



Standard Test Method for Abrasion Resistance of Pipeline Coatings¹

This standard is issued under the fixed designation G 6; 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 of accelerated test is a procedure for determining the relative resistance of steel pipeline coatings to abrasion by a slurry of coarse abrasive and water. The method is intended to apply to the testing of all types of electrical insulating pipeline coatings and tapes, including thermoplastics, thermoset, and bituminous materials.

1.2 Pipeline coatings are not normally subjected to the type of abrasion herein specified.

1.3 Metallic protective coatings such as zinc may be compared visually, but do not meet the electrical requirements of this test method.

1.4 The values stated in SI units to three significant decimals are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *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.*

2. Referenced Documents

2.1 ASTM Standards:

G 12 Test Method for Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel²

G 62 Test Methods for Holiday Detection in Pipeline Coatings²

3. Terminology

3.1 Definition:

3.1.1 *holidays*—small faults or pinholes which permit current drainage through protective coatings on steel pipe.

4. Summary of Test Method

4.1 Apparatus and materials are described whereby coatings on steel pipe are worn away by an abrasive slurry contained in a horizontally revolving drum. Specimens extend through both ends of the drum and are electrically insulated from contact

with the test apparatus.

4.2 Periodic measurement of the electrical resistance between the specimen and the drum indicates the degree of abrasion resistance of the coating.

5. Significance and Use

5.1 This procedure defines a test method for comparing the relative resistance of pipeline coatings to abrasion.

5.2 Abrasion resistance may be used to specify optimum coating thickness of candidate materials both in development and research work to study new coating systems or methods and in quality control.

6. Apparatus

6.1 *Drum*—A cylindrical steel container suitable for testing nine specimens simultaneously. Figs. 1-3 show construction details which may be altered at the cap assembly if desired. A valve shall be provided to release any pressure built up during test.

6.2 *Apparatus for Revolving the Drum*—Any suitable apparatus used to revolve the drum at 30.48 m (100 linear ft)/min. A modified jar rolling mill³ has been found satisfactory for revolving the drum.

6.3 *Thickness Gage*, to be used in accordance with Test Method G 12.

6.4 *Holiday Detectors*, low-voltage wet-sponge type for thin film coatings (coatings thinner than 20 mils), and high-voltage type for thick film coatings (coatings thicker than 20 mils).

NOTE 1—Low voltage detectors are used to locate pinholes, voids, or thin spots in pipeline coatings. The potential used with wet-sponge detectors can be up to 100 V DC. Procedures for using these detectors are found in Method A of G62. For use of high voltage detectors operating in the 900 to 20 000 Vdc range, see Method B of G62.

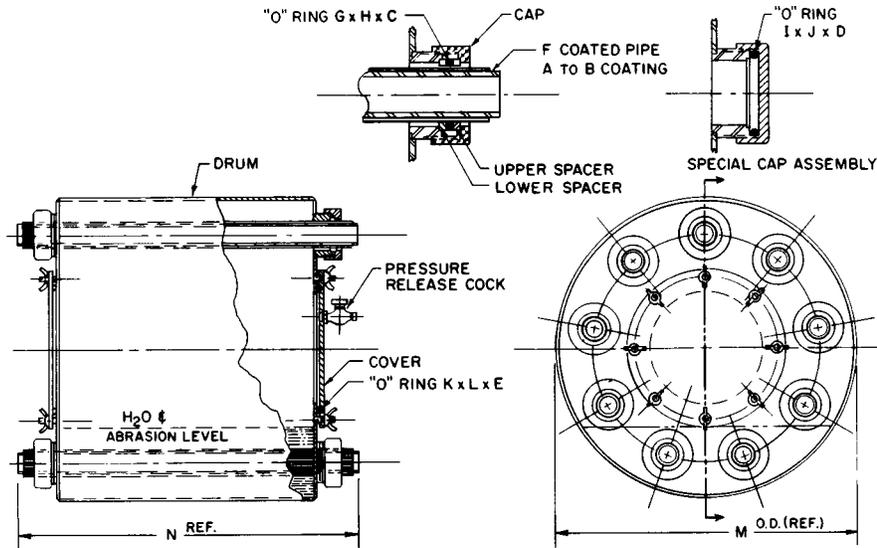
6.5 *Volt-ohm-meter*—Any electrical test instrument for measuring electrical resistance of the circuit.

¹ This test method is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.48 on Durability of Pipeline Coatings and Linings.

Current edition approved May 27, 1988. Published July 1988. Originally published as G 6 – 69 T. Last previous edition G 6 – 83.

² *Annual Book of ASTM Standards*, Vol 06.02.

³ The sole source of supply known to the committee at this time, to provide a means for revolving the drum is Figure 801-V Jar Mill available from U.S. Stoneware, Inc., Akron, OH. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.



Dimensions for Fig. 1:

Symbol	mm	in.
A	0.15	0.006
B	2.28	0.090
C	3.17	0.125
D	4.76	0.188
E	6.35	0.250
F	19.05	0.750
G	25.40	1.000
H	31.75	1.125
I	38.10	1.500
J	47.63	1.875
K	136.53	5.375
L	149.23	5.875
M	355.6	14.0
N	406.4	16.0

NOTE 1—Estimated weight includes water and abrasive 39.5 kg (87 lb)

FIG. 1 Abrasion-Tester Assembly

7. Reagents and Materials

- 7.1 The test slurry shall consist of the following:
 - 7.1.1 *Aluminum Oxide Grit*,⁴ 13.6 kg (30 lb).
 - 7.1.2 *Tap Water*, 5.68 L (1½ gal).

8. Test Specimen

- 8.1 A 19.1 mm test specimen 406 mm (16 in.) long shall be prepared with its surface preparation and coating procedures equivalent to that of production coated pipe. Only holiday-free specimens, in duplicate, shall be used in this test.
- 8.2 Control specimens shall be included in each test, the selection of which is optional with the user.

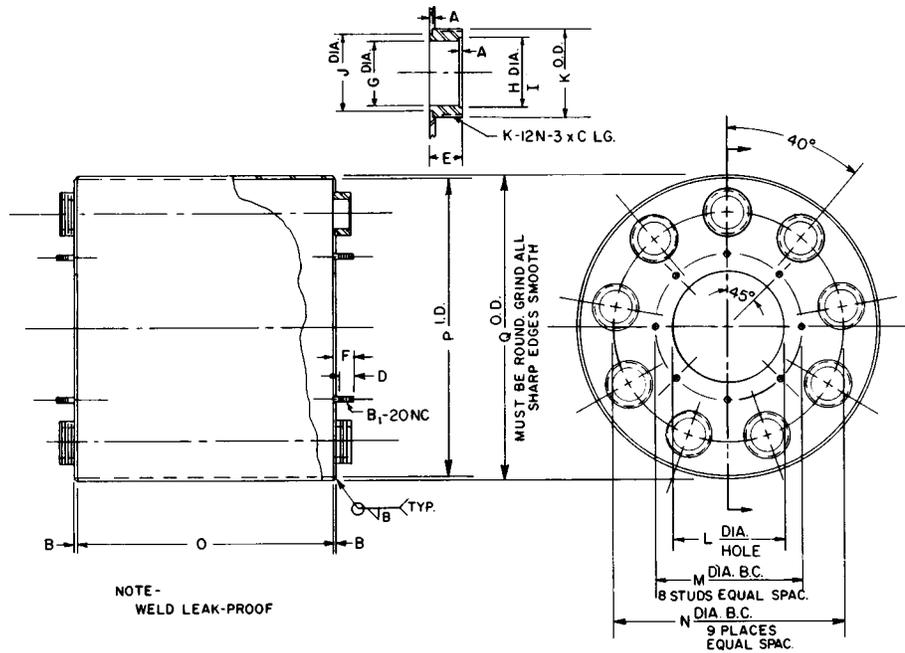
9. Conditioning

- 9.1 The specimen shall be exposed to a room temperature of 21° to 25°C (70° to 77°F) for a period of 24 h before beginning the test.

⁴ The sole source of supply of aluminum oxide abrasive, No. 3 mesh, Type TA, untumbled, known to the committee at this time is Exolon Co., Tonawanda, NY 14150. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

10. Procedure

- 10.1 Perform the test at a room temperature of 21° to 25°C (70° to 77°F).
- 10.2 Measure and record the coating thickness of each specimen in accordance with Test Method G 12.
- 10.3 Check all specimens or holidays using an appropriate detector.
- 10.4 Position the specimens in the drum taking care not to damage the coating.
- 10.5 Load the apparatus with 13.6 kg (30 lb) of unused abrasive and 5.68 L (1½ gal) of water.
- 10.6 Test each specimen for electrical resistance after sealing the drum by using the volt-ohm-meter. Immerse the specimen in the slurry at the time the electrical resistance is measured. Reject and replace any specimen showing less than infinite resistance.
- 10.7 Revolve the drum at the rate of 30.5 m (100 linear ft)/min.
- 10.8 Determine the electrical resistance at 25-h intervals for a test period of 200 h.
- 10.9 Relieve the pressure built up during the test by opening



Dimensions for Fig. 2:

Symbol	mm	in.
A	1.59	0.063
B	3.18	0.125
B ₁	6.35	0.250
C	12.70	0.500
D	19.05	0.750
E	22.23	0.875
F	25.40	1.000
G	38.10	1.500
H	41.25	1.624
I	41.28	1.625
J	44.45	1.750
K	50.8	2.0
L	127.0	5.0
M	165.1	6.5
N	266.7	10.5
O	304.8	12.0
P	349.25	13.75
Q	355.6	14.0

FIG. 2 Drum

the release valve each time the electrical resistance is measured.

11. Report

11.1 The report shall include the following:

11.1.1 Complete identification of test specimens, including name and code number of coating, size of the pipe, production date, production run number, and any other information that may be pertinent to identification,

11.1.2 Date of starting and of terminating the test,

11.1.3 Coating thickness of the test specimen before testing and minimum coating thickness after testing,

11.1.4 Volt-ohm-meter readings at 25-h intervals, and

11.1.5 Description of coating appearance after testing.

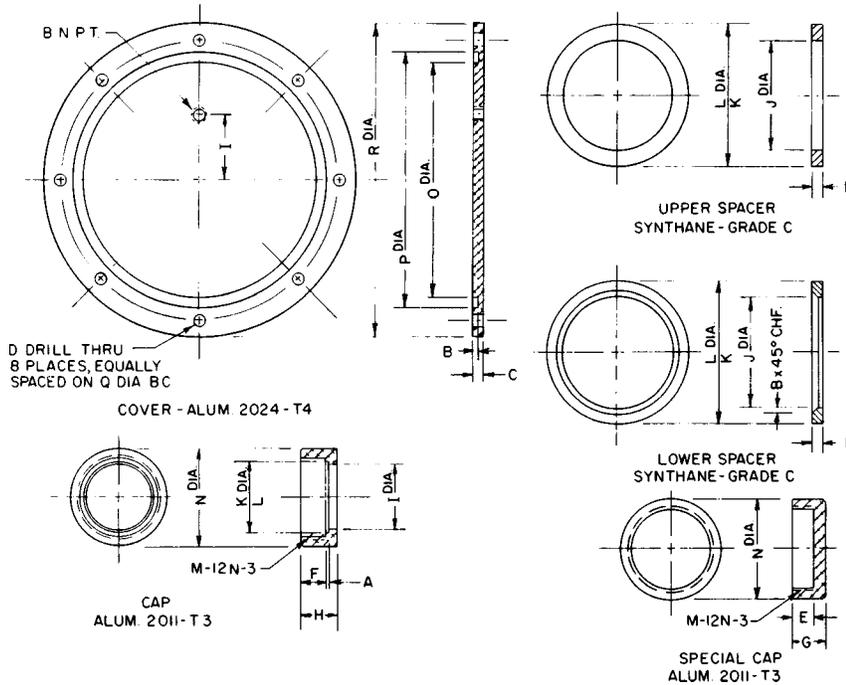
12. Precision

12.1 Precision data are limited to two adjacent specimens taken from the same production-coated pipe, assuming that the

production process was uniform with respect to pipe surface condition and coating material. Specimens that were not adjacent in the as-produced condition, or were taken from different lengths of pipe may represent differing process conditions.

12.2 *Repeatability*—When more than one test of the same coating material is involved, the standard deviation of the results should not be greater than 1.0 times the hourly time interval between inspections for the specific coating material. The standard deviation⁵ of a set of numbers is the square root of the average of the squares of the deviations of the numbers from their average. The standard deviation of two or more specimen results may be found by the following procedure:

⁵ For more information see the *ASTM Manual on Presentation of Data and Control Chart Analysis, STP 15D*, October 1976.



Dimensions for Fig. 3:

Symbol	mm	in.
A	1.59	0.063
B	3.18	0.125
C	6.35	0.250
D	7.94	0.313
E	12.70	0.500
F	15.88	0.625
G	19.05	0.750
H	22.23	0.875
I	38.10	1.500
J	25.68	1.281
K	41.25	1.624
L	41.28	1.625
M	50.80	2.0
N	51.05	2.250
O	136.53	5.375
P	149.23	5.875
Q	165.10	6.500
R	184.15	7.250

FIG. 3 Details

Standard deviation, $\sigma = 1/n[(n\Sigma X^2 - (\Sigma X)^2)^{1/2}]$ (1)

where:

- ΣX = sum of all values of X, from X_1 to X_n inclusive,
- n = number of observed values (observations), and
- σ = standard deviation, the root-mean-square (rms) deviation of the observed values from their average.

12.3 *Reproducibility*—Agreement between laboratories should be such that the standard deviation of the results for a specific coating should not be greater than 1.5 times the inspection time interval.

13. Keywords

13.1 abrasion; coatings; pipeline; revolving; slurry

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