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Standard Practice for ~~Testing~~ Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method[1]

This standard is issued under the fixed designation C 924; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

[1] This practice is under the jurisdiction of ASTM Committee C-13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.09 on Methods of Test.
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1. Scope

1.1 This practice covers procedures for testing concrete pipe sewer lines, when using the low-pressure air test method to demonstrate the integrity of the installed material and the construction procedures. This practice is used for testing 4 to 24-in. circular concrete pipe sewer lines utilizing gasketed joints.

1.2 This practice ~~may~~ is also ~~be~~ used as a preliminary test to enable the installer to demonstrate the condition of the line prior to backfill.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use* (see Section 6, Safety Precautions).

1.4 A complete metric companion to Practice C 924 has been developed—C 924 M; therefore, no metric equivalents are presented in this practice.

NOTE 1—~~A~~The user of this practice is advised that air test criteria presented in this practice are similar to those in general use. The test and criteria have been used widely and successfully in testing smaller diameter pipe, but additional data are required to confirm the safety and applicability or develop criteria for pipe larger than 24 in. in diameter. Larger pipe ~~may~~ will be accepted more conveniently by visual inspection and individual joint testing.

NOTE ~~2—It should be understood~~ 2—The user of this practice is advised that no correlation has been found between air loss and water leakage.

2. Referenced Documents

2.1 *ASTM Standards:*

C 822 Terminology Relating to Concrete Pipe and Related Products[2]

C 969 Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines[2]

3. Terminology

3.1 Definitions—For definitions of terms relating to concrete pipe, see Terminology C 822.

4. Summary of Practice

4.1 The sewer line to be tested is plugged. Air is introduced at low pressures into the plugged line. The amount of air loss is used to determine the acceptability of the sewer line.

5. Significance and Use

5.1 This is not a routine test. The values recorded are applicable only to the sewer being tested and at the time of testing.

6. Safety Precautions

6.1 The air test ~~may~~ will be dangerous if a line is not prepared properly and proper procedures are not followed.

6.2 It is extremely important that plugs be installed and braced in such a way as to prevent blowouts. It is also imperative that the pressure in the pipe be relieved completely before any plug is loosened for removal.

NOTE 3—As an example, 4-psi air pressure acting on one side of a 15-in. plug results in a total force of approximately 700 lbf on the plug. Such a force ~~could cause~~ is capable of causing the expulsion of an improperly installed plug.

[2] *Annual Book of ASTM Standards*, Vol 04.05.

6.3 Pressurizing equipment ~~should~~ shall include a 6-psi pressure relief device to reduce hazards and avoid over-pressurization with possible damage to the line.

6.4 No one ~~should~~ shall be allowed in or near the manholes during pressurization, testing, or depressurization.

7. Capacity of Air Compressor

7.1 To provide satisfactory test results, the air compressor ~~should~~ shall be capable of pressurizing the sewer test section in the required test time, or less, as determined by 9.1. The compressor capacity required to accomplish the pressurization is equal to the rate necessary to fill the sewer to the desired pressure plus the allowable air loss rate:

$$C = \frac{0.17D^2L}{T} + Q \quad (1)$$

where:
C = compressor capacity, cfm,
T = required test time, or less, min,
D = pipe internal diameter, ft,
L = length of test section, ft, and
Q = allowable air loss, rate, cfm.

8. Preparation of the Sewer Line

8.1 Where practical, clean the sewer line prior to testing to wet the pipe surface and eliminate debris.

NOTE 4—~~A~~The user of this practice is advised that a wetted interior pipe surface is desirable and will produce more consistent test results. Air may pass through the walls of dry pipe. This can be overcome by wetting the pipe. If the problem persists, segmental testing of the line will establish if there is a significant leak.

8.2 Plug all pipe outlets including laterals, which ~~should~~ shall be given special attention. Review safety precautions in Section 6.

9. Procedure

9.1 Determine the test time for the sewer line to be tested by using Table 1. Table 1 has been established using the criteria specified in Table 2, and the formulas contained in the Appendix. The test time is the time required for the pressure to drop from 3.5 psi to 2.5 psi.

NOTE 5—All test pressures are measured as gage pressure, which is defined as any pressure greater than atmospheric pressure. Since water produces a pressure of 0.43 psi for every foot of depth, air test pressures must be increased to offset the depth of ground water over the sewer line. If 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 is greater than 5-psi gage, the air test method ~~should~~ shall not be used. In that event, the infiltration test, (see Practice C 969), shall be used.

9.2 Add air until the internal air pressure of the sewer line is raised to approximately 4 psi. Allow the air pressure to stabilize. The pressure will normally drop until the temperature of the air in the line stabilizes.

9.3 When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi, commence the test by allowing the gage pressure to drop to 3.5 psi at which point the time recording is initiated. Record the drop in pressure for the test period.

9.4 If the drop in pressure is 1 psi or less during the test period, accept the line. If the drop in pressure is more than 1 psi during the test period, inspect, evaluate, and retest the line to determine the cause of excessive air loss.

9.5 Use or failure of this air test shall not preclude acceptance by appropriate water infiltration or exfiltration testing, (see Practice C 969), or other means.

10. Air Test Criteria

10.1 An appropriate allowable air loss, Q, in cubic feet per minute has been established for each nominal pipe size. Based on field experience the Q~~'s~~s that have been selected will enable detection of any significant leak. Table 2 lists the Q established for each pipe size.

TABLE 1 Minimum Test Time for Varous Pipe Sizes

Nominal Pipe Size, in.	T (time), min/100 ft	Nominal Pipe Size, in.	T (time), min/100 ft
4	0.3	15	2.1
6	0.7	18	2.4
8	1.2	21	3.0
10	1.5	24	3.6
12	1.8		

TABLE 2 Allowable Air Loss for Various Pipe Sizes

D, Nominal Pipe Size, in.	*Q* ft^3/min	*D*, Nominal Pipe Size, in.,	*Q* ft^3/min
4	2	15	4
6	2	18	5
8	2	21	5.5
10	2.5	24	6
12	3		

10.2 When a main line with connected laterals is to be tested as a unit, the total volume of the main and laterals shall be considered, and the allowable air loss rate shall be that listed for the main.

11. Precision and Bias

11.1 No justifiable statement is presently capable of being made either on precision or bias of this procedure since the test result merely states whether there is conformance to the criteria for success specified. Due to the sealing effects of ground water and internal flow on sewer line, the test conditions and results are not reproducible.

APPENDIXES

(Nonmandatory Information)

X1. EQUATIONS USED IN PRACTICE C 924

X1.1 The required test time per 100 ft of pipe for a single diameter pipe using Table 2:

$$T_T = (0.00037)\left(\frac{D^2L}{Q}\right) \quad \text{(X1.1)}$$

X1.2 The required test time for a single diameter pipe system using Table 1:

$$T_T = (L)\left(\frac{T}{100}\right) \quad \text{(X1.2)}$$

X1.3 For testing a sewer system involving different diameter pipe, the allowable air loss rate is equal to that of the main sewer line (using Table 2). For this system the minimum test time per 100 ft of pipe is equal to that of the main sewer line (using Table 1). Each length of lateral pipe is converted into an equivalent length of main sewer line. Then each length is added to the test length of main sewer. The minimum test time for the total system is computed as follows:

$$L_e = \Sigma\left(\frac{d^2 1}{D^2}\right) \quad \text{(X1.3)}$$

$$L_e = \Sigma\left(\frac{d^2 l}{D^2}\right) \quad \text{(X1.3)}$$

$$T_T = (L + L_e)\left(\frac{T}{100}\right) \quad \text{(X1.4)}$$

X1.4 The symbols used in the equations in this practice are defined as follows;

where:

T = minimum test time per 100 ft of pipe for pressure to drop from 3.5 to 2.5 psi, min,
T_T = minimum test time for total system, min,
D = designated inside diameter of test section of main sewer, in.,
d = designated inside diameter of lateral, in.,
L = length of test section or main sewer, ft,
L_e = total volume of all laterals connected to the main sewer expressed as an equivalent length of the main sewer, ft,
1 = total length of each diameter lateral, ft, and
Q = allowable air loss rate, ft^3/min.

X2. APPLICATION OF PRACTICE C 924

X2.1 The following examples have been prepared to demonstrate the technique of applying this practice.

X2.2 —*Example 1*—A sewer system consists of 600 ft of 18-in. diameter concrete pipe between manholes A and B; 35 ft of 12-in. diameter pipe between manholes B and C.

X2.2.1 *Find*

The appropriate test times to demonstrate the integrity of the installed lines.

X2.2.2 *Solution*:

X2.2.2.1 For the main sewer between manholes A and B, use equation X1.2 and from Table 1, T = 2.4 min/100 ft, for 18-in. pipe.

$$T_T = (L)\left(\frac{T}{100}\right) \quad \text{(X2.1)}$$

$$T_T = (600)\left(\frac{2.4}{100}\right) \quad \text{(X2.2)}$$

$$T_T = 14 \text{ min.} \quad \text{(X2.3)}$$

$$T_T = 14 \text{ min} \quad \text{(X2.3)}$$

X2.2.2.2 Similarly, for the main sewer between manholes B and C:

$$T_T = (35)\left(\frac{1.8}{100}\right) \quad \text{(X2.4)}$$

$$T_T = 0.6 \text{ min} \quad \text{(X2.5)}$$

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X2.3 Example 2—The 600 ft. of 18-in. diameter concrete pipe between manholes A and B in Example 1 has connected 6-in. laterals with a total length of 900 ft.

X2.3.1 Find—The appropriate test time to demonstrate the integrity of the installed lines.

X2.3.2 Solution:

X2.3.2.1 Use equation X1.3 to convert the total volume of 6-in. laterals to an equivalent length of main sewer:

$$L_e = \Sigma\left(\frac{d^2 1}{D^2}\right) \quad \text{(X2.6)}$$

$$L_e = \Sigma\left(\frac{d^2 l}{D^2}\right) \quad \text{(X2.6)}$$

$$L_e = \left(\frac{6^2 \text{ x } 900}{18^2}\right) \quad \text{(X2.7)}$$

$$L_e = \left(\frac{6^2 \times 900}{18^2}\right) \quad \text{(X2.7)}$$

$$L_e = 100 \text{ ft} \quad \text{(X2.8)}$$

X2.3.2.2 For the connected system, use Table 1 and from Table 1, T = 2.4 min/100 ft, for 18-in pipe:

$$T_T = (L + L_e)\left(\frac{T}{100}\right) \quad \text{(X2.9)}$$

$$T_T = (600 + 100)\left(\frac{2.4}{100}\right) \quad \text{(X2.10)}$$

$$T_T = 17 \text{ min.} \quad \text{(X2.11)}$$

X2.4 If a line fails the air test, the following courses of action should shall be considered:

(1) Segmentally test the line and compare the time-air loss values in each segment.

(2) If the values in each segment are comparable, the air-loss problem may shall be distributed throughout the line, and further analysis should shall be made.

(3) If the values in each segment are significantly different, each segment may shall be evaluated and further analysis be made to determine the location of any significant air losses.