



Standard Test Method for Penetration Resistance of Pipeline Coatings (Blunt Rod)¹

This standard is issued under the fixed designation G 17; 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 accelerated test method is used to determine the relative resistance of steel pipeline coatings to penetration or deformation by a blunt rod under a specified load. The test method is intended to apply to the testing of all types of nonmetallic pipeline coatings subjected to various temperatures.

1.2 *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.*

1.3 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.

2. Summary of Test Method

2.1 The depth or rate of penetration or deformation that is caused by a weighted blunt rod to a coating system applied to steel pipe is measured over a period of time with a micrometer depth gage. Three consecutive identical readings taken at specified intervals conclude the test.

3. Significance and Use

3.1 Since pipeline coatings are subjected to concentrated pressures exerted by the weight of the pipe and the backfill, this test is intended primarily for determining the resistance of the coating to penetration or deformation under controlled conditions.

3.1.1 Deformation of a compressible coating does not signify a potential weakness in underground burial service, if the coating is not penetrated. Deformation cannot be compared to penetration into and through a coating.

4. Apparatus

4.1 Test apparatus shall consist of a dead weight tester that can press the flat tip of a rod against the coated pipe. The flat-tipped end of the rod contacting the coating shall have a

diameter of $6.350 \text{ mm} \pm 0.0254 \text{ mm}$ ($0.250 \text{ in.} \pm 0.001 \text{ in.}$) and together with supplementary weight and any other weight-contributing parts shall have a total weight of 4.453 kg (9.817 lb), resulting in a unit pressure of 14.060 kg/cm^2 (200 psi) against the coating. Detailed design of the apparatus is shown in Figs. 1-6 and Tables 1-4 show dimensions.

4.2 *Depth Gage*, a device capable of measuring the penetration movement of the rod accurately to 0.0254 mm (0.001 in.).

4.3 *Temperature Chamber*, a thermostatically controlled enclosure to provide heating and cooling of the specimen and test apparatus (excluding depth gage) to within $\pm 2^\circ\text{C}$ (3.6°F) of the desired test temperature. This equipment is optional when the test can be run within $\pm 2^\circ\text{C}$ (3.6°F) of the desired test temperature without its use.

4.4 *Temperature Controlled Box*, to fully enclose the test apparatus except the indicating means of the depth gage, as optional equipment in cases where a test is to be run at a temperature higher than room temperature. The enclosure shall be thermostatically controlled, capable of maintaining the temperature to within $\pm 2^\circ\text{C}$ (3.6°F) of the test temperature, which normally will be in the range of 23 to 76.6°C (73.4 to 170°F).

4.5 *Thermometer*, a temperature measurement device accurate to $\pm 0.5^\circ\text{C}$ ($\pm 1^\circ\text{F}$).

5. Test Specimens

5.1 The test specimens shall be 150 mm (6 in.) long and prepared with its surface preparation and coating procedures equivalent to that of production coated pipe. Duplicate tests shall be run.

6. Conditioning

6.1 The specimen shall be exposed to the test temperature for a period of 24 h before beginning the test. If the test temperature is the same as room temperature, it shall be 21° to 25°C (70° to 77°F).

7. Procedure

7.1 Perform the test at room temperature or at the selected temperature.

7.2 Accurately measure the thickness coating in the area to be tested. Assemble the sample and end plates. Position the sample in the test unit so that the known film thickness area is

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 the Durability of Pipeline Coatings and Linings.

Current edition approved May 27, 1988. Published July 1988. Originally published as G 17 – 71 T. Last previous edition G 17 – 83^{e1}.

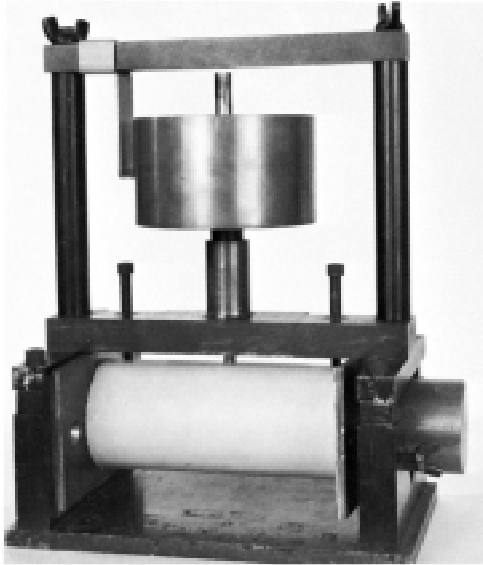


FIG. 1 Blunt Rod Penetration Tester

directly under the weighted rod and hold the sample in position by use of the cap screws.

7.3 Loosen the shaft collar and allow the weight to rest on the shaft guide. Using the depth gage take a measurement without the load applied. Raise the weight and tighten the set screw in the collar so that the weight rests on the shaft.

7.4 Take measurements every 24 h.

7.5 Continue the test until the maximum penetration has been reached as evidenced by three consecutive unchanged measurements.

8. Calculation

8.1 Calculate the net change and the percent change as follows:

$$\begin{aligned} C_N &= M_F - M_I \\ C_P &= (C_N/T) \times 100 \end{aligned} \quad (1)$$

where:

C_N = net change,
 M_F = final measurement,
 M_I = initial measurement,
 C_P = percent change, and
 T = film thickness.

9. Report

9.1 The report shall include the following:

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

9.1.2 Film thickness of the specimen at the test location in millimetres (inches),

9.1.3 Temperature at which the test was conducted,

9.1.4 Final and initial measurements in millimetres (inches),

9.1.5 Whether the weighted rod has caused penetration or deformation,

9.1.6 Net penetration or deformation in millimetres (inches) and the percent penetration or deformation, and

9.1.7 Number of hours or days to net penetration or deformation.

10. Precision

10.1 *Precision Data* are limited to two adjacent specimens taken from the same source coated pipe and assume that the coating 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.

10.2 *Repeatability*—Initial and final measurements should be ± 0.0127 mm (0.0005 in.) or 5 %.

10.3 *Reproducibility*—The results reported by one laboratory should not differ from those of another laboratory by more than ± 5 % of the net penetration.

11. Keywords

11.1 blunt rod; coating; compression; deformation; load; penetration; pipeline; resistance

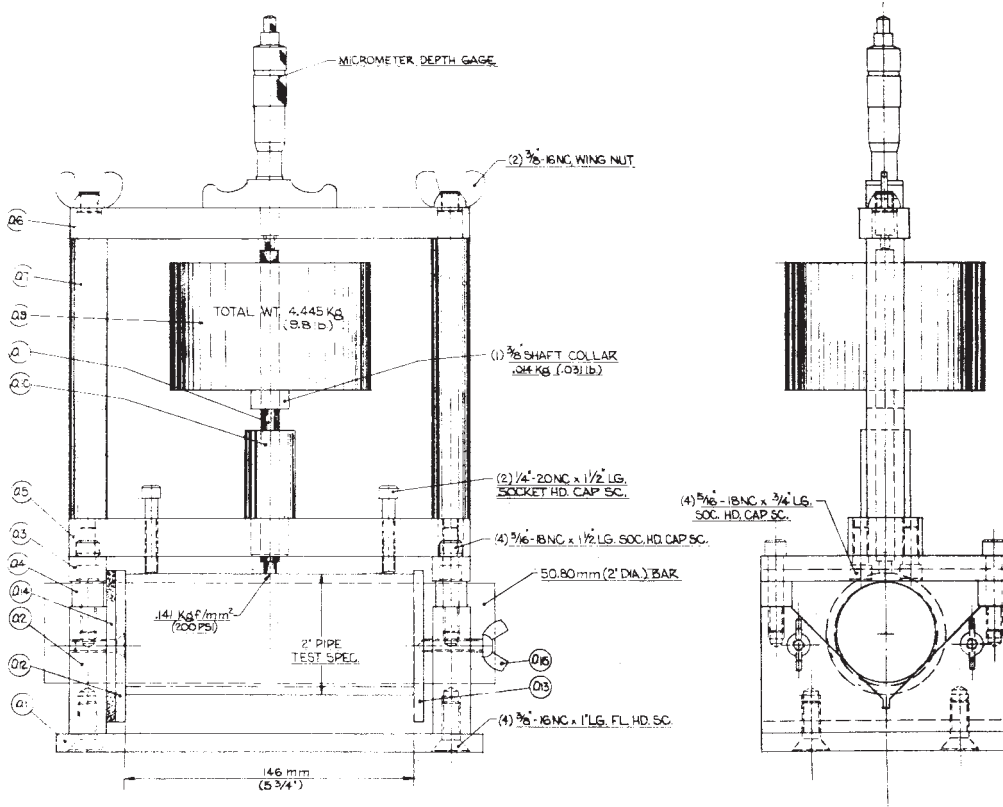


FIG. 2 Blunt Rod Penetration Tester, Assembly

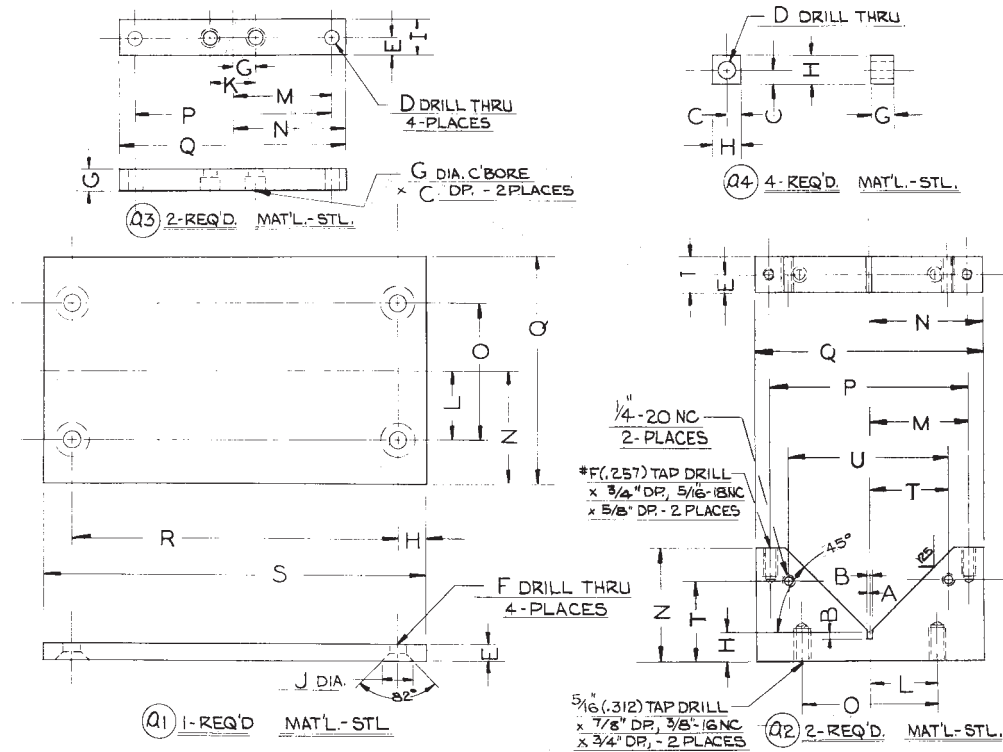


FIG. 3

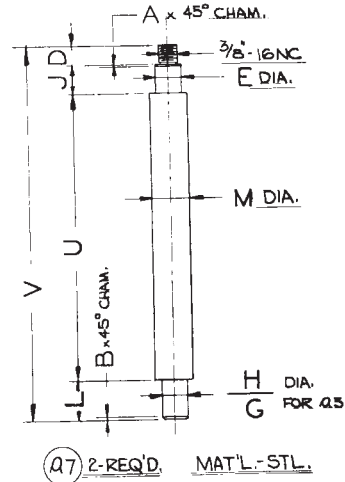
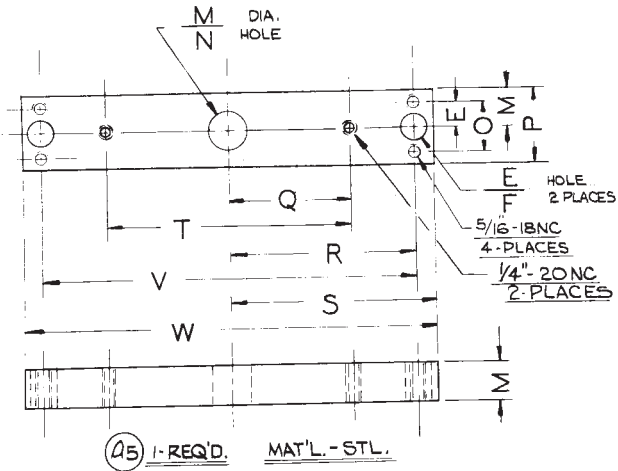
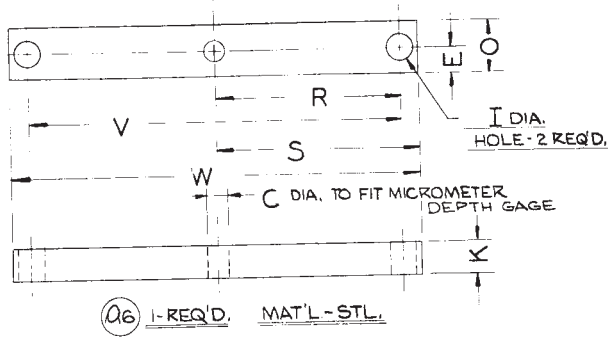


FIG. 4

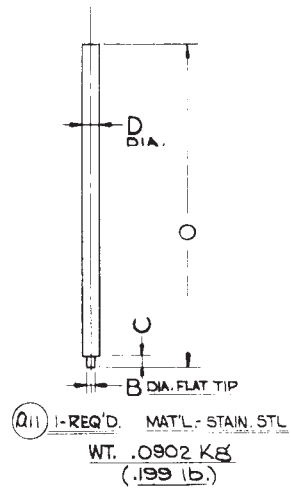
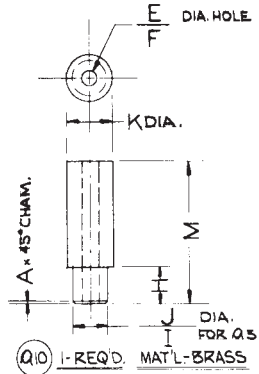
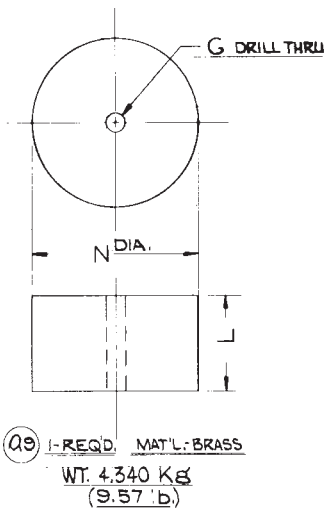


FIG. 5

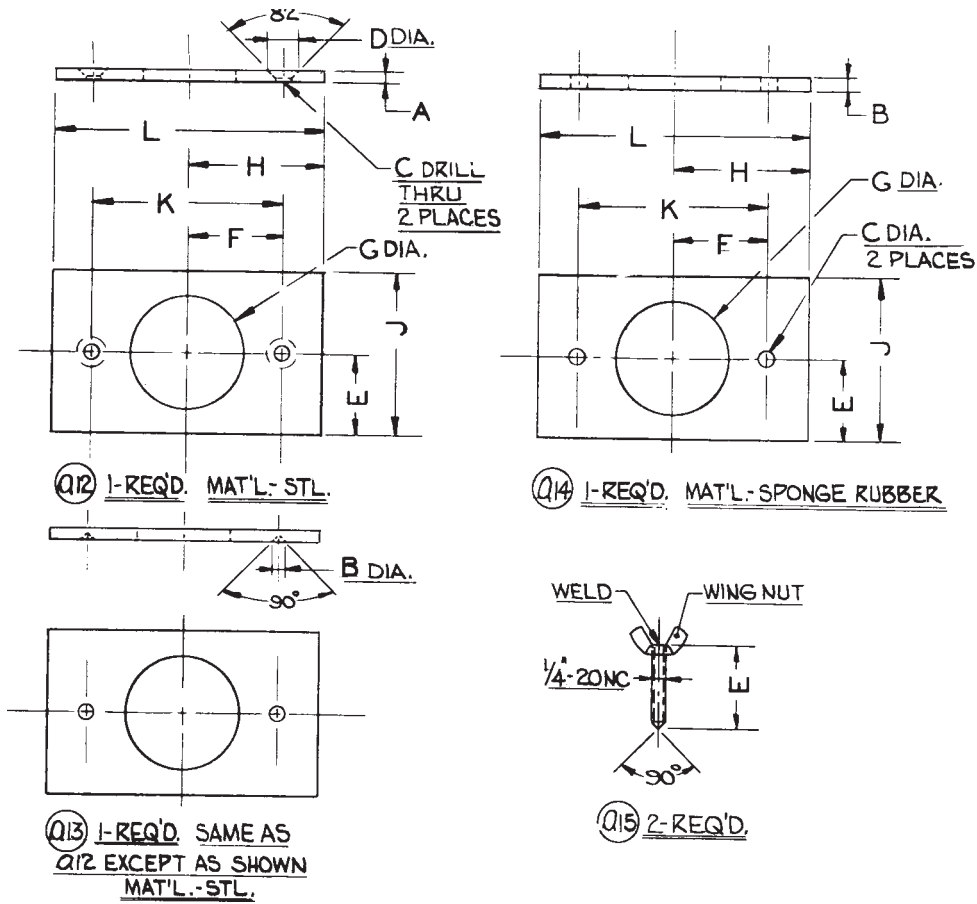


FIG. 6

TABLE 1 Dimensions for Fig. 3

Symbol	mm	in.
A	1.59	0.063
B	3.18	0.125
C	7.94	0.313
D	8.73	0.343
E	9.53	0.375
F	10.32	0.406
G	12.70	0.500
H	15.86	0.625
I	19.05	0.750
J	20.64	0.813
K	25.40	1.000
L	38.10	1.500
M	55.56	2.188
N	63.50	2.500
O	76.20	3.000
P	111.13	4.375
Q	127.00	5.000
R	184.15	7.250
S	215.90	8.500
T	50.80	2.000
U	88.90	3.500

TABLE 2 Dimensions for Fig. 4

Symbol	mm	in.
A	0.79	0.031
B	1.59	0.063
C	3.99	0.157
D	11.11	0.438
E	12.70	0.500
F	12.70	0.500
G	12.71	0.500
H	12.72	0.501
I	13.49	0.531
J	14.29	0.563
K	15.88	0.625
L	17.46	0.688
M	19.05	0.750
N	19.06	0.751
O	25.40	1.000
P	38.10	1.500
Q	60.33	2.375
R	92.08	3.625
S	101.60	4.000
T	120.65	4.750
U	141.29	5.563
V	184.15	7.250
W	203.20	8.000

TABLE 3 Dimensions for Fig. 5

Symbol	mm	in.
A	1.59	0.063
B	6.35	0.250
C	6.35	0.250
D	9.50	0.374
E	9.53	0.375
F	9.55	0.376
G	10.32	0.406
H	19.05	0.750
I	19.06	0.750
J	19.07	0.751
K	25.40	1.000
L	64.29	2.531
M	63.50	2.500
N	101.60	4.000
O	165.10	6.500

TABLE 4 Dimensions for Fig. 6

Symbol	mm	in.
A	4.76	0.188
B	6.35	0.250
C	7.14	0.281
D	13.49	0.531
E	38.10	1.500
F	44.45	1.750
G	52.38	2.062
H	63.50	2.500
I	76.20	3.000
J	88.90	3.500
K	127.00	5.000
L		

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).