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METRIC

Standard Test Method for Concrete Pipe Sewerlines by Negative Air Pressure (Vacuum) Test Method [Metric][1]

This standard is issued under the fixed designation C 1214M; 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.

1. Scope

1.1 This test method covers procedures for testing concrete pipe sewerlines, when using the negative air pressure (vacuum) test method to demonstrate the integrity of the installed material and the construction procedures. This test method covers testing of 100 to 900-mm diameter circular concrete pipe sewerlines utilizing gasketed joints.

1.2 Methods described in this test method may also be used as a preliminary test to enable the manufacturer or installer to demonstrate the condition of sewer pipe prior to delivery or backfill. Minimum test times presented in Table 1 are for pipelines. Holding times for testing an individual pipe may have to be increased to allow for the accumulation of leakage when the tested pipe are incorporated into a continuous pipeline.

1.3 This test method is the metric companion to Test Method C 1214.

NOTE 1—The negative air pressure (vacuum) test criteria presented in this test method are similar to those in general use. The test and criteria have been used widely and successfully in testing smaller diameter pipe. Larger pipe may be accepted more conveniently by visual inspection and individual joint testing.

NOTE 2—It should be understood that no correlation has been found between loss of vacuum and water leakage.

1.4 *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 for specific safety precautions.

2. Referenced Documents

2.1 *ASTM Standards:*

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

C 924 Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method[2]

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

TABLE 1 Minimum Test Time

Nominal Pipe Size, mm	T (Time), min/100 m	Nominal Pipe Size, mm	T (Time), min/100 m
100	0.9	525	9.7
150	2.0	600	11.0
200	3.5	675	13.0
250	4.7	750	15.0
300	6.0	825	17.0
375	6.8	900	19.0
450	7.7		

3. Terminology

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

4. Summary of Test Method

4.1 The sewerline to be tested is plugged. Air is removed from the plugged line by a vacuum pump or vacuum reservoir. The amount of vacuum loss is used to determine the acceptability of the sewerline.

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 This test may be dangerous if a line is not prepared properly and proper procedures are not followed.

6.2 Access manholes or structures must be ventilated and air quality continuously monitored.

6.3 No one should be allowed in or near the manholes during testing.

7. Preparation of the Sewerline

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

NOTE 3—A wetted exterior 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. Usually, moisture absorbed

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

TABLE 2 Allowable Air Loss

Nominal Pipe Size, mm	Q, m³/min	Nominal Pipe Size, mm	Q, m³/min
100	0.6	525	0.15
150	0.6	600	0.17
200	0.6	675	0.18
250	0.7	750	0.20
300	0.8	825	0.21
375	0.11	900	0.23
450	0.14		

from the backfill is sufficient to cope with this situation. If the problem persists, segmental testing of the line will establish if there is a significant leak.

7.2 Plug all pipe outlets including laterals. Review safety precautions in Section 6.

8. Procedure

8.1 Determine the test time for the sewerline 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 Appendixes. The test time is the time required for the vacuum to drop from 23.6 to 16.9 kPa.

NOTE 4—To provide satisfactory test results, the vacuum pump should be capable of evacuating the sewer test section in the required test time, or less, as determined by 8.1. The pump capacity required to accomplish the evacuation of the line is equal to the rate necessary to reduce the sewer to the desired pressure plus the allowable vacuum loss rate:

$$C = 0.17D^2L/T + Q$$

where:
C = vacuum pump capacity, m^3/s,
T = required test time, or less,
D = pipe internal diameter, m,
L = length of test section, m, and
Q = allowable vacuum loss rate, m^3/s.

8.2 Evacuate air until the internal air pressure of the sewerline is lowered by approximately 27.0 kPa of mercury. Close the valve on the vacuum line and shut off the vacuum pump. Allow the air pressure to stabilize.

8.3 When the pressure has stabilized and is at or below the starting test vacuum of 23.6 kPa of mercury, commence the test by allowing the gage pressure to drop to 23.6 kPa of mercury, at which point the time recording is initiated. Record the drop in vacuum for the test period.

8.4 If the drop in vacuum is 6.8 kPa of mercury or less during the test period, accept the line. If the drop in vacuum is more than 6.8 kPa of mercury during the test period, inspect, evaluate, and retest the line to determine the cause of excessive vacuum loss.

8.5 Use or failure of this vacuum test shall not preclude acceptance by appropriate low-pressure air (see Practice C 924), water infiltration or exfiltration testing (see Practice C 969), or other means.

9. Vacuum Test Criteria

9.1 An appropriate allowable vacuum loss, Q, in cubic metres per second has been established for each nominal pipe size. Based on field experience, the vacuum loss Qs that have been selected will enable detection of any significant leak. Table 2 lists the Q established for each pipe size.

9.2 When a main line with connected lateral 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.

10. Precision and Bias

10.1 No justifiable statement can be 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 sewerline, the test conditions and results are not reproducible.

APPENDIXES

(Nonmandatory Information)

X1. EQUATIONS USED IN PRACTICE C 1214M

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

$$T_T = (5.3 \times 10^{-8})\,(D^2L/Q) \quad (X1.1)$$

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

$$T_T = (L)\,(T/100) \quad (X1.2)$$

X1.3 For testing a sewer system involving different diameter pipe, the allowable vacuum loss rate shall be that for the main sewer. The volume of each size of lateral pipe is converted to an equivalent length of required test time as follows:

$$L_e = \Sigma(d^21/D^2) \quad (X1.3)$$

$$T_T = (L + L_e)\,(T/100) \quad (X1.4)$$

X1.4 The symbols used in the equations in this test method are defined as follows:

where:
T = minimum test time per 100 m of pipe vacuum to drop from 23.6 to 16.8 kPa of mercury, min,
T_T = minimum test time for total system, min,

D = designated inside diameter of test section or main sewer, mm,
d = designated inside diameter of lateral, mm,
L = length of test section or main sewer, m,
L_e = total volume of all laterals connected to the main sewer expressed as an equivalent length of the main sewer, m,
l = total length of each diameter lateral, m, and
Q = allowable air loss rate, m^3/min.

X2. APPLICATION OF PRACTICE C 1214M

X2.1 The following examples have been prepared to demonstrate the techniques of applying this test method.

X2.2 *Example 1*—A sewer system consists of 180 m of 450-mm diameter concrete pipe between manholes A and B; 10 m of 300-mm 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 Eq X1.2 and from Table 1, T = 7.7 min/100 m for 450-mm pipe.

$$T_T = (L)\,(T/100)$$
$$T_T = (180)\,(7.7/100)$$
$$T_T = 14 \text{ min}$$

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

$$T_T = (10)\,(6/100)$$
$$T_T = 0.6 \text{ min}$$

X2.3 *Example 2*—The 180 m of 450-mm diameter concrete pipe between manholes A and B in Example 1 has connected 150-mm laterals with a total length of 275 m.

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 Eq X1.3 to convert the total volume of 150-mm laterals to an equivalent length of main sewer:

$$L_e = \Sigma\,(d^2 1/D^2)$$
$$L_e = (150^2 \times 275)/(450^2)$$
$$L_e = 30.6 \text{ m}$$

X2.3.2.2 For the connected system, use Eq X1.4 and from Table 1, T = 7.7 min/100 m for 450-mm pipe:

$$T_T = (L + L_e)\,(T/100)$$
$$T_T = (180 + 30.6)\,(7.7/100)$$
$$T_T = 16 \text{ min}$$

X2.4 If a line fails the vacuum test, the following course of action should be considered:

X2.4.1 Segmentally test the line and compare the time-vacuum loss values in each segment.

X2.4.2 If the values in each segment are comparable, the vacuum loss problem may be distributed throughout the line, and further analysis should be made.

X2.4.3 If the values in each segment are significantly different, each segment may be evaluated and further analysis be made to determine the location of any significant vacuum loss.