shall be equipped with a corporation stop at the main with an angle stop at the back of sidewalk.
 2. A flanged gate valve shall be furnished at the mainline tee for services 3-inch in diameter and larger.
 3. The size of the corporation stop and angle stop or gate valve shall be the same as the service line except in the case of a 3 inch service.
 4. A meter box at the back of walk or as shown on the plans is required for all services.
 5. Only neoprene or rubber gaskets shall be used between the saddle and the pipe.
 6. All valves 2-inches in diameter and smaller shall be of a ball type rated at 300 psi.
- D.** The location of each service shall be permanently indicated by inscribing the letter "W" in the curb directly above the line when the service is perpendicular to the street centerline or at the right angle to the end of the service for a skewed or angling service.
- E.** The water main shall be tapped at the service locations shown on the Project Plans and construction completed by the Contractor in accordance with the Standard Drawings. A minimum distance of 18-inches between taps must be maintained.

CS-8-09. WATER SYSTEMS INSTALLATION:

- A. GENERAL:** All pipes, valves, fittings, and appurtenances shall be installed in accordance with the requirements of Section CS-8-09, the manufacturer's

recommendations, and AWWA C600 for ductile iron pipe and AWWA C605 for PVC pipe. The interiors of all pipes, fittings, and valves shall be protected from contamination by following the precautions described in AWWA C651. Pipe shall not be installed in a trench that contains standing water. The Contractor shall keep the pipe interior free from foreign materials and in a clean and sanitary condition until acceptance by the City. Pipe shall not be laid when the condition of the trench or the weather is unsuitable or when there is the possibility of water or other foreign material entering the pipe.

B. POLYETHYLENE ENCASEMENT: The exterior of all buried ductile iron pipe, fittings, and other appurtenances shall be encased with polyethylene in accordance with AWWA C105.

C. DEFLECTION: The Contractor shall submit a table of maximum deflections allowed for the combination of pipe and fittings necessary to complete the installation of the water facilities based upon the manufacturer's specifications proposed to be furnished and the following criteria outline below:

1. **DIP** – The pipe shall be laid true and uniform to line and grade, with no visible change in alignment at any joint unless curved alignment is called for on the plans; in which case the allowable joint deflection is dependent upon the pipe diameter size and joint type. The allowable deflection per joint shall not exceed 70% of the manufacturer's maximum deflection for the joint type and pipe and/or fitting size. If there is a difference in the manufacturer's recommendation between the pipe and fitting, the smallest deflection shall govern. Deflections in excess of 70% of the manufacturer's recommendations must be made with a fitting per AWWA C110 or C153.
2. **PVC** – The pipe shall be laid true and uniform to line and grade, with no visible change in alignment at any joint unless curved alignment is called for on the plans, in which case the installation shall be subject to the following criteria:
 - a. No deflections shall be allowed at a pipe bell to spigot joint.
 - b. Curved alignments shall be constructed by manually bending the pipe or by providing a bell by bell PVC coupling or ductile iron fitting.
 - c. The PVC coupling shall provide a maximum of 5 degrees of total angular deflection, (2 ½ degrees at each end).
 - d. The coupling shall be a Class 200 psi fabricated fitting conforming to AWWA C900.
 - e. Deflections equal to and greater than 11¼ degrees shall be made with a ductile iron fitting and shall conform to AWWA C110 or C153.

Minimum pipeline radii for uniformly bending the pipe without couplings or fittings are:

R = 350 feet for 8-inch diameter pipe
R = 550 feet for 12-inch diameter pipe

D. THRUST RESTRAINT

1. **Thrust Blocks** – Thrust blocks of minimum strength 3000 psi concrete shall be cast-in-place at all horizontal or vertical bends of 11¼ degree angle or more, behind each plug, cap, tee, or cross which is valved or plugged in such a manner that it can act as a tee or elbow, and at the back of each fire hydrant bury. The thrust block shall extend from the fitting to undisturbed soil, and shall be kept clear of the joint, nuts, and bolts. The size of the thrust block shall be in accordance with the Standard Drawings.
2. **Restrained Joints** – Flange, restrained push-on, or restrained mechanical joints may be used in lieu of concrete thrust blocks when approved by the Director of Public Works and shall be the type accepted by the pipe manufacturer. PVC pipe restraint shall conform to ASTM F-1674. The type of restraining device and specific product shall be subject to the approval of the Director of Public Works through the submittal process. Thrust restraint calculations with recommended restrained length on each side of the fitting and appurtenance shall be prepared and submitted for approval to the Director of Public Works.

E. CONSTRUCTION INTERRUPTION - Whenever pipe laying is discontinued for an hour or more, the open ends of all mains and fittings shall be closed with watertight plugs or bulkheads. The plug or bulkhead shall not be removed unless, or until, the trench is dry and the Contractor is ready to proceed with the work.

F. SYSTEM TIE-INS - When a water service is to be connected to an existing line, the Contractor shall make the tap or tie-in into the existing main, under the direct supervision of a Certified Distribution System Operator of the Department of Public Works. The Contractor shall contact the Department of Public Works and schedule a Pre System Tie-in meeting to occur at least 72 hours in advance of the time of the proposed tap or tie-in. The Contractor shall notify all affected customers in case of a shutdown/interruption of service. Customers shall receive notification no fewer than 48 hours prior to the shutdown.

<p>NOTE: Under no circumstances shall anyone other than a Certified Distribution System Operator of the Department of Public Works, open or close any valve connected to a City-operated water system.</p>

G. LOCATING WIRE – All water mains, services, and appurtenances shall have a direct burial wire laid above the top of pipe before backfilling. The wire shall be installed and spliced in accordance with the Standard Drawings to form a set of continuous electrical conductors throughout the pipe system. A continuity test

shall be conducted on the entire system by the Contractor in the presence of the Inspector.

H. Trench excavation, bedding and backfill shall conform to Section CS-2 and Section CS-3 of the City Standard Specifications.

CS-8-10. REGULATIONS RELATING TO SANITARY HAZARDS: All construction shall conform to applicable regulations relative to safeguarding the public health, particularly the regulations relating to cross connections as established by the California Administrative Code, Title 17, Chapter V, Sections 7583-7622 and the Cross Connection Control Program of the City of Vacaville.

CS-8-11. WATER FOR TESTING, FLUSHING, AND DISINFECTION: Water for hydrostatic testing, flushing, and disinfection shall be supplied by a new valve installed by the Contractor and operated by a Certified Distribution System Operator of the Department of Public Works. Alternative methods shall not be permitted except at the sole discretion of the Director of Public Works.

CS-8-12. HYDROSTATIC PRESSURE TESTING. The pipe shall be subject to a hydrostatic pressure test prior to the placement of any asphalt.

A. The test shall be performed after the entire water system as shown on the Improvement Plans is backfilled, the concrete curb, gutter, and sidewalk is installed, the street aggregate base rock material is in place to final grade, and the fire hydrants and water services are set to grade.

B. Testing of a partial system will not be permitted unless otherwise directed by the Director of Public Works.

C. The pipe to be tested shall have only one physical connection to the existing water system. The new valve at the single point of connection shall be solely operated by a Certified Distribution System Operator of the Department of Public Works. All other work related to the Hydrostatic Pressure Testing shall be performed by the Contractor.

D. The pipe shall be slowly filled with water by a Certified Distribution System Operator of the Department of Public Works and all air shall be expelled from the pipe by the Contractor. The release of the air may be accomplished by the Contractor by opening hydrants and service line cocks at the high points of the system and the blow-offs at all dead ends. The valve controlling the admission of water into the section of pipe to be tested should be opened wide before shutting the hydrants or blow-offs. After the system has been filled with water and all air expelled, all the valves controlling the section (including the connection to the existing system) to be tested shall be closed and the line be allowed to set for a period of not less than 24 hours.

- E.** The pipe shall then be refilled, if necessary, and subjected to a pressure of not less than 150 psi or the service pressure plus 50 psi, whichever is greater, for a period of four hours. All tests shall be witnessed by an authorized representative of the Department of Public Works.
- F.** All exposed pipe, fitting, valves, hydrants, and all joints shall be carefully examined during the pressure test. Any cracked or defective pipe, fittings, valves, or hydrants discovered during the test shall be removed and replaced with sound material and the test repeated until the system is proved satisfactory.
- G.** The allowable leakage in the test section shall be in accordance to AWWA C600 and shall not exceed 0.0919 gallons per hour per inch diameter per 1,000 feet of main being tested.
- H.** All leaks shall be immediately corrected and the system again subjected to a hydrostatic pressure test. Even if the leakage is less than the allowable, all observed leaks shall be repaired.
- I.** Upon the successful completion of the hydrostatic pressure test and the water bacteria test, and prior to final paving, the remaining connections, if any, shall be made in accordance with AWWA C651.
- J.** The backfill material for the tie-in shall be Class II aggregate base compacted to 95% relative compaction.

CS-8-13. FLUSHING AND DISINFECTION:

- A. CONNECTION AND TESTING PLAN** – The Contractor shall conform to the requirements for the connection to the existing system, flushing, disinfection, sampling, testing and disposal of flushing water as shown on the Project Plans and as specified within the Standard Specifications.
- B. INITIAL FLUSHING** – Flushing shall be performed under the direct observation of a Certified Distribution System Operator of the Department of Public Works. A minimum continuous velocity of 2.5 feet/second shall be achieved for the duration of flushing. Flushing shall be continuous until all the water in the line has been replaced a minimum of two times, and for such additional time as necessary for the blow-off water to flow clean and free of debris. Blow-offs, curb stops, hydrants, or other outlets, temporary or permanent, shall be installed on water mains to allow the minimum continuous flushing flow in the main.
- C. DISINFECTION** - All disinfection and flushing activities shall be performed under the direction of a Certified Distribution System Operator of the Department of Public Works.

1. The water pipes shall be thoroughly flushed and cleaned as described above and shall then be treated with a chlorine solution by the continuous feed method described in AWWA C651. Hypochlorite tablets or granules are not permitted.
2. Chlorine shall be applied in a stream of water entering the main in a concentration of not less than 25 mg/L free chlorine.
3. The chlorinated water shall remain in the main for a minimum of 24 hours after which the chlorine concentration shall be not less than 10 mg/L free chlorine as determined by the Certified Distribution System Operator of the Department of Public Works.

D. FLUSHING AFTER DISINFECTION - The water pipes shall be thoroughly flushed at the end of the specified contact time. Flushing shall continue until the chlorine residual of the water has been reduced to an amount equivalent to the residual normally present in the existing distribution system (0.5 – 1.0 mg/L). All chlorinated water that is flushed to disposal must be dechlorinated.

E. BACTERIOLOGICAL SAMPLING - After flushing, samples of the water shall be taken for bacteriological analysis and delivered to the laboratory. Two complete sets of samples shall be taken by the City at least 24 hours apart. No hose or fire hydrant shall be used in the collection of samples. Sampling procedures in AWWA C651 shall be followed.

The pipe shall remain out of service until satisfactory bacteriological results are obtained. If necessary, chlorinating, flushing, and sampling of the water main shall be repeated until satisfactory bacteriological results are obtained.

F. DISPOSAL OF FLUSHING WATER - The disposal of flushing water shall be performed by the Contractor in accordance with the Connection and Testing Plan. Sanitary sewers may be acceptable locations for disposal upon approval by the Department of Public Works. Storm drains may be acceptable locations with dechlorination to 0.0 mg/L chlorine. Testing of the disposal water to confirm complete neutralization of chlorine shall be performed in the presence of the Certified Distribution System Operator.

Proper mitigation measures shall be identified if there is any possibility that water discharge will cause damage to the environment. The Contractor shall be responsible for any penalties associated with discharging flushing water containing chlorine.

CS-8-14. CONSTRUCTION WATER:

When water is desired prior to operation of the fully tested system, a separate bacteria test shall be taken after the pipe has been backfilled to 24 inches over the top. The preliminary test does not eliminate the need for a bacteria test after the required

hydrostatic pressure test. All tests shall be at the expense of the Developer. Connection to the existing distribution system shall comply with CS-8-11. Under no circumstances shall anyone other than a Certified Distribution System Operator of the Department of Public Works, open or close any valve connected to pipe lines approved for construction water use.

Fire Hydrant Supply – A permit and hydrant meter shall be obtained from the Department of Public Works prior to drawing any water from a fire hydrant.

CS-8-15. UNACCEPTED MAINS IN SERVICE: Having a water main placed in service prior to complete acceptance of the project is a courtesy extended by the City to its customers, and does not imply any act of acceptance by the City. The City will not maintain the water main or any portion of the improvements until the City Council accepts the improvements for the entire project for both private development and City Capital Improvement Program projects.