



SECTION 11

SEWER TESTING AND INSPECTION

11.1 PURPOSE

This section outlines the requirements for acceptance testing of gravity sewer pipe (plastic composite and ductile iron).

11.2 GENERAL

Testing shall be accomplished through the combination of visual inspections, deflection tests, low-pressure air tests, and leakage tests methods. Acceptance tests shall only be performed after **all** work adjacent to and over the pipeline has been completed. Backfilling, placement of fill, grading, initial/base layer of paving, concrete work, and any other superimposed loads shall be completed and in place prior to any testing. All testing shall be performed in the presence of the Board's representative, after the installation of all other utilities (including power poles). Tests performed in the absence of the Board's representative shall be considered invalid and shall be repeated at the Contractor's expense.

11.2.1 VISUAL INSPECTION

The Board's representative shall visually inspect all gravity sewer pipe (plastic composite and ductile iron) installed to verify alignment and ensure the pipe is free from obstructions and debris. The inspector shall use a pole camera system or the sun light and mirrors to "flash" the sewer pipe one section at a time. When the full diameter of the pipe is visible between adjacent manholes, the segment of piping is deemed properly aligned and free of sags and debris. If the segment of pipe fails the visual inspections the pipe shall be cleaned and/or replaced and re-tested.

11.2.2 DEFLECTION TEST

A deflection test shall be required for all plastic sewer piping installed (ductile iron piping will be tested at the discretion of the Board's Inspector). A GO-NO-GO Mandrel shall be pulled through the pipe a minimum of 60 days after the final placement of backfill and superimposed loads. The deflection of the sewer pipe shall not exceed 5.0 percent of average inside diameter when tested with a mandrel specifically designed for the type and size of pipe installed. Pipe segments failing the Mandrel test shall be removed and replaced.

(Note: Mandrel shall have a factory stamped identification mark indicating its size (in inches) or shall be verified in the field by the use of a stamped following ring)

MATERIAL TYPE	NOMINAL INSIDE DIAMETER (INCHES)	AVERAGE INSIDE DIAMETER (INCHES)	95% OF INSIDE DIAMETER (INCHES)
Solid Wall PVC (PS115 SDR 26)	8	7.754	7.37
	10	9.692	9.21
	12	11.538	10.96
	15	14.124	13.42
	18	17.261	16.40
	21	20.349	19.33
	24	22.891	21.75
A2000	18	17.6	16.72
	21	20.7	19.67
	24	23.5	22.33
Ductile Iron*			

*Average inside diameter varies. See Board Engineer for mandrel sizing.

11.2.3 LOW-PRESSURE AIR TEST

On all sanitary sewer lines (plastic composite and ductile iron), including private sewer lines, the Contractor shall conduct a line acceptance test using low-pressure air testing. For ductile iron pipelines test in accordance with the applicable requirements of ASTM C924. For PVC pipelines test in accordance with ASTM F1417-98 and UBPPA UNI-B-6.

For gasketed joint plastic composite pipe (Truss Pipe), it is often desirable to begin and finish a run with the factory bell in place (lay the upstream section of the pipe backwards) or coat the spigot ends at each manhole with a heavy bodied moisture cured urethane adhesive. Take care to coat both ends of spigot/spigot section entering the manhole.

The Contractor shall furnish all labor, equipment, and any appurtenant items necessary to satisfactorily perform the vacuum test. All testing equipment shall be approved for vacuum testing manholes.

11.2.3.1 Air Test Procedure (Dry Conditions)

The following procedure shall be used during the low-pressure air testing of sewer mains located above the ground water table:

- Isolate section of sewer by inflatable stoppers or other suitable test plugs. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test. Securely brace all plugs or caps to prevent blow-out. One of the plugs or caps should have an inlet tap, or other provision for connecting a hose to a portable air source.

(Note: Special attention should be placed on the exposed spigot end of composite plastic pipe. If not properly sealed, air can leak through the porous material in the pipe's annulus.)

- Connect the air hose to the inlet tap. Add air slowly to the test section until the pressure inside the pipe reaches 4.0 psig.
- Allow the pressure to stabilize such that a pressure between 4.0 psig and 3.5 psig is maintained for at least two minutes. The pressure will normally drop slightly until equilibrium is obtained; however a minimum of 3.5 psig is required.
- Disconnect the air supply and decrease the pressure to 3.5 psig. before starting the test.
- Use the Time-Pressure Drop Method to determine if the segment of pipe is "Acceptable". Determine the minimum acceptable time for a 1 psig drop in pressure from 3.5 psig to 2.5 psig. Compare the minimum acceptable time to that actually observed in the field to determine if the rate of air loss is within acceptable limits. Minimum holding times are listed in the following table depending on length and size of mains.

Minimum specified time required for a 1.0 psig pressure drop for size and length of pipe.

Pipe Diameter (inches)	Specification Time for Length Shown (Minutes : Seconds)							
	100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	14:10	17:48	22:15	26:42	31:09	35:35	40:04
18	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33

11.2.3.2 Air Test Procedure (Wet Conditions)

All test pressures are measured as gage pressure, which is any pressure greater than atmospheric. Since water produces a pressure of 0.43 psig for every foot of depth over the main, air test pressures **must** be increased to offset the depth of ground water over the sewer line.

In areas where groundwater is known to exist, the contractor shall install a one-half inch diameter capped PVC pipe nipple, approximately 10" long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to performing the line acceptance test, the ground water elevation shall be determined by removing the pipe cap, blowing air through the pipe nipple

into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic tube.

Multiply the height in feet above the pipe invert to the ground water table by 0.43 psig/ft and add it to the required 3.5 psig minimum test pressure. For example, if the height of water is 11.5 ft, then the added pressure will be $0.43 \text{ psig/ft} \times 11.5 \text{ ft}$ or 4.9 psig. This increases the test pressure from 3.5 psig to 8.4 psig and the 2.5 psig to 7.4 psig, respectively. The allowable drop of 1 psig for the time allowed as outlined in Table 1 still remains the same.

If however, the ground water level is 2 ft or more above the top of the pipe at the upstream end, or if the air pressure required for the test calculates out to be greater than the 9 psig gage, the air test method should not be used. In these case, a visual inspection for leakage would produce a more conservative test. Before the air test method is used, the ground water level should be lowered by pumping or dewatering.

11.2.4 VACUUM TESTING OF MANHOLES

All sanitary sewer manholes constructed by the Contractor shall be vacuum tested for leakage in the presence of a Board Representative. Vacuum testing shall be performed in accordance with ASTM C1244. The vacuum test requirement will not apply to any existing manhole, or any existing manhole that has been converted to a drop manhole by the Contractor.

The Contractor shall furnish all labor, equipment, and any appurtenant items necessary to satisfactorily perform the vacuum test. All testing equipment shall be approved for vacuum testing manholes.

11.2.4.1 Vacuum Testing Procedure

All lifting holes shall be plugged with an approved non-shrink grout inside and out. Manhole joints shall be grouted from the outside only. All pipes entering the manhole shall be plugged. The Contractor shall securely brace the plugs in order to keep them from being drawn into the manhole. The test head shall be placed at the inside of the top of the cone section of the manhole and the seal inflated in accordance with the manufacturer's recommendations.

A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time for the vacuum to drop to 9 inches of mercury shall not be less than that shown in the table below:

DEPTH (FEET)	MANHOLE DIAMETER (INCHES)		
	48	60	72
0-8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

(Times shown are minimum elapsed times, in seconds, for a drop in vacuum of 1 inch of mercury.)

11.3 SPARK TESTING

All Class III Manholes shall be spark tested prior to being placed in service. Spark testing shall be required of the entire surface area of the manhole (field and joint) and shall be conducted in accordance with the liner manufacturer's recommendations. Results of the spark tests will be logged in duplicate and a copy of this log will be submitted to Board's Inspector at the end of the project.

Unless specifically stated otherwise on the approved plans, testing voltages shall be as stated below:

Liner Material	Testing Voltage (KV)
Sparywall (non-structural application minimum 150 mil)	21
Agro	20
Anchor Lok (Ameron International)	10

11.4 SEQUENCE OF TESTING

The sequence of testing shall be as follows:

- Construction completed and all backfill and superimposed loads in place
- Landscaping over and around sewer appurtenances is completed

- Manholes completed
- Manholes inspected with pole camera or visual “flashing.”
- Lines and laterals thoroughly cleaned, main segments CCTV’d, and inspected.
- Visual testing (“flashing”)
- Mandrel testing (all non ductile iron pipe)
- Determination of ground water table
- Air Testing or Infiltration Testing
 - Pipe
 - Manhole
- Spark Testing (Class III Manholes)

11.5 TEST FAILURE

Should a line or manhole fail to pass any of the acceptance test as outlined, the Contractor shall, at his expense, determine the source of the failure, make any necessary repairs, and re-test the segment of piping or manhole in question at no cost to the Board.

11.6 MANDREL EQUIPMENT

Because the inside diameter of composite plastic piping varies from that of solid wall PVC, equipment systems used to perform Mandrel tests shall be specifically designed for the pipe material being tested. Mandrels that do not specifically state the size and type of piping for which it is applicable shall not be allowed.

11.7 AIR/VACUUM TEST EQUIPMENT

Equipment systems used to perform low-pressure air tests shall be specifically designed for this purpose. Systems approved by the Board shall be Cherne Air-Loc Equipment, Lansas Products, or approved equal. Isolation of pipe segments shall be accomplished through the use of plugs (mechanical or pneumatic type). Pressurization of the sewer main shall be accomplished through the use of an air compressor that has an oil free air source, singular control panel, main shut-off valve, pressure-regulating valve, 9 psig pressure relief valve, input pressure gauge, and a continuous monitoring pressure gage. The continuous monitoring pressure gage shall have a pressure range from 0 psig to at least 10 psig with minimum divisions of .10 psig. The gage face shall be a minimum of 4 inches in diameter and have an accuracy of $\pm .04$ psig.

11.8 SPARK TESTING EQUIPMENT

Equipment systems used to perform spark test shall be compatible with the material to be tested. Spark testing equipment shall provide a visual as well as an audible indicator to identify pinholes or splits in the liner system. Testing equipment shall be Model No. AP/W by Tinker & Razor or as approved by the Board’s engineering department.



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