# SECTION 02660

# WATER SYSTEMS

## PART 1 - GENERAL

### 1.01 WORK INCLUDED

**A.** Trenching and other excavation.

**B.** Ground water control.

**C.** Pipe bedding.

**D.** Installation of water lines and appurtenances.

**E.** Backfill and compaction of backfill.

**F.** Sterilization and testing.

**G.** Dust alleviation and control.

**H.** Cleanup and restoration of surface in improved areas.

**I.** Supplying all labor, materials, equipment and apparatus not specifically mentioned herein or noted on the plans, but which are incidental and necessary to complete the work specified.

### 1.02 APPLICABLE PUBLICATIONS

**A.** The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text only by their general designation only.

**B.** American Society for Testing and Materials (ASTM) Publications:

A - 276 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.

D - 2737 Specification for Polyethylene (PE) Plastic Tubing.

F - 477 Elastomeric Seals (Gaskets) for joining Plastic Pipe.

**C.** American Water Works Association (AWWA) Publications

C-153 Ductile-Iron Fittings 3" through 48" for Water and Other Liquids.

C - 111 Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.

C - 502 Dry Barrel Fire Hydrants.

C - 503 Standard for Wet-Barrel Fire Hydrant.

C - 504 Rubber-sealed Butterfly Valves.

C - 509 Resilient Seated Gate Valves, 3 through 12 NPS for Water and Sewage Systems.

C - 550 Protective Epoxy Interior Coatings for Valves and Hydrants.

C - 601 Disinfecting Water Mains.

C - 900 Polyvinyl Chloride (PVC) Pressure Pipe, 4" through 12" for Water.

C - 905 Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14" through 36".

### 1.03 QUALITY ASSURANCE

**A.** Water mains, services and appurtenances shall be subject to hydrostatic and leakage tests.

**B.** Water mains, services, and appurtenances shall be sterilized prior to connection to existing systems.

**C.** Submit manufacturer's data on the pipe material, fittings, valves and service material.

**D.** The maximum allowable deflection (out of roundness) of PVC pipe under superimposed loads, shall be 5%, or 75% of the manufacturers recommended maximum, whichever is smaller.

**E.** The Engineer may require manufacturer's certificates showing conformance with this specification for any of the pipe materials, fittings, valves and appurtenances delivered to the job site.

**F.** For Fire Service lines, the lines shall be subject to a high velocity flushing test. Methods of flushing shall be approved in advance by the Engineer.

### 1.04 JOB CONDITIONS

**A.** Comply and conform with conditions and requirements indicated and specified under Section 02202 of these specifications.

## PART 2 - PRODUCTS

### 2.01 PIPE MATERIALS

**A.** Water mains 12" in diameter or less shall be PVC pressure pipe conforming to the applicable requirements of AWWA Specification C900 for class 200 pipe

having a dimension ratio (DR) of 14 and a cast iron pipe equivalent outside diameter.

**B.** Pipes 14" in diameter or larger shall be PVC transmission pipe conforming to AWWA C905, having a DR of 18 and cast iron pipe equivalent outside diameter.

**C.** Maximum length of each section of pipe between elastomeric rings shall be twenty (20) feet.

**D.** Each length of pipe shall have the words "DOMESTIC WATER" stenciled with 1-5/8" high lettering in permanent ink, at 2-foot spacing along its length.

**E.** The Contractor may substitute pressure-sensitive tape in lieu of stenciling. Adhesive Backed Pipe Labeling Tape shall be PVC Plastic tape manufactured specifically for direct placement onto pipe, cable or conduit for warning and identification. Tape shall be a minimum of 2.2 mils, an adhesive strength of 26 psi, and with tensile strength of 32 lb. per inch of width. Tape shall be of the type provided in rolls, color coded for the utility involved with warning and identification imprinted in bold letters continuously and repeatedly over entire tape length. Code and letter coloring shall be permanent, unaffected by moisture or other substances contained in trench material.

## 2.02 PIPE COUPLINGS

**A.** All couplings for use on PVC pipe for water lines shall be manufactured from the same materials and in compliance with the specifications set forth herein before for PVC pipe for water lines. Each coupling shall be equipped with two rubber rings, which fit into individual grooves formed in the inner wall of the coupling to eliminate blowouts or leaks.

**B.** Rubber rings for use with PVC pipe couplings, fittings and appurtenances shall be manufactured from properly vulcanized rubber compounds to a uniform cross-section free from porosity, pits and blisters in conformance with the requirements of ASTM Designation F-477.

## 2.03 FITTINGS

**A.** Fittings for use on PVC pressure pipe shall be ductile iron castings conforming to the applicable requirements of AWWA Standard C153 for two-hundred fifty (250) psi working pressure. Joints shall be rubber gasketed per AWWA C-111.

~~**B.**~~ Tapping sleeves shall be Smith Blair 665 or approved equal***,*** all stainless steel, with flat-faced flange to mate with standard tapping valves, with ¾" NPT test plug.

**C.** Fittings shall be fusion-epoxy lined and coated as specified in Section 02661 of these Specifications.

**D.** All bolt-up sets (nuts, bolts and washers) and tie rods for valves, fittings and buries shall be stainless steel, ASTM A-276 Type 316.

**E.** Air release valves shall be Cla-Val model 36 combination air release and vacuum valves with bronze trim or approved equal.

## 2.04 VALVES AND VALVE BOXES

**A.** Gate valves shall conform to the requirements of AWWA C509 for resilient-seated valves. Stems shall be, fitted with a 2" x 2" square wrench nut and shall be manufactured to open counter-clockwise. Stem extensions shall be installed to bring the operating nut to within two (2) feet of finish grade where the depth from finished grade to operating nut exceeds four (4) feet. Gate valves shall be used for all valves ten (10) inches and smaller and shall be FUSION EPOXY lined and coated in conformance with the requirements of Section 02661 of these Specifications.

**B.** Butterfly valves shall comply with the latest revision of AWWA Standard C504, Class 150-B having Cast Iron Bodies, Cast or Ductile Iron discs, Stainless Steel Shafts, adjustable field replaceable rubber seats mating against Stainless Steel seat rings, and field-replaceable seals. End connections shall be flanged or Mechanical Joint. Wafer type valves shall not be allowed. Valve actuators shall be of the traveling nut type designed for buried service, sized to operate the valves against 150 psi unbalanced line pressure, with field adjustable and stops capable of withstanding input torque of 450 ft. lbs. All internal and external surfaces of butterfly valves shall be covered with a factory applied 2-part, polyamide cured, epoxy coating applied over a sand blasted "near white" metal surface per SSPC-SP10 to a minimum of 8 mils and a maximum of 12 mils, in compliance with AWWA Standard C550.

**C.** Square wrench nut shall be brass and all other nuts, bolts, and washers throughout the valve and valve body shall be stainless steel, ASTM A-276, Type 316.

**D.** Valves shall be provided with traffic valve boxes and cast iron traffic covers with "water" canted thereon, set in a concrete base as shown and dimensioned on the detail therefore on the plans.

## 2.05 WATER SERVICES

**A.** Commercial water service lines four (4) inches in diameter and larger shall be PVC pressure pipe and couplings conforming to the requirements of AWWA Standard C900 for Class 200 pipe and couplings as herein specified for PVC pressure water mains.

**B.** Commercial, irrigation, and residential water service lines two (2) inches in diameter or less, shall be polyethylene Plastic Pipe Class 200, conforming to the requirements of ASTM Designation D2737 for the size indicated on the plans.

**C.** Fittings, couplings and water service material shall be bronze and all nipples shall be brass of the size and type called for on the plans.

**D.** Water meters and detector meters shall be purchased from and installed by the City of Redwood City, unless otherwise shown.

**E.** Meter box shall be provided for each water meter as shown on the plans, and shall conform to the size shown on the City Standard Details.

## 2.06 FIRE HYDRANTS

**A.** All fire hydrant service runs shall be PVC pressure pipe as herein specified and shall be six (6) inches in diameter.

**B.** Fire hydrant assemblies shall consist of a six (6) inch gate valve, the run of six (6) inch pipe, cast-iron bury, and the hydrant. Break off bolts shall be used to fasten the hydrant to the bury.

~~**C.**~~ Fire Hydrants shall be one of the four (4) different types depending on location and the size of the watermain.

1. Type A - Mueller A-423 dry barrel or approved equal fusion epoxy lined and coated; provided with two 2-1/2” and one 4-1/2” outlets, conforming to AWWA C502.
2. Type B – Clow 92 low silhouette, wet barrel or approved equal fusion epoxy lined and coated; provided with two 2-1/2” and one 4-1/2” outlets, conforming to AWWA C503.
3. Type C – Clow 76 wet barrel or approved equal fusion epoxy lined and coated; provided with two 2-1/2” and one 4-1/2” outlets, conforming to AWWA C503.
4. Type D – Clow 865 wet barrel or approved equal fusion epoxy lined and coated; provided with one 2-1/2” and two 4-1/2” outlets, conforming to AWWA C503.

**D.** All exterior metal parts of the hydrant from the ground up shall be painted with two coats of paint, or one coat of primer and one coat of paint, in either Redwood Shores "DOLPHIN BLUE" or City Standard "LIME YELLOW", (DTM Mid Tone Base B66W102 enamel and #B66W1 primer), as appropriate to the location. Both paint colors are available from Sherwin Williams Company.

**E.** Wet barrel fire hydrants, burys and break-off spools shall be epoxy lined and coated as herein specified for fittings.

**F.** All fire hydrant heads, burys and extension spools shall be bolted with stainless steel bolts, and washers, as herein specified for fittings.

## 2.07 LOCATING WIRE

**A.** Locating wire for use with plastic pipe installations shall be stranded copper, eight (8) gauge type TW or THHN electrical wire with solid blue jacket.

**B.** Connect locating wire to metalic fittings with brass wire split nuts.

### 2.08 CONCRETE FOR THRUST BLOCKING

**A.** Reinforcement for concrete thrust blocking shall be deformed steel bars conforming to Section 02550 of these Specifications.

**B.** Concrete for thrust blocking shall be Portland cement concrete conforming to the applicable requirements of Section 02550 of these Specifications.

### 2.09 PIPE BEDDING AND BACKFILL MATERIAL

**A.** Shall conform to Section 02202 of these Specifications.

## PART 3 - EXECUTION

### 3.01 TRENCHING, BACKFILLING AND SHORING

**A.** Shall conform to Section 02202 of these Specifications.

### 3.02 PIPE INSTALLATION

**A.** Installation: Pipe, valves, fittings and appurtenances shall be installed in accordance with the best practice, and in conformance with the applicable requirements of the AWWA Standards. Each length of PVC pipe shall be rotated so that the stenciled or taped words "DOMESTIC WATER" will be located on the top of the pipe.

**B.** Handling: Pipe, valves, and fittings shall be carefully handled during hauling, unloading, and placing operations, so as to avoid breakage or damage. Strap-type slings shall be used for lifting and placing; no chains or hooks will be permitted. Broken or damaged pipe or appurtenances will be rejected by the Engineer and shall thereupon be removed from the work and replaced.

**C.** Alignment: All pipe shall be accurately laid in conformity with the prescribed lines and grades as established by the Engineer. Each length shall be jointed to the preceding section as specified, and after said jointing has been completed, there shall be no movement of the pipe in subsequent operations.

**D.** Pipe Deflections: The laying of pipe on curved alignment will be permitted up to one-half the deflection as recommended by the respective pipe manufacturer.

**E.** Cleaning: Before each new length of pipe is placed, the interior of the preceding pipe shall be carefully cleaned of all dirt and debris. When pipe laying is not in progress, all open pipe ends shall be closed with watertight plugs in a satisfactory manner.

**F.** Bearing: Pipe in the trench shall have continuous uniform bearing along its bottom, except at bell holes. Blocking used to support the pipe during laying shall be placed at the end of the section and shall be removed before laying the next section. Before lowering pipe into the trench, the Contractor shall remove

all stakes, debris, loose rock and other hard material from the bottom of the trench.

**G.** Positioning: After the final positioning, the pipe shall be held in place in the trench with backfill material placed equally on both sides of the pipe at as many locations as are required to hold the pipe section in place. After joints are completed, the backfill material shall be redistributed and compacted as herein required.

**H.** Closure: At the end of each day and when work is not in progress, the open ends of pipe installed in the line shall be closed with watertight plugs or caps.

**I.** Thrust: Blocking: Concrete thrust blocks of the form and dimensions shown or noted on the plans shall be provided at all changes in horizontal or vertical alignment and at such other points as may be called for on the plans. Thrust blocks shall be installed in strict conformance with the details shown or noted on the plans.

## 3.03 CONNECTIONS TO EXISTING SYSTEMS

**A.** Connections to existing systems shall not be made until the new mains have been satisfactorily disinfected ~~sterilized~~ and ~~tested~~ have passed all tests herein specified.

**B.** Connection of new water main to existing distribution system shall be performed no later than 48 hours after Bacteriological Examination Results have been received and approved by the Engineer. If the system connection is not performed within this period of time, Disinfection and Bacteriological Examination processes shall be repeated.

## 3.04 PRESSURE AND LEAKAGE TESTS

**A.** Preparation:

1. The Contractor shall provide all necessary material and equipment, and shall perform all work required in connection with the testing of the water system, as specified herein.

2. Hydrostatic and leakage tests shall be made only after the trenches have been backfilled sufficiently to hold the pipe firmly in position.

3. The Contractor shall provide all water necessary for filling, flushing, disinfection and any required tests including all labor and equipment required.

**B.** Procedure:

1. Any flaw disclosed by any of the above tests shall be repaired and satisfactorily re-tested.

2. Hydrostatic and Leakage Tests**:** Each section being tested shall be slowly filled with water, care being taken to expel all air from the pipe by such means as are necessary.

3. Water shall be allowed to stand in the pipe for twenty-four (24) hours before test pressure is applied.

**C.** Test Pressure:

1. Pressure and leakage tests will be performed at the same time. All water pipe shall be subjected to a hydrostatic test of at least fifty percent higher than the normal expected operating pressure or 150 psi, whichever is larger, unless otherwise specified or directed.

2. The minimum hydrostatic and leakage pressure for fire service line is 200 psi.

**D.** Allowable Leakage:

1. For domestic water and fire service lines the duration of each leakage test shall be not less than two (2) hours, unless otherwise specified, and during the test the pipe shall be continuously subject to hydrostatic pressure , as specified, and measured at the lowest elevation.

2. The specified test pressure shall be satisfactorily applied by means of a pump connected to the pipe. The test pressure shall be maintained for the specified time and shall not be allowed to drop more than 5 psi during which all exposed pipe, couplings, fittings, valves and hydrants shall be examined carefully.

3. No PVC pipe installation will be accepted if the leakage for the section of line that is tested is more than that determined by the formula below:

$$L = \frac{ND\sqrt{P}}{7400}$$

Where:
- L = allowable leakage, gph
- N = number of joints in the length of pipeline tested
- D = nominal diameter of pipe, in.
- P = average test pressure during the leakage test, psig

4. When test results indicate leakage beyond that allowed, Contractor shall conduct a survey of the line, and any leaks found shall be repaired, after which the leakage test shall be repeated until satisfactory conformance to this specification is demonstrated.

## 3.05 DISINFECTION AND BACTERIOLOGICAL TEST

**A.** Following the Pressure Test and before being placed in service, all new water lines shall be chlorinated in accordance with the requirements of AWWA Standard C651-99.

1. Disinfection: The Contractor shall have the option of applying chlorine with tablet method, continuous-feed method or slug method to the entire water content of the line, including services, fire hydrants and stubs, in sufficient quantity as stipulated in the above mentioned AWWA Standard.

    a. If the Contractor elects to employ the use of the "Tablet" for of chlorination by mounting tablets into the pipe sections as they are installed, he shall determine the minimum number of tablets per AWWA C651-99 requirement. This method may be used only if the pipes and appurtenances are left clean and dry during construction. In the event that adequate disinfection is not obtained using said minimum number of tablets, it shall be the Contractor's responsibility for re-chlorination until a satisfactory result is obtained.

    b. After chlorination has been satisfactorily completed, the lines shall be thoroughly flushed until the chlorine content in all parts of the system has been proven by test to be comparable to the chlorine content of the City Water System.

    c. It shall be the responsibility of the Contractor to lawfully dispose of the chlorinated water and flushing water, and avoid flooding or damage to adjacent properties or facilities.

2. Bacteriological Test: After flushing the chlorine from the water system and prior to placing line in service, the Contractor shall engage the services of an approved Commercial testing laboratory, approved by the State of California Department of Public Health, to gather an approved number of representative water samples, the location and number of which shall be determined by the Engineer.

    a. No section of water systems will be allowed to be connected to the City's existing water system when any sample of water tests indicate coliform bacteria as tested by the 24 Hour Membrane Filtration Method. Should the laboratory report show that any sample taken was not acceptable, Contractor shall re-chlorinate and test the water again as herein before specified. This process shall be repeated until a satisfactory disinfection has been accomplished.

    b. Contractor shall direct the laboratory to send the original report of Bacteriological Examination to the Engineer.

## 3.06 HIGH VELOCITY FLUSH TEST

**A.** This test is required for single, dedicated fire service lines only and is to be done in the presence of the Fire Department Inspector.

**B.** The purpose of the test is to clean the pipe of debris and sediment. If a large amount of sediment is trapped in the filter, then the test shall be re-done as directed.

**C.** The test shall be done under maximum flow conditions, and the flushed water shall be filtered to collect any debris in the line.

**D.** The test may be combined with other flushing of the water main following disinfection.

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