

SECTION 02623

POLYVINYL CHLORIDE (PVC) SEWER PIPE AND SERVICE PIPE

PART 1 - GENERAL

1.1 SCOPE

The work covered by this section includes furnishing all labor, equipment, and materials required to install and test polyvinyl chloride (PVC) pipe, including accessories, as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

- A. The Contractor, at the Engineer's request, shall furnish a certificate from the manufacturer of the pipe and fittings that the manufacturer is fully competent and capable of manufacturing PVC sewer pipe, fittings, and accessories of uniform texture and strength that will fully comply with these Specifications and have so manufactured this class of pipe in sufficient quantities to be certain that it will meet all normal field conditions of usage. The manufacturer must have adequate equipment and quality control facilities to be sure that each extrusion of pipe is uniform in texture, dimensions, and strength.
- B. Pipe shall be tested when requested by the Engineer and all pipe so designated shall be tested in accordance with ASTM D 2412 "Standard Method of Test for External Loading Properties of Plastic Pipe by Parallel Plate Loading."
- C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
 - 1. Manufacturer's name
 - 2. Pipe size and use
 - 3. PVC compound used
 - 4. ASTM material specification for the PVC compound used

1.3 SHOP DRAWING AND ENGINEERING DATA

Complete shop drawing and engineering data shall be submitted to the Engineer in accordance with the requirements of the section entitled "Submittals" of these Specifications.

1.4 STORAGE AND PROTECTION

- A. PVC piping and accessories shall be stored and protected in accordance with the requirements of the section entitled "Storage and Protection" of these Specifications.
- B. PVC pipe and fittings shall be stored under cover.
- C. All pipe and accessories shall be stored above ground and fully supported so as not to bend or deflect excessively under its own weight.

1.5 GUARANTEE

The Contractor shall provide a guarantee against defective equipment and workmanship in accordance with the requirements of the section entitled "Warranties and Bonds" of these Specifications.

1.6 COLOR

Service pipe shall be any color other than white.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. The pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.
- B. The manufacturer shall provide waterstops, acceptable to the Engineer, which shall be applied to the outside of the plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.
- C. No Single piece of pipe shall be laid on any project covered by this Specification unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16-inch per foot of length. If the deviation exceeds this requirement, then the particular piece of pipe shall be rejected from use until it can comply with this provision.

- D. Wyes, tees, bends, adapters, and any other fittings required or directed by the Engineer shall be provided. Engineering data for such fittings showing cross-sectional views with dimensions shall be provided and such data and fittings shall be approved by the Engineer prior to their use. The materials used in the manufacture of fittings shall conform to the requirements for the pipe with which they shall be used and any variation of such requirements shall be subject to the approval of the Engineer. Fittings shall have wall thicknesses equal to or greater than that of the pipe to which they are joined.

2.2 PIPE

- A. PVC piping and accessories shall be made from Virgin Type I, Grade 1 PVC compounds with physical and chemical properties conforming to those defined and described in ASTM D 1784 for "Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds."
- B. The standard length of PVC pipe under this Specification shall be 12.5 feet, except that all pipe used in service lines shall not exceed 10 feet in length unless otherwise approved by the Engineer.
- C. The PVC pipe and accessories shall be manufactured in accordance with the requirements of ASTM D 3034, Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings. All pipe for gravity sewers shall have an SDR of 35 or less.

2.3 JOINTS

- A. PVC pipe joints shall be the bell and spigot type subject to the approval of the Engineer. The bell shall consist of an integral wall section stiffened with two PVC retainer rings which securely lock the solid section rubber ring into position and shall meet or exceed the requirements of ASTM D-3212.
- B. Joints shall be sealed with a rubber O-ring gasket, and shall be of a composition and texture which is resistant to common water, and which will endure permanently under the conditions likely to be imposed by this usage. The gasket installation shall be done in accordance with the pipe manufacturer's instructions using all the necessary materials, lubricants and equipment recommended by the manufacturer.

PART 3 -EXECUTION

3.1 PIPE LAYING

- A. Before sewer pipe is placed in position in the trench, the bottom and sides of the trench shall be carefully prepared and bracing and sheeting installed where required. A mason's line, supported at intervals not exceeding 50 feet, shall be stretched tightly above ground level at a grade parallel to and directly above the axis line of the pipe. Each pipe shall be accurately placed to the exact line and grade called for on the Drawings by measuring down from this line to the invert of the pipe in place. The Contractor shall furnish all labor and materials necessary for erecting batter boards and establishing lines and grades therefor.
- B. The Contractor may use the laser beam method of setting a line and grade for the sewer by using the laser beam coaxially through the center of the sewer being laid. The laser beam projector is to be rigidly mounted to its support platforms, with a 2-point suspension, or equivalent, assuring that all ground and equipment vibrations are kept to an absolute minimum. All equipment including equipment necessary to control atmospheric conditions in the pipe to keep line and grade to acceptable standards of accuracy shall be furnished by the Contractor. The laser beam system must be operated by competent experienced men who have been properly trained to operate the equipment used.
- C. The Contractor shall stake check pegs at all manholes throughout the job. Check pegs midway between manholes and any other check points deemed necessary to assure accuracy of the equipment shall be provided by the Contractor.
- D. Each piece of pipe and special fitting shall be carefully inspected before it is placed and no defective pipe shall be laid in the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells uphill. No Pipe shall be laid except in the presence of an inspector representing the Engineer. Trench bottoms found to be unsuitable for foundations after pipe laying operations have started shall be corrected and brought to exact line and grade with approved compacted materials.
- E. Bell holes shall be of sufficient size to allow ample room for making the pipe joints properly. Bell holes shall not be cut out more than ten joints ahead of pipe laying. The bottom of the trench between bell holes shall be carefully graded so that the pipe barrel will rest on a solid foundation for its entire length as shown on the Drawings. Each joint shall be laid so that it will form a close concentric joint with adjoining pipe in order to avoid sudden offsets of inequalities in the flow line.

- F. Water shall not be allowed to run or stand in the trench while pipe laying is in progress or before the joints are completely set or before the trench has been backfilled. The Contractor at no time shall open up more trench than his available pumping facilities are able to dewater. Where sewer pipelines are located in or across stream beds or drainage ditches, the Contractor shall divert the stream flow and dewater each section as the work progresses.
- G. No joints shall be made where pipe or joint materials have been soiled by earth in handling until such soiled surfaces are thoroughly cleaned by wire brushing and wiping until all traces of the earth are removed.
- H. As the work progresses, the interior of all pipe shall be kept thoroughly clean. After each line of pipe has been laid, it shall be carefully inspected and all earth, trash, rags, and other foreign matter removed from the interior. A filled bag or other approved type of follower shall be pulled through the line immediately after each joint is made in order to remove any debris which may be left on the inside of the pipe.
- I. Backfilling of trenches shall be started immediately after the pipe in place has been inspected and approved by the Engineer and backfill shall be deposited and compacted as detailed on the Drawings.
- J. Installation of service pipe shall conform to the appropriate requirements of main line sewers.

3.2 INSTALLATION OF TEES, WYES, AND PLUGGED STUBS

- A. Tee branches or wyes shall be installed in the sewer lines at all places shown on the Drawings, specified herein or otherwise directed by the Engineer. Tee branches on pipe less than 12 inches in diameter shall be cast or extruded and manufactured monolithic with the barrel.
- B. Plugged pipe stubs for future connections to manholes and sewerage structures shall be installed where shown on the Drawings or directed by the Engineer.
- C. Plugged stubs and such branches of pipelines that are not to be used immediately shall be closed with PVC stoppers held securely in place.
- D. Where specifically directed by the Engineer or shown on the Drawings, connections to reinforced concrete pipe over 18 inches in diameter shall be made in accordance with details shown on the Drawings.

3.3 CONNECTIONS

- A. If the work consists of the construction of a sewer that is to replace an existing sewer, all of the existing service lines shall be kept in operation and connected to the new line.
- B. Connections shall be made to all existing sewer lines in the vicinity of the work by removing a section of the sewer from the existing line and inserting in the space a tee branch of proper size, or by the construction of a manhole over the existing line.
- C. Connections to existing manholes or inlets where no plugged stubs exist shall be made by cutting a hole in the wall of the existing structure, inserting a length of sewer pipe into the hole, filling around same with concrete or mortar and troweling the inside and outside surfaces of the joint to a neat finish. The bottom of the manhole shall be shaped to fit the invert of the sewer pipe as specified under the section entitled "Manholes" of these Specifications.
- D. Connections to building services shall be made in a neat and workmanlike manner. Cleanout plugs shall be installed, wherever feasible, by making the connections with a standard wye or tee.

3.4 EXISTING UTILITIES

- A. All existing sewers, water lines, gas lines, underground conduits, telephone lines, sidewalks, curbs, gutters, pavements, electric lines, or other utilities or structures in the vicinity of the work shall be carefully protected by the Contractor from damage at all times. Where it is necessary for the proper accomplishment of the work to repair, remove and/or replace any such utility, the work shall be done under the provisions set forth in the "General Conditions." No separate payment shall be made for removing and replacing and/or repairing damaged existing sewers; water, gas, electric, telephone lines or conduits; or other utilities, culverts, drains, or conduits of similar existing services or structures. Similar repair and replacement of sidewalks, curbs, gutters, and pavements are provided elsewhere in these Specifications.
- B. Sewers shall be laid at least 10 feet, horizontally, from any existing or proposed water main. If conditions prevent the 10 foot separation, the sewer may be constructed closer to a water main if it is laid in a separate trench and if the elevation of the top of the water main is at least 18 inches above the invert of the sewer.

- C. When sewers cross under water mains, the top of the sewer shall be at least 18 inches below the bottom of the water main. If necessary, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint cast iron or ductile iron pipe for a distance of 10 feet on each side of the sewer. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.
- D. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both water main and sewer shall be constructed of mechanical-joint cast iron pipe and shall be pressure tested to assure water tightness.
- E. When sewer lines cross under culverts where the sewer and the culvert are less than 18 inches apart, the sewer line shall be encased in concrete or shall be constructed of ductile iron if shown on the drawings.

3.5 INSPECTION AND TESTING

- A. After completion of any section of sewer, the grades, joints and alignment shall be true to line and grade. Joint surfaces shall be smooth. There shall be no visual leakage and the sewer shall be completely free from any cracks and from protruding joint materials, deposits of sand, mortar, or other materials on the inside.
- B. Infiltration or exfiltration shall not exceed 50 gallons per 24 hours per inch of diameter per mile of sewer. Contractor shall furnish all supplies, materials, labor, services, etc., needed to make infiltration or exfiltration tests including water. No separate payment will be made for equipment, supplies, material, water or services.
- C. Any leakage, including active seepage, shall be corrected by removal and replacement of pipe or joint where such leakage exists until the pipelines meet the requirements of the allowable leakage specifications.
- D. Infiltration tests shall be made when groundwater level is 18 inches or more above the top of the outside of the pipe.
- E. When normal groundwater does not stand at a level outside the pipe to enable infiltration tests to be made to the satisfaction of the Engineer, the Contractor shall make exfiltration tests by filling the pipe or sections thereof with water to a head of not less than 2 feet above the top of the outside of the pipe and observing the amount of water required to maintain this level.

- F. Low pressure air testing may be used in lieu of infiltration testing at the Contractor's request and upon approval by the Engineer. When approved by the Engineer, Low Pressure Air Test shall be made in accordance with the procedures and standards listed below.
1. Clean pipe to be tested by propelling snug-fitting inflated rubber ball through pipe with water.
 2. Plug all pipe outlets with suitable test plugs. Brace each plug securely to prevent blowouts. As a safety precaution, pressurizing equipment shall include a regulator set at slightly above test pressure to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manhole during testing.
 3. If the pipe to be tested is submerged in groundwater, insert a pipe probe by boring or jetting, into the backfill material adjacent to the center of the pipe, and determine the pressure in the probe when air passes slowly through it. This is the back pressure due to groundwater submergence over the end of the probe. All gauge pressures in the test should be increased by this amount.
 4. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
 5. After an internal pressure of 4.0 psig is obtained, allow at least two (2) minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
 6. When pressure decreases to 3.5 psig, start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times for runs of single pipe diameter are indicated in the table in seconds. Times for mixed pipe sizes of varying lengths should be calculated as described in ASTM C 828-76T using formula $t = K \times d/q$ ($q = 0.0020$).

1 Pipe Diameter (in.)	2 Minimum Time (min:sec)	3 Length For Minimum Time (ft.)	4 Time for Longer Length (sec)	Specified Minimum for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17

*Q is the allowable leakage rate in cu.ft./min/ft² of inside surface area of pipe (Q=0.0015)

- G. The maximum allowable deflection for PVC pipe is 5%. After the PVC pipe has been installed and backfilled, the Contractor shall check the deflection by pulling a vertical floating pin type go/no go mandrel sized at 95% of the actual inside diameter of the pipe used through the pipe. Deflection tests shall not be conducted before the elapse of 24 hours after backfilling. Any pipe not passing the mandrel shall be replaced and rechecked. Minimum diameters of mandrels to be used are:

- 8" = 7.37"
- 10" = 9.22"
- 12" = 10.98"
- 15" = 13.43"

- H. Final Inspection Preceding Acceptance: Final inspection will include a visual inspection of each section sewer by looking from manhole to manhole with the aid of reflected sunlight or an electric torch. Such light used for inspection shall

be plainly visible from manhole to manhole. Reflected light from manhole to manhole will not be considered as plainly visible light and shall be reason for rejection of the section of sewer as not being laid true to line and grade. The pipe shall be true to both line and grade; shall show no leaks, shall be free from cracks, and protruding joint materials which will reduce the full cross sectional area. Ground water infiltration shall not exceed the rates hereinbefore stipulated and shall be distributed uniformly throughout the collecting system and not occur through a few joints. All joints shall be tight. All finished work shall be neat in appearance and of first class workmanship.

3.6 CLEANUP

After completing each section of the sewer line, the Contractor shall remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line and leave the entire right-of-way in a clean, neat, and serviceable condition.

END OF SECTION 02623.