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Standard Test Method for Leak Rates Versus *y* Stresses and *m* Factors for Gaskets[1]

This standard is issued under the fixed designation F 586; 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.

ε1 NOTE—Editorial changes were made throughout in July 1989.

1. Scope

1.1 This test method covers the determination of leak rates versus *y* stresses and *m* factors for gaskets gripped by pressure-containing flanged connections.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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:*

F 104 Classification System for Nonmetallic Gasket Materials[2]

F 363 Test Method for Corrosion Testing of Gaskets[2]

2.2 *ANSI Standard:*

16.5 Steel Pipe Flanges and Flanged Fittings[3]

2.3 *ASME Standard:*

Pressure Vessel Code, Table UA-49.1, Section VIII, Div. 1[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *gasket contact area*—the area of the gasket that is under load from the flange surfaces.

3.1.2 *leak rate*—the leakage in cubic centimetres of fluid per second passing through or around the gasket under the conditions of this test, reduced to standard.

3.1.3 *maintenance factor, m*—the factor that provides the additional preload capability in the flange fasteners to maintain sealing pressure on a gasket after internal pressure is applied to a joint.

3.1.4 *yield factor, y*—the factor that represents the pressure in kilopascals (or pounds-force per square inch) over the contact area of the gasket that is required to provide a sealed joint, with no pressure in the assembly.

3.2 *Symbols:*

W	=	total fastener force, N (or lbf)
D	=	outside diameter of gasket, mm (or in.)
d	=	inside diameter of gasket, mm (or in.)
A_1	=	gasket area, cm^2 (or $in.^2$)
A_2	=	inside area of gasket, cm^2 (or $in.^2$)
P	=	test pressure, kPa (or psi)
y	=	yield factor or *y* stress, kPa (or psi)
m	=	maintenance factor or *m* factor
P_s	=	standard pressure, 101.3 kPa (or 14.7 psi)
P_a	=	atmospheric pressure, kPa (or psia)
P_1	=	pressure in buret at height, h_1, kPa (or psia)
P_2	=	pressure in buret at height, h_2, kPa (or psia)
P_3	=	pressure in buret at height, h_3, kPa (or psia)
P_s	=	standard pressure, kPa (psi)
h_1	=	height of water in buret at P_a, mm (or in.)
h_2	=	height of water after opening valve, mm (or in.)
h_3	=	height of water after end of run, mm (or in.)
V_1	=	volume of measuring system, cm^3 (or $in.^3$)
V_2	=	volume after opening valve, cm^3 (or $in.^3$)
V_3	=	volume at end of run, cm^3 (or $in.^3$)
C_1	=	scale number on buret at start, cm^3 (or $in.^3$)
C_2	=	scale number on buret after opening valve, cm^3 (or $in.^3$)
C_3	=	scale number on buret at end of run, cm^3 (or $in.^3$)
T_1	=	temperature, at start, K
T_2	=	temperature, open valve, K
T_3	=	temperature, end of run, K
TS	=	273.15 K
TA	=	ambient temperature, K
t	=	time of run, s
K	=	0.00142 psi/mm H_2O
VLS	=	leakage in standard, cm^3 (or $in.^3$)
VLS/t	=	leak rate, cm^3/s (or $in.^3/s$)
VLA	=	leak volume under ambient conditions, cm^3 (or $in.^3$)

4. Significance and Use

4.1 This test method determines both the *y* stress and the *m* factor as curves rather than as single or constant numbers.

5. Apparatus

5.1 *Pressure Vessel*, Fig. 1, fabricated from two 600-psi welding flanges in accordance with ANSI B16.5, to remove flange bending from consideration. See Figs. 2 and 3 for details. One flange is welded to a short pipe and suitable base plate, and one flange is welded shut at the neck with a suitable closure. Both fabrications shall be hydrotested at 1.5

[1] This test method is under the jurisdiction of ASTM Committee F-3 on Gaskets and is the direct responsibility of Subcommittee F03.20 on Methods of Test for Nonmetallic Gaskets.

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[2] *Annual Book of ASTM Standards*, Vol 09.02.

[3] Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

[4] Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.

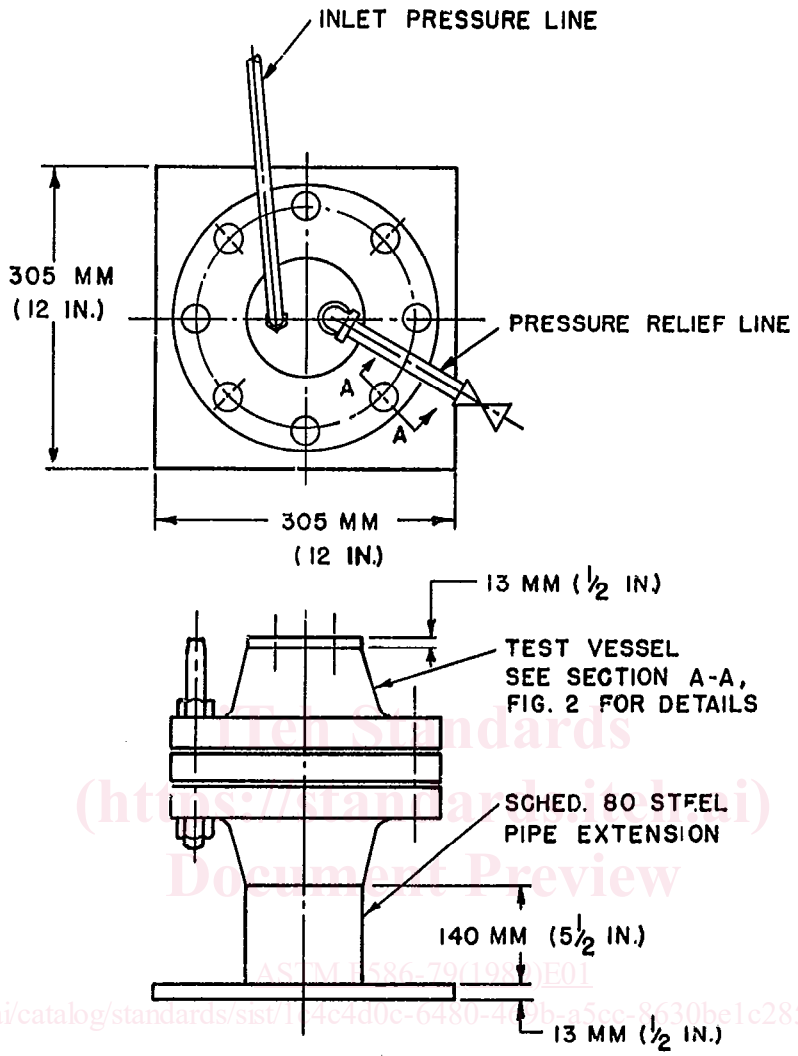

FIG. 1 Pressure Vessel for Testing Gasket Factors

times the rated pressure or 6.205 MPa (900 psi). If necessary, both fabrications shall be remachined after hydrotest to conform to the details in Fig. 1. The vessel shall be fitted with calibrated strain-gaged bolts, each capable of 53 378-N (12 000-lbf) axial load. The top part of the vessel shall be fitted with one vent valve and with one pressure inlet that is also connected to a pressure gage. The pressure gage shall be a 0 to 5000-kPa (0 to 500-psi) oil-filled type, accurate to ± 0.25 %, and having a face at least 152.4 mm (6 in.) in diameter to provide sufficient resolution. The vessel shall be fitted further with a metal seal plate and two O-rings in the manner detailed on Fig. 2 for containment of leakage past the gasket.

5.2 *Buret Assembly*, consisting of one 50-mL buret with stand, one 152.4-mm (6-in.) diameter battery jar, one 203.2-mm (8-in.) diameter battery jar, suitable length of 6.4 mm (0.250 in.) in inside diameter plastic tubing, and one tubing-to-buret clamp.

6. Test Specimen

6.1 The test specimen shall be a nominal 4-in. pipe size, raised-face gasket having an inside diameter 6.4 to 12.7 mm (0.250 to 0.500 in.) larger than the inside diameter of the pipe and an outside diameter no larger than the 157.2-mm (6.1875-in.) outside diameter of a standard raised-face gasket.

6.2 A minimum of six gaskets are required for determination of any *y* stress and leak rate combination.

7. Preparation of Apparatus

7.1 *Buret:*

7.1.1 Measure the length of the buret scale in millimetres (inches) and make a conversion chart for the correction of the actual height of the water to the standard height of each cubic centimetre. For example, if a 570-mm (22.5-in.) long scale represents 50 cm^3 (3 $in.^3$) in the buret, the actual measured heights (h_1, h_2, and h_3) must be multiplied by a factor of 570/500 to arrive at the standard height for the given cubic centimetre.

7.1.2 Lift a column of water into the buret by suction and close the buret stop cock.

7.1.3 Fill the inner battery jar to overflowing.

7.1.4 Set zero on the buret to the liquid level of the inner battery jar.

7.1.5 Connect the buret to the seal plate.

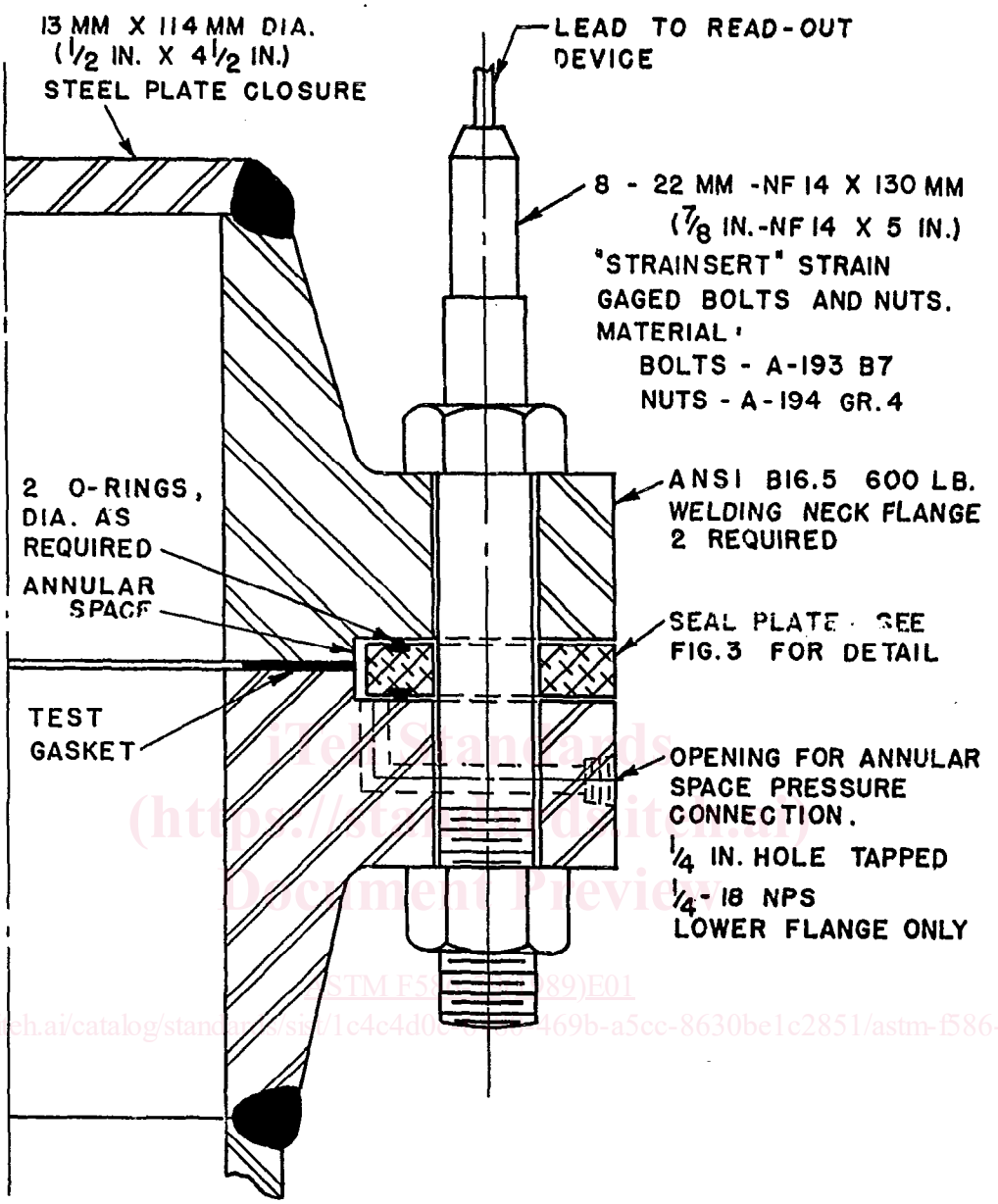

FIG. 2 Section A-A, Pressure Vessel for Testing Gasket Factors

8. Calibration of O-rings

8.1 Calibrate the O-rings sealing the metal plate before each series of tests for compressive load versus deflection (see Fig. 3).

8.2 Measure the O-ring deflection with each gasket tested and deduct its corresponding compressive force from the total flange fastener load.

9. Conditioning

9.1 Condition the gaskets in accordance with Classification System F 104 or as agreed upon between the purchaser and the seller of the gaskets.

10. Procedure for Determining *y* Stress

10.1 Measure and record the initial gasket thickness in millimetres (inches).

10.1.1 Center the gasket on the flange face.

10.2 Using the Bolt-Tightening Procedure in accordance with Test Method F 363, tighten the bolts to 90 % of the *y* value for the gasket material in Table UA-49.1, Section VIII, of the ASME Unfired Pressure Vessel Code or to some other value indicated by judgment or experience of the gasket manufacturer.

10.2.1 Open the valve between the seal plate and buret and record the new height of the water column.

10.3 Pressurize the vessel with either water or nitrogen to 13.8 kPa (2 psia).

10.4 Record the height of the water column in millimetres (inches) and the volume in cubic centimetres (cubic inches). Measure the temperature to the nearest 0.1°C. These measurements are to be taken at time zero, at 5-min intervals, and at the end of the run.