

SECTION 331010

POLYVINYL CHORIDE (PVC) PRESSURE WATER PIPE

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment and incidentals required and install and test polyvinyl chloride (PVC) water pipe and fittings, complete as shown on the Drawings and as specified herein.
- B. Pipe or piping refers to all pipe, fittings, material and appurtenances required to construct PVC water pipe complete, in place.

1.2 RELATED WORK

- A. Trenching, backfilling and compacting is included in Section 311020.
- B. Fill materials, including granular bedding materials, are included in Section 311030.
- C. Valves and appurtenances are included in Section 331040.
- D. Fire hydrants are included in Section 333040.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 013000, and within 30 days of the effective date of the agreement, the name of the pipe and fitting manufacturers and a list of materials to be furnished by each manufacturer. Also, include information on local representative for each manufacturer, if product is sold through a distributor.
- B. Shop Drawings including piping layouts and schedules shall include dimensioning, fittings, types and locations of valves and appurtenances, joint details, methods and location of supports, anchorage, gasket material, grade of material and all other pertinent technical information for all items to be furnished.
- C. Prior to each shipment of pipe, certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM and AWWA Standards specified herein shall be submitted.

1.4 REFERENCED STANDARDS (LATEST REVISION)

A. ASTM International

1. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
2. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
3. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
4. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association (AWWA)

1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in (75mm Through 1219mm) for Water.
2. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
4. AWWA C-605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
5. AWWA C651 - Disinfecting Water Mains.
6. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in through 12-in for Water Distribution.
7. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14-in through 48-in for Water Transmission and Distribution.
8. AWWA M-23 - Manual of Water Supply Practices PVC Pipe, Design and Installation.

C. National Sanitation Foundation (NSF)

1. Standard No. 14 - Plastic Piping Components and Related Materials.
2. Standard No. 61 - Drinking Water System Components - Health Effects.

- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. All PVC water pipe shall be from a single manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034 and NSF Standard No. 14 as applicable. In addition, all PVC pipe to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory provided by the Owner. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract, plus the cost of inspection of a reasonable amount of disapproved pipe, will be borne by the Owner. Final payment will be reduced by excessive costs of plant inspection of pipe. Contractor shall have no claim thereto. Excessive inspection costs are defined as the costs of inspection of that amount of pipe which exceeds 125 percent of the aggregate length of each type installed.
- B. Inspections of the pipe may also be made by the Engineer or other representatives of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

1.6 SYSTEM DESCRIPTION

- A. The equipment and materials specified herein are intended to be of standard types for use in transporting potable water.
- B. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.
- C. Unless otherwise noted, PVC pipe systems shall be designed for the following condition(s).
 - 1. Class: 235 (DR 18)
 - 2. System: Potable Water Mains
 - 3. Pressure:
 - a. Operating: 100 psi
 - b. Testing: 150 psi

1.7 DELIVERY, STORAGE AND HANDLING

- A. All items shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Engineer.
- B. PVC items deteriorate in sunlight and are slightly brittle, especially at lower temperatures, so care shall be taken in loading, transporting and unloading items to prevent injury to the items. All items shall be examined before installation and no piece shall be installed which is found to be defective. Handling and installation of pipe and fittings shall be in accordance with the manufacturer's instructions, referenced standards and as specified herein.
- C. Any pipe or fitting showing a crack, or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- D. Any gouges or scratches that extend 10 percent or more into the pipe wall shall be cause for rejection of that pipe. The undamaged portion may be cut off and used. Rejected materials shall be clearly marked as rejected, segregated and removed from the site.
- E. While stored, pipe shall be adequately supported from below at not more than three (3') foot intervals to prevent deformation. The pipe shall be stored in stacks no higher than that given in the following table:

Pipe Diameter (inches)	Max. No. of Rows Stacked
8 or less	5
12 to 21	4
24 to 30	3
33 to 48	2

- F. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of the sunlight or delivered to the site so that no pipe is exposed to sunlight for more than [60] days. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature build-up, or direct or indirect sunlight will not be permitted.
- G. If any defective item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and the interior shall be kept clean until testing.

- H. In handling the items, use special devices and methods as required to achieve the results specified herein. No uncushioned devices shall be used in handling the item.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. PVC pressure pipe sized 4 through 12-inch shall conform to the requirements of AWWA C900. All piping shall be Class 150 with a Dimension Ratio of 18. The pipe shall be PVC 1120 made from PVC compounds Class 12454-A or 12454-B as defined in ASTM D1784. Each pipe length shall be marked with the manufacturer's name or trademark, size, material code, pressure class, AWWA designation number and seal of test agency that verified pipe material for potable-water service.
- B. PVC pressure pipe sizes 14 through 48-inch shall conform to the requirements of AWWA C905. All piping shall be Class 150 with a Dimension Ratio of 18. The pipe shall be made from PVC compounds Class 12454-A or 12454-B as defined in ASTM D1784. Each pipe length shall be marked with the manufacturer's name or trademark, size, material code, pressure class, AWWA reference and seal of test agency that verified pipe material for potable-water service.
- C. PVC pipe and fittings shall have bell and spigot push-on joints. The bell shall consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly. Installation of elastomeric gasketed joints and performance of the joint shall conform to ASTM F477, ASTM D3139. Joint lubricants shall be as recommended by the manufacturer and meet all requirements of NSF61.
- D. All fittings and accessories for waterlines shall have bell and/or spigot configurations compatible with the pipe.
- E. All fittings for water mains shall be cast or ductile iron conforming to AWWA C110 for mechanical joints. All adaptors, fittings and transition gaskets necessary to connect cast or ductile iron fittings to PVC shall be furnished. Approved mechanical joint fittings are the following.
 - 1. U.S. Pipe and Foundry
 - 2. American Cast Iron Pipe
 - 3. Tyler Union
 - 4. SIP Industries
 - 5. Star Pipe Products
 - 6. Sigma

7. Approved equal

- F. Underground PVC pipes used for potable water lines shall be solid-wall blue pipe, will have a co-extruded blue external skin, or will be white or black pipe with blue stripes incorporated into, or applied to, the pipe wall. PVC pipes used for raw water shall be white in color.
- G. Where restrained joints are shown on the Plans, restraining glands shall be installed. Restraining glands for PVC pipe shall conform to AWWA C111.

PART 3 – EXECUTION

3.1 INSTALLATION OF PVC PIPE AND FITTINGS

- A. No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement, check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.
- B. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. PVC pipe and fittings shall be installed in accordance with requirements of the manufacturer, AWWA C605 or as otherwise provided herein.
- C. As soon as the excavation is complete to normal grade of the bottom of the trench, bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Bedding shall then be placed to 12-inches above the top of the pipe. The initial three (3') foot of backfill above the bedding shall be placed in one (1) foot layers and carefully compacted. Generally, the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment

used in compacting the initial three (3') feet of backfill shall be approved by the pipe manufacturer's representative prior to use.

- D. All piping shall be sound and clean before installation. When installation is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved during installation. The deflection at joints shall not exceed 75 (75%) percent of that recommended by manufacturer. Fittings, in addition to those shown on the Plans, shall be provided, if required, in crossing utilities that may be encountered upon opening the trench.
- E. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end and a reference mark made at the same distance from the pipe end as measured from a factory marked end from the same manufacturer.
- F. The Engineer or authorized representative may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. All pipe having defective joint surfaces shall be rejected, marked as such and immediately removed from the job site.
- G. Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be "pulled" or "cramped".
- H. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.
- I. Precautions shall be taken to prevent flotation of the pipe in the trench.
- J. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. If trench boxes, moveable sheeting, shoring or plates have been installed below the top of pipe, they shall be moved slowly taking care not to disturb pipe, bedding or backfill. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids

created and the backfill shall be recompacted to provide uniform side support for the pipe.

K. Restrained joints shall be installed where shown on the Plans.

3.2 JOINTING PVC PIPE (PUSH-ON TYPE)

A. Joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe and the joint surfaces cleaned and an approved lubricant applied in accordance with the manufacturer's recommendations. The plain end of the pipe to be installed shall then be inserted into the bell of the pipe to which it is to be joined and when in alignment pushed home with a come-along or by other means. Check that the reference mark on the spigot end is flush with the end of the bell.

3.3 JOINTING MECHANICAL JOINT FITTINGS

A. Mechanical joints at valves, fittings and where designated shall be in accordance with the AWWA C111 and the instructions of the manufacturer. Suitable PVC to cast iron adaptors shall be installed prior to installing fittings. PVC beveled spigot shall be cut flush prior to insertion in mechanical joint pipe.

B. Joints shall be assembled as specified in Section 332040 – Lay and Jointing Buried Pipe.

3.4 FILLING AND TESTING

A. After installation, the pipe shall be tested for compliance as specified herein. The Contractor shall furnish all necessary equipment and labor for the hydrostatic pressure test on the pipelines.

B. Submit detailed test procedures and method for Engineer's review. In general, testing shall be conducted in accordance with AWWA C605. The method and procedures for performing the hydrostatic pressure test shall be approved by the Engineer. Submit the plan for testing to the Engineer at least 10 (ten) days before starting a test.

C. Pressure pipelines shall be subjected to a hydrostatic pressure of 150 psig. This test pressure shall be maintained for a minimum of two (2) hours. The hydrostatic testing allowances shall not exceed those indicated in AWWA C605. Provide suitable restrained bulkheads as required to complete the hydrostatic testing specified.

- D. Contractor shall make any taps and furnish all necessary caps, plugs etc., as may be required in conjunction with performing the testing.
- E. All valves and valve boxes shall be properly located and installed and operable prior to testing. Bulkheads shall be provided with enough outlets for filling and draining the line and for venting air.
- F. Hydrostatic pressure tests shall conform to Section 7.3 of AWWA C605. Furnish gauges, meters, pressure pumps and other equipment needed to fill the line slowly and perform the required hydrostatic pressure tests.
- G. The Owner will provide a source of supply from the existing treated water distribution system for Contractor's use in filling the lines. An air break shall be maintained at all times between the Owner's distribution system and the Contractor's equipment to prevent cross-connection. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the Contractor. Provide accurate means for measuring the quantity of makeup water required to maintain this pressure.
- H. Duration of pressure test shall not be less than two (2) hours. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves and accessories shall be removed and replaced.

3.5 FLUSHING AND CHLORINATION OF PIPELINES

- A. Before being placed in service and prior to hydrostatic testing, all new water pipelines shall be chlorinated in accordance with AWWA C651. The procedure shall be approved by the Engineer in advance.
- B. The location of the chlorination and sampling points will be determined by the Engineer in the field. Taps for chlorination and sampling shall be installed by Contractor. Uncover and backfill the taps as required.
- C. The general procedure for chlorination shall be first to flush all dirty or discolored water from the pipeline. The flushing velocity shall be a minimum of three (3) ft/sec and continue until at least three changes of water have passed through the segment being flushed. Flushing operations shall be conducted without causing erosion, damage, nuisance or interruption of traffic and comply with all regulatory requirements. Then introduce chlorine in approved dosages through a tap at one end, while water is being withdrawn at the other end of the line. The concentration and residence time of the chlorine solution in the pipeline will depend on the type of disinfection method used, as

described in AWWA 651. Note: Pigging of the pipe may be required at the discretion of the City and/or Engineer, at no additional cost to the City.

- D. Following the chlorination period, all treated water shall be flushed from the lines at their extremities and replaced with water from the distribution system. All treated water flushed from the lines shall be disposed by discharging to the nearest sanitary sewer or other approved means. No discharge to any storm sewer or natural water courses will be allowed. Bacteriological sampling and analysis of the replacement water may then be made by the Engineer in full accordance with AWWA C651. Re-chlorination will be required, if necessary and the line shall not be placed in service until the requirements of the Department of Health are met.
- E. Special disinfecting procedures shall be used in connections to existing mains and where the method outlined above is not practical.

END OF SECTION