Section 02702 - SEWER PIPE INSTALLATION AND TESTING AND MANHOLE TESTING

1. SCOPE. This section covers installation and testing of all sewer pipe and testing of manholes. Sewer pipe materials are specified in other sections.

Pipe trenching, bedding, and backfill are covered in the earthwork section.

2. HANDLING. Pipe, fittings, and appurtenances shall be transported, stored, and handled in a manner which prevents damage. Hooks shall not be permitted to contact joint surfaces. Materials shall be removed from trucks in a careful manner to reduce banging against the truck. In no instances shall materials be dropped from the truck during unloading. Plastic pipe shall be shaded if necessary to prevent curvature due to thermal expansion. Damaged pipe and fittings shall be removed from the site.

3. CLEANING. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

Foreign material shall be prevented from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe.

4. ALIGNMENT. Piping shall be laid to the lines and grades indicated on the drawings. Batter boards, laser beam equipment, or surveying instruments shall be used to maintain alignment and grade.

Batter boards, if used, shall be erected at intervals of not more than 25 feet. Batter boards shall be used to determine and check pipe subgrades. Not less than three batter boards shall be maintained in proper position at all times when trench grading is in progress.

If laser beam equipment is used, periodic elevation measurements shall be made with surveying instruments to verify accuracy of grades. If such measurements indicate thermal deflection of the laser beam due to differences between ground temperature and the air temperature within the pipe, precautions shall be taken to prevent or minimize further thermal deflections.

5. LATERAL SEPARATION OF WATER AND SEWER MAINS. Separation of water and sewer mains shall be as specified in the Earthwork section and Standard Details.

6. LAYING PIPE. Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water, nor under unsuitable weather or trench conditions.

Pipe laying shall begin at the lowest elevation with bell ends facing the direction of laying except when reverse laying is permitted by the Engineer.
Whenever pipe laying is stopped, the open end of the pipe shall be closed with an end board closely fitting the end of the pipe, to keep sand and earth out of the pipe. The end

board shall have several small holes near the center to permit water to enter the pipe and prevent flotation in the event of flooding of the trench.

Core holes and handling holes in concrete pipe shall be repaired by cementing a properly shaped concrete plug in place with epoxy cement or by other methods acceptable to the Engineer.

6.01. Creek Crossings. For crossings below water level, the top of the pipe (ductile iron pipe) should be located at or below the bottom of the streambed. For crossings above water level, the bottom of the pipe (ductile iron pipe) should be located above the 25-year flood elevation.

7. JOINTING. All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer.

Immediately before rubber gasketed bell-and-spigot type joints are pushed together, all joint surfaces shall be coated with the lubricant furnished with the pipe. The position and condition of each rubber gasket (unbonded gaskets) shall be checked with a feeler after the joint is completed.

8. CONNECTING TO EXISTING MANHOLES. All connections to existing manholes shall be made in accordance with the specifications and standard details for pipe connections to new manholes. All connections to existing manholes shall be cored unless written permission is given by the Engineer to use other means. Resilient connectors conforming to ASTM C923 and as specified in the sewer manhole section shall be provided at all pipe-to-manhole connections.

Connections to existing manholes will not be allowed until the new sewer system has been completely installed, cleaned, tested, and accepted by the Owner. Following acceptance by the Owner, Contractor shall provide 48 hour advance notice of all connections to existing manholes.

9. SERVICE CONNECTIONS. Service connections shall not be installed as vertical risers but shall be laid on a slope not to exceed 2 feet vertical to one foot horizontal. Each service connection pipe shall have a solid bearing on undisturbed earth. Service connections shall be as specified in the Wastewater Service Connections section.

10. CONCRETE ENCASEMENT. Concrete encasement shall be installed where indicated on the drawings. Concrete and reinforcing steel shall be as specified in the cast-in-place concrete section. All pipe which is to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation.

11. ACCEPTANCE TESTS. Each reach of sewer shall meet the requirements of the following acceptance tests. All defects shall be repaired to the satisfaction of the Engineer.

11.01. Lamping. Unless otherwise indicated on the drawings, each section of sewer line between manholes shall be straight and uniformly graded. Each such section will be lamped by the Engineer. The Contractor shall furnish suitable assistants to assist the Engineer. The Contractor shall provide all equipment to assure that the manholes are properly ventilated in compliance with confined space requirements prior to any personnel entering the manhole.

11.02. Exfiltration. For pipe greater than 24 inches in diameter, an exfiltration test shall be conducted on each reach of sewer between manholes. The first line between manholes shall be tested before backfilling and before any sewer pipe is installed in the remainder of the work. Thereafter, exfiltration testing shall be done after backfilling, and individual or multiple reaches may be tested at the option of the Contractor.

Exfiltration tests shall be conducted by blocking off all manhole openings except those connecting with the reach being tested, filling the line, and measuring the water required to maintain a constant level in the manholes. Each manhole shall be subjected to at least one exfiltration test.

During the exfiltration test, the water depth above the pipe invert at the lower end shall be at least to the elevation of the ground surface, unless otherwise specified. The maximum depth at the lower end shall not exceed 25 feet and the minimum depth at the upper end shall be at least 5 feet above the crown of the pipe or 5 feet above groundwater elevation, whichever is higher.

The total exfiltration shall not exceed 100 gallons per inch of nominal diameter per mile of pipe per day for each reach tested. For purposes of determining maximum allowable leakage, nominal diameter and depth of manholes shall be included. The exfiltration tests shall be maintained on each reach for at least 2 hours and as much longer as necessary, in the opinion of the Engineer, to locate all leaks.

The Contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, and all labor, equipment, and materials required for the tests. The methods used and the time of conducting exfiltration tests shall be acceptable to the Engineer.

11.03. Low Pressure Air Testing. For pipe 24 inches in diameter and less, low pressure air testing shall be used in lieu of exfiltration testing.

Low pressure air testing shall comply with ASTM C828 for PVC pipe, and shall comply with ASTM C924 for concrete pipe. The schedule of testing shall be submitted to the Engineer prior to starting the tests. The time of conducting the tests shall be acceptable to the Engineer.
The time elapsed for a one psi drop in air pressure from 4 psi to 3 psi shall be not less than as shown in the following table:

AIR TEST TABLE
Based on equations from ASTM C-828

SPECIFICATION TIME (min. sec.) REQUIRED FOR PRESSURE DROP
FROM 4 to 3 PSIG
WHEN TESTING ONE PIPE DIAMETER ONLY

Length of Line in Feet	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	9:55	11:20
175	0:31	1:09	2:03	3:13	4:37	7:05	8:30	9:55	11:20
200	0:35	1:19	2:21	3:40	5:17	7:05	8:30	9:55	11:20
225	0:40	1:29	2:38	4:08	5:40	7:05	8:30	10:25	13:36
250	0:44	1:39	2:56	4:35	5:40	7:05	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	5:40	7:05	9:21	12:44	16:38
300	0:53	1:59	3:31	4:43	5:40	7:05	10:12	13:53	18:09
350	1:02	2:19	3:47	4:43	5:40	8:16	11:54	16:12	21:10
400	1:10	2:38	3:47	4:43	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	3:47	4:43	6:48	10:38	15:19	20:50	27:13
500	1:28	2:50	3:47	5:15	7:34	11:49	17:01	23:09	30:14

The air test table has been prepared utilizing applicable equations from ASTM C-828. It is based on an allowable air loss of 0.0003 ft/min ft of internal pipe surface, a maximum air loss per test section of 3.5 ft/min and a minimum significant air loss per test section of 2.0 ft/min (test sections of such length that an air loss of 3.5 ft/min would be exceeded using the allowable loss of air per square foot of internal pipe surface may be tested in segments where total air loss would be between 2.0 and 3.5 ft/min). It applies when testing one pipe only.

The air test may be dangerous if a line is improperly prepared. It is extremely important that the various plugs shall be installed and braced in such a way as to prevent blowouts. In so much as a force of 250 LBF (112 N) is exerted on an 8 inch (203 mm) plug by an internal pipe pressure of 5 psi (34 kPa), it should be realized that sudden expulsion of a

poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous. As a safety precaution, pressurizing equipment may include a regulator or relief valve set at perhaps 10 psi (69 kPa) to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

If the length of sewer to be tested is submerged or partially submerged in groundwater, the test pressure shall be increased as required to overcome the actual static pressure exerted by the groundwater. If a test pressure greater than 8 psi results, air testing shall not be used, and exfiltration testing will be required.

Leaks shall be located by testing short sections of pipe. Leaks shall be repaired and the reach of sewer retested.

11.04. Infiltration. All sewer lines below the water table shall be checked for infiltration. If, at any time prior to expiration of the correction period stipulated in the General Conditions, infiltration exceeds 100 gallons per inch of nominal diameter per mile of sewer per day, the Contractor shall locate the leaks and make repairs as necessary to control the infiltration.

All visible leaks in manholes shall be repaired.

11.05. Deflection. At least thirty days after backfilling is complete, and prior to acceptance of the Work, each reach of sewer shall be checked for excessive deflection by pulling a mandrel through the pipe, or by other methods acceptable to the Engineer. The mandrel shall be cylindrical in shape and constructed with 9 evenly spaced arms. The critical dimension of the mandrel shall have a +/- 0.01 inch tolerance. Pipe with diametrical deflection exceeding 5 percent of the inside diameter shall be uncovered, and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested.

11.06. Television Inspection. Prior to final acceptance, each section of sewer line between manholes and all services lines shall be visually inspected by means of a closed-circuit television system.

Contractor shall use a color video camera specifically designed and constructed for internal inspection of gravity sewer lines. The camera shall be equipped with lighting suitable to allow clear picture of the entire periphery of the pipe and capable of operating in conditions of 100 percent humidity. Only high quality cameras, television monitors, recorders, and other components of the video system capable of producing detailed video records of the sewer lines inspected shall be used. The equipment shall be capable of displaying and recording selected digital (manhole numbers) and automatic digit (feet of distance) information. The location accuracy of the equipment shall be within 1 foot for each 1,000 feet inspected.

For each section of line inspected, Contractor shall maintain television inspection logs recording locations, relative to an adjacent manhole, of all points of significance in the

line, such as locations of sewer service connections, bends, points of infiltration, broken or damaged pipe sections, or obstructions. Copies of inspection logs shall be provided to the Owner.

Contractor shall produce a high quality color video tape or DVD recording of each line inspected, providing both an audio and visual record of the installed sewer system. All points of significance in the lines shall be identified, including locations of sewer service connections, bends, points of infiltration, broken or damaged pipe sections, or obstructions. Video shall identify location of camera in feet from an adjacent manhole as the camera travels through pipeline. Contractor shall provide Owner with a copy of all video recording, appropriately labeled, on VHS or DVD format.

Contractor shall repair all defective work identified by the television inspections and the defective lines re-inspected.

12. MANHOLE TESTING. After the manhole is installed and all pipes are tied in, but before backfilling or installing frame and cover, the manhole shall be vacuum tested. All pipes that enter the manhole shall be plugged and properly braced. Then the testing machine shall be installed and a vacuum of 10 inches of mercury shall be placed on the inside of the manhole. Once the 10 inches of mercury vacuum is achieved the vacuum shall be shut-off and the amount of time to drop to 9 inches of mercury shall be recorded. If the vacuum drops from 10 to 9 in less than 60 seconds for a 4-foot manhole, 75 seconds for a 5-foot manhole, 90 seconds for a 6-foot manhole, 105 seconds for a 7-foot manhole, 120 seconds for an 8-foot manhole, and 150 seconds for a 10-foot manhole the manhole fails the vacuum test. If the test fails, Contractor shall determine the location of the leak and make all necessary repairs. Once the repairs are made the manhole shall be retested. This process shall continue until the manhole passes the vacuum test.

End of Section