STANDARD SPECIFICATION
SECTION 15293 POLYVINYL CHLORIDE (PVC) DISTRIBUTION PIPE (AWWA C905)

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of PVC distribution pipe conforming to AWWA C905. Size range is 14- to 24-inch nominal pipe size. Maximum working pressure will be limited to 150 psi with a dimension ratio (DR) of 18.

1.02 PIPE IDENTIFICATION SYMBOLS

Interpret pipe identification symbols used on the Drawings as follows: PVC-14"-DR 18 designates type of pipe (polyvinyl chloride); nominal pipe size (14 inches); and dimension ratio (DR 18).

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Standard Drawings.

B. Record Drawings and Submittals: STD SPEC 01300.

C. Trenching, Backfilling, and Compacting: STD SPEC 02223.

D. General Concrete Construction: STD SPEC 03000.

E. Painting and Coating: STD SPEC 09900.

F. Cold Applied Wax Tape Coating: STD SPEC 09952.

G. Polyethylene Sheet or Tube Encasement: STD SPEC 09954.

H. Fusion-Bonded Epoxy Lining and Coating: STD SPEC 09961.

I. General Piping Requirements: STD SPEC 15050.

J. Miscellaneous Piping Specialties: STD SPEC 15080.

K. Flexible Pipe Couplings: STD SPEC 15122.

L. Disinfection of Piping: STD SPEC 15141.

M. Pressure Testing of Piping: STD SPEC 15144.

1.04 SUBMITTALS

A. Submit submittal packages in accordance with Standard Specification Section 01300.

B. Provide affidavit of compliance with AWWA C905.

C. Submit copies of the following manufacturer required tests conducted on the project pipe:

1. Quick-burst strength of pipe.

2. Flattening resistance of pipe.

3. Impact resistance of pipe.

4. Acetone-immersion test of pipe material.

5. Internal pressure and vacuum tests of joints per ASTM D 3139.

6. Laboratory tests of gaskets per ASTM F 477.

7. Record of additional tests after test sample failure.

D. Submit manufacturer's literature on ductile iron fittings including dimensions, thickness, weight, coating, lining, and a statement of inspection and compliance with the acceptance tests of AWWA C110 or C153. Submit copy of report of pressure tests for qualifying the designs of all sizes and types of AWWA C153 fittings that are being used in the project. The pressure test shall demonstrate a minimum safety factor of three times the rated working pressure as described in AWWA C153, Section 5.5.

E. Submit manufacturer's catalog data and descriptive literature for couplings, service saddles, tracer wire, marking tape, and miscellaneous piping materials.

1.05 INSPECTION AND FIELD VERIFICATION

A. The District's Representative or his authorized representative may inspect materials, production, and testing at manufacturer's plant.

B. Where new pipelines are to be connected to existing waterlines of the District, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing waterline before proceeding with the pipe installation. This field verification shall be performed in the presence of the District's Representative. Adjust and align the new piping as necessary to meet the field conditions and provide all required material, labor, and equipment to make the connection.

PART 2 - MATERIALS

2.01 PVC PIPE

Provide PVC pipe conforming to AWWA C905 with material cell classification 12454-B per ASTM D 1784. Provide standard pipe having integral bell and spigot with elastomeric gasket. Provide pipe in standard 20-foot laying lengths. Straight pipe sections with plain ends for use with high deflection couplings are not available. Random lengths will not be permitted. Provide pipe with cast iron equivalent outside diameter and a dimension ratio (DR) of 18.

2.02 PVC PIPE COLORING AND MARKING FOR RECYCLED WATER SERVICE

PVC pipe shall be purple (Pantone 522) and shall be marked on both sides of the pipe with the wording "CAUTION: RECYCLED WATER--DO NOT DRINK." The lettering shall be minimum 1-inch-high black letters and shall be repeated every 36 inches. The purple coloring shall be achieved by adding pigment to the PVC material as the pipe is being manufactured.

2.03 HIGH DEFLECTION COUPLINGS

Provide ductile iron connecting pieces with push-on joints for a maximum deflection per each joint as tabulated in paragraph 3.08, D. Couplings shall conform to the same criteria as specified for fittings. Provide U.S. Pipe Bell and Bell TYTON Connecting Pieces, or District approved equal.

2.04 FITTINGS

A. Provide ductile iron fittings conforming to AWWA C110 with a minimum rated working pressure of 350 psi. Provide fittings with bells and gaskets specifically designed for cast iron equivalent outside diameter PVC pipe. Use mechanical joint fittings or fittings with bells and gasket ends.

B. In lieu of paragraph 2.04, A., provide ductile iron fittings conforming to AWWA C153 with a minimum rated working pressure of 350 psi. Provide fittings constructed of Grade 70-50-05 ductile iron having a minimum weight equal to the weight tabulated in AWWA C153. Provide fittings with bells and gaskets specifically designed for cast iron equivalent outside diameter PVC pipe. Use mechanical joint fittings or fittings with bells and gasket ends conforming to the dimensional values of AWWA C111. Mechanical joint glands shall be Grade 70-50-05 ductile iron and cast in one continuous ring. Fittings with repaired defects are not acceptable and will be rejected.

C. For mechanical joint fittings with glands, use tee-head or non-hex head bolts and hex head nuts for joint makeup and gasket seating. Bolts and nuts shall be carbon steel and coated with a corrosion inhibiting fluoropolymer composite material. Provide Tripac 200 Blue Coating System, or District approved equal.

2.05 LINING AND COATING FOR FITTINGS

A. Line interior of fittings with cement mortar per AWWA C104 and line interior of bells per Standard Specification Section 09900, System No. 5. Provide double thickness lining and

use cement conforming to ASTM C150 Type II. Coating on interior bells shall be holiday free.

B. Coat exterior of fittings with an asphalt material per AWWA C151.

C. As an alternative to paragraphs 2.05, A. and B., line and coat fittings and bells with fusion-bonded epoxy per Standard Specification Section 09961. Coating shall be holiday free on interior surfaces of the fittings including the bells.

2.06 FLANGES

Flanges on ductile iron fittings shall conform to AWWA C110 or ASME B16.42 Class 150 with a minimum rated working pressure of 250 psi.

2.07 BOLTS, NUTS AND GASKETS FOR FLANGES

See Standard Specification Section 15050.

2.08 OUTLETS

A. For outlets 2 inches and smaller with working pressure 150 psi or less, attach a service saddle to the pipe. Provide service saddles constructed completely of Type 304 stainless steel. Saddles shall be a two-piece, full circumference shell band bolted together with six bolts. Saddles shall have O-ring gaskets and outlets for iron pipe threads. All stainless steel shall be fully passivated for enhanced corrosion resistance. All saddles shall be sized for installation on cast iron equivalent outside diameter PVC pipe conforming to AWWA C905. Service saddles shall be Romac Industries Style 305, or District approved equal.

B. For outlets 3 inches and larger, use a ductile iron tee with a flanged outlet.

C. For outlets on existing pipes, see Standard Specification Section 15080 for material requirements.

2.09 RESTRAINED JOINTS

Restrained joints are not allowed on C905 pipe.

2.10 FLEXIBLE PIPE COUPLINGS

See Standard Specification Section 15122.

2.11 FLANGE COUPLING ADAPTERS

See Standard Specification Section 15122.

2.12 POLYETHYLENE ENCASEMENT

See Standard Specification Section 09954.

2.13 TRACER WIRE

Use AWG No. 8 stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for direct burial in corrosive soil or water. Polyethylene insulation shall conform to ASTM D 1248, Type 1, Class C. Wires with cut or damaged insulation are not acceptable and replacement of the entire wire which has been damaged will be required at the Contractor's expense.

2.14 MARKING TAPE

Use detectable marking tape consisting of one layer of aluminum foil laminated between two colored layers of inert plastic film. The lamination bond should be strong enough that the layers cannot be separated by hand. Tape shall be a minimum of 5 mils thick and 6 inches wide. Tape shall bear a continuous, printed message every 16 to 36 inches warning of the installation buried below. Tape shall be Terra Tape, Linetec, or District approved equal.

2.15 MARKER POSTS

Provide marker posts for buried pipelines at 500 feet on center except where pipeline is located in a paved street or as directed by the District's Representative. Use construction heart garden grade redwood per Standard Specifications for Grades of California Redwood Lumber issued by the Redwood Inspection Service. Provide seasoned redwood, 4 inches by 4 inches, and surfaced on four sides.

2.16 FACTORY TESTING OF PIPE

A. Test the quick-burst strength of pipe produced from each extrusion outlet at the beginning of production of each specific material, style, or size; thereafter, test one sample every 24 hours. Test a minimum of five specimens total. Test in accordance with ASTM D 1599. At least three of the test specimens from the production lot shall have a portion of the required markings located at least one pipe diameter away from an end closure. For bell-end pipe, include the bell (with any reinforcement sleeve) as part of at least two specimens.

B. Hydrostatically test each length of pipe including the joint in accordance with Section 4.6 of AWWA C905.

C. Test the flattening resistance of pipe produced from each extrusion outlet at the beginning of production of each specific material or size; thereafter, test one sample every eight-hour shift. Test a minimum of three specimens total. Test per ASTM D 2241, Section 7.6.

D. Test the pipe produced from each extrusion outlet by the acetone-immersion method at the beginning of production of each specific material or size; thereafter, test one sample every eight-hour shift. Test per ASTM D 2152.

E. Perform the sustained pressure test described in ASTM D 2241 at the beginning of production.

F. Perform other factory testing per ASTM D 2241 and AWWA C905.

G. The phrase "beginning of production" means the beginning of production of pipe for this project. Do not use test results from other projects.

H. When any product fails to meet a specified test requirement, perform additional tests to determine which products are acceptable of those produced from the same extruder or mold as of the last favorable test. Reject pipe that fails to meet any test requirement.

PART 3 - EXECUTION

3.01 PRODUCT MARKING

Legibly mark pipe at 5-foot intervals to identify the nominal pipe size, OD base, PVC, dimension ratio number and pressure class, AWWA C905, manufacturer's name and production code, and the seal of the testing agency that verified the suitability of the material for potable water service where applicable.

3.02 DELIVERY AND TEMPORARY STORAGE OF PIPE

A. Ship, store, and place pipe at the storage yard or installation site, supporting the pipe uniformly. Avoid scratching the pipe surface. Do not stack higher than 4 feet nor stack with weight on bells. Cover to protect from sunlight.

B. Do not install pipe that is gouged or scratched forming a clear depression.

C. Do not install pipe contaminated with a petroleum product (inside or outside).

D. Do not install any pipe that shows evidence of exposure to sunlight, age, surface deterioration, or other physical damage. The decision of the District’s Representative shall be final as to the acceptability of the pipe to be installed.

3.03 HANDLING OF PIPE

Lift pipes with mechanical equipment using wide belt slings. Do not use cable slings or chains.

3.04 SANITATION OF PIPE INTERIOR

A. During laying operations, do not place tools, food, clothing, trash, or other materials in the pipe. Keep the interior of the pipe clean as the pipeline construction progresses. The purpose of maintaining a clean interior is to aid in the passage of the bacteriological quality testing after disinfection.

B. When pipelaying is not in progress, including the noon hour, close the ends of the installed pipe with a plug to deter entry of vermin, children, dirt, storm water, or foreign material.

3.05 PIPE LAYOUT FOR STRAIGHT AND CURVED ALIGNMENTS

A. Use integral bell end pipe for straight alignments and for radii greater than 1,150 feet.

B. Use the following various combinations of plain end pipe lengths with high deflection couplings and integral bell end pipe for curved alignments in both horizontal and vertical directions. Do not bend pipe between couplings. Saw cut integral bell end of standard pipe and bevel end for use with deflection couplings. Pipe lengths shorter than 9 feet will not be used unless specifically authorized by the District's Representative.

1. Use 9.5-foot plain end pipe lengths with deflection couplings for all radii between 140 feet to 270 feet.

2. Use 19-foot plain end pipe lengths with deflection couplings for all radii between 270 feet to 560 feet.

3. Use an integral bell end pipe length joined together with a 19-foot plain end pipe length to form a chord. Use deflection couplings on each end of the chord and continue this combination through the curved alignment for all radii between 560 feet to 1,150 feet.

3.06 INSTALLING PIPE IN TRENCH

A. See Standard Specification Section 02223 for earthwork requirements.

B. Inspect each pipe and fitting before lowering into the trench. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

C. Handle pipe in a manner to avoid any damage to the pipe. Do not drag pipe over the ground, drop it onto the ground, or drop objects on it. Do not drop or allow pipe to fall into trenches.

D. Laying tolerances for the installed pipe shall not vary greater than 0.3-foot horizontally, or greater than 0.1-foot vertically from the alignment and elevations shown on the Drawings.

E. Grade the bottom of the trench to the line and grade to which the pipe is to be laid. Remove hard spots that would prevent a uniform thickness of pipe base material (imported sand). Before laying each section of the pipe, check the grade and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of pipe handling slings.

F. At the location of each joint, dig bell holes in the bottom of the trench and at the sides to permit visual inspection of the entire joint and to prevent the pipe from being supported by the bell end or fitting.

G. Keep the trench in a dewatered condition during pipelaying. Removal of water shall be in conformance with Standard Specification Section 02223.

3.07 ASSEMBLING PIPE JOINTS

A. The spigot and integral bell shall be dirt free and slide together without displacing the rubber ring gasket. Lay the pipe section with the integral bell facing the direction of laying.

B. Clean the groove of the bell of all foreign materials. If the gasket groove is dirty or contains debris, carefully remove the gasket and clean the groove. Insert the gasket back into the groove of the bell prior to installation. Observe the correct direction of the shaped gasket. Feel that the gasket is completely and evenly seated in the groove.

C. Mark the full insertion depth on the spigot end of the pipe. This mark indicates when the pipe is fully inserted into the bell. Lubricate the exposed gasket surface and the beveled spigot up to the full insertion mark with the lubricant supplied by the pipe manufacturer. If the lubricated pipe end touches dirt, clean the pipe end and reapply lubricant.

D. Insert the spigot into the bell and force it slowly into position.

E. Check that the rubber ring gasket has not left the groove during assembly by passing a feeler gage around the completed joint.

3.08 INSTALLING BURIED FITTINGS

A. The District's Representative will inspect all fittings prior to installation for damage to the interior protective coatings. Coating shall be holiday free on interior surfaces. Patch damaged areas in the field with material similar to the original.

B. For mechanical joint fittings, clean the bell socket and the plain end of the pipe of all foreign material and dirt. Place the gland on the pipe spigot with the lip extension toward the plain end. Lubricate the pipe spigot and gasket. Use the same lubricant as supplied by the pipe manufacturer. Install the gasket on the pipe spigot with the narrow edge of the gasket toward the plain end. Insert the pipe into the bell socket and press the gasket firmly into the gasket recess. Keep the joint straight during assembly. Push the gland towards the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make joint deflection after assembly but before tightening nuts. Uniformly tighten bolts and nuts in a progressive diametrically opposite sequence, and torque nuts to 75- to 90-foot-pound with a calibrated torque wrench. Coat exposed surfaces of tee-head bolts and nuts after tightening with primer for wax tape coating per Standard Specification Section 09952.

C. For push-on joint fittings, clean the bell ends of the fitting of all foreign material and dirt. Insert the gasket in the groove of the bell and make sure the gasket faces the correct direction. Feel that the gasket is completely and evenly seated in the groove. When pipe is cut in the field, bevel the plain end prior to installation. Lubricate the exposed gasket surface and the beveled pipe spigot with the same lubricant supplied by the pipe manufacturer. Insert the spigot into the bell and force it slowly into position. Keep the joint straight while pushing. Make joint deflection after the joint is assembled.

D. When necessary to deflect pipe from a straight line in either the horizontal or vertical plane, do not exceed the following joint deflection angles for buried fittings. The angles shown are for each joint and are maximum deflections.

Nominal Pipe Size (inches)	Mechanical Joint (degrees)	Push-on Joint (degrees)
14	3	2-1/2
16	3	2-1/2
18	2-1/2	2-1/2
20	2-1/2	2-1/2

24	2	2-1/2

3.09 INSTALLING FLANGED JOINTS

See Standard Specification Section 15050 for installation instructions.

3.10 INSTALLING SERVICE SADDLES

A. Place the service saddle on the pipe and hand tighten the nuts while positioning the saddle in its final location. Uniformly tighten the nuts in a progressive diametrically opposite sequence and torque with a calibrated torque wrench to the saddle manufacturer's recommended values.

B. Connect a corporation stop to the saddle per Standard Specification Section 15080. Apply Teflon joint compound or tape to the male threads before installing the corporation stop. Make joints watertight.

C. Mount a tapping machine on the corporation stop to cut a hole in the pipe with a shell type cutter made specifically for PVC pipe. Do not use other devices or hand equipment to bore through the pipe wall.

3.11 INSTALLING FLEXIBLE PIPE COUPLINGS

Install flexible pipe couplings per Standard Specification Section 15122.

3.12 INSTALLING FLANGE COUPLING ADAPTERS

Install flange coupling adapters per Standard Specification Section 15122.

3.13 INSTALLING POLYETHYLENE ENCASEMENT

Wrap buried service saddles, fittings and flanged joints with polyethylene material per Standard Specification Section 09954. Wrap metallic items and buried joints with polyethylene sheet and overlap the adjoining pipe a minimum of one foot. Secure in place with 2-inch-wide plastic adhesive tape. Complete the wrap prior to placing concrete anchors, supports, or thrust blocks per Standard Specification Section 02223. Repair polyethylene material damaged during construction.

3.14 INSTALLING TRACER WIRE

Prior to backfill, install tracer wire on top of pipe and secure in place with 2-inch wide plastic adhesive tape at maximum 10-foot intervals. Run tracer wire continuously along pipe and terminate in adjacent valve boxes for buried assemblies or buried valves. Where buried splices occur, use an electrical splicing kit consisting of a split bolt connector, mold, and two part encapsulating epoxy resin such as Scotchcast, or District approved equal. Provide 24 inches of coiled wire at access points for attachment of pipe locating equipment. Each installed run of pipe shall be capable of being located using the tracer wire. Protect wire insulation from damage during installation and backfilling. Wire insulation that is broken, cut, or damaged shall be replaced.

3.15 INSTALLING MARKING TAPE

After the pipe has been backfilled and compacted, place the marking tape on the compacted pipe zone material and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.16 SETTING MARKER POSTS

Locate marker posts on centerline of pipeline and space at 500 feet on center. Cut redwood post to a 5-foot length and chamfer the top. Paint post per Standard Specification Section 09900, System No. 60. Use white paint for the finish coats. For potable water, use blue paint for the top 4 inches of the chamfered end and stencil in 2-inch-high blue letters the word "WATER" on the post. For recycled water, use purple paint for the top 4 inches of the chamfered end and stencil in 2-inch-high purple letters the abbreviation "RW" on the post. Excavate a hole 16 inches in diameter by 2 feet deep. Set the redwood post plumb, fill hole with concrete to 2 inches above finish grade, and crown to slope away from post. Concrete shall be Class C per Standard Specification Section 03000.

3.17 PRESSURE TESTING

See Standard Specification Section 15144 for pressure testing requirements.

3.18 DISINFECTION

See Standard Specification Section 15141 for chlorination requirements.

END OF SECTION