



Designation: D943 – 04a

BS 2000-280:1999

Standard Test Method for Oxidation Characteristics of Inhibited Mineral Oils¹

This standard is issued under the fixed designation D943; 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. Scope*

1.1 This test method covers the evaluation of the oxidation stability of inhibited steam-turbine oils in the presence of oxygen, water, and copper and iron metals at an elevated temperature. This test method is limited to a maximum testing time of 10 000 h. This test method is also used for testing other oils, such as hydraulic oils and circulating oils having a specific gravity less than that of water and containing rust and oxidation inhibitors.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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.* For specific warning statements, see Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*²

A510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

B1 Specification for Hard-Drawn Copper Wire

D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration

D1193 Specification for Reagent Water

D3244 Practice for Utilization of Test Data to Determine Conformance with Specifications

D3339 Test Method for Acid Number of Petroleum Products by Semi-Micro Color Indicator Titration

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.09 on Oxidation.

Current edition approved Nov. 1, 2004. Published November 2004. Originally approved in 1947. Last previous edition approved in 2004 as D943–04.

In 1976, this test method ceased to be a joint ASTM-IP standard. DOI: 10.1520/D0943-04A.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

D4310 Test Method for Determination of Sludging and Corrosion Tendencies of Inhibited Mineral Oils

D5770 Test Method for Semiquantitative Micro Determination of Acid Number of Lubricating Oils During Oxidation Testing

E1 Specification for ASTM Liquid-in-Glass Thermometers

2.2 *Energy Institute Standards:*³

Specifications for IP Standard Thermometers

2.3 *British Standard:*⁴

BS 1829

3. Summary of Test Method

3.1 The oil sample is contacted with oxygen in the presence of water and an iron-copper catalyst at 95°C. The test continues until the measured acid number of the oil is 2.0 mg KOH/g or above. The number of test hours required for the oil to reach 2.0 mg KOH/g is the "oxidation lifetime."

4. Significance and Use

4.1 This test method is widely used for specification purposes and is considered of value in estimating the oxidation stability of lubricants, especially those that are prone to water contamination. It should be recognized, however, that correlation between results of this method and the oxidation stability of a lubricant in field service may vary markedly with field service conditions and with various lubricants. The precision statement for this method was determined on steam turbine oils.

NOTE 1—Furthermore, in the course of testing a lubricant by this method, other signs of deterioration, such as sludge formation or catalyst coil corrosion, may appear that are not reflected in the calculated oxidation lifetime. The subcommittee responsible for this method is investigating the application of alternative criteria for evaluation of lubricants using this test apparatus. Test Method D4310 is now available for sludge measurement.

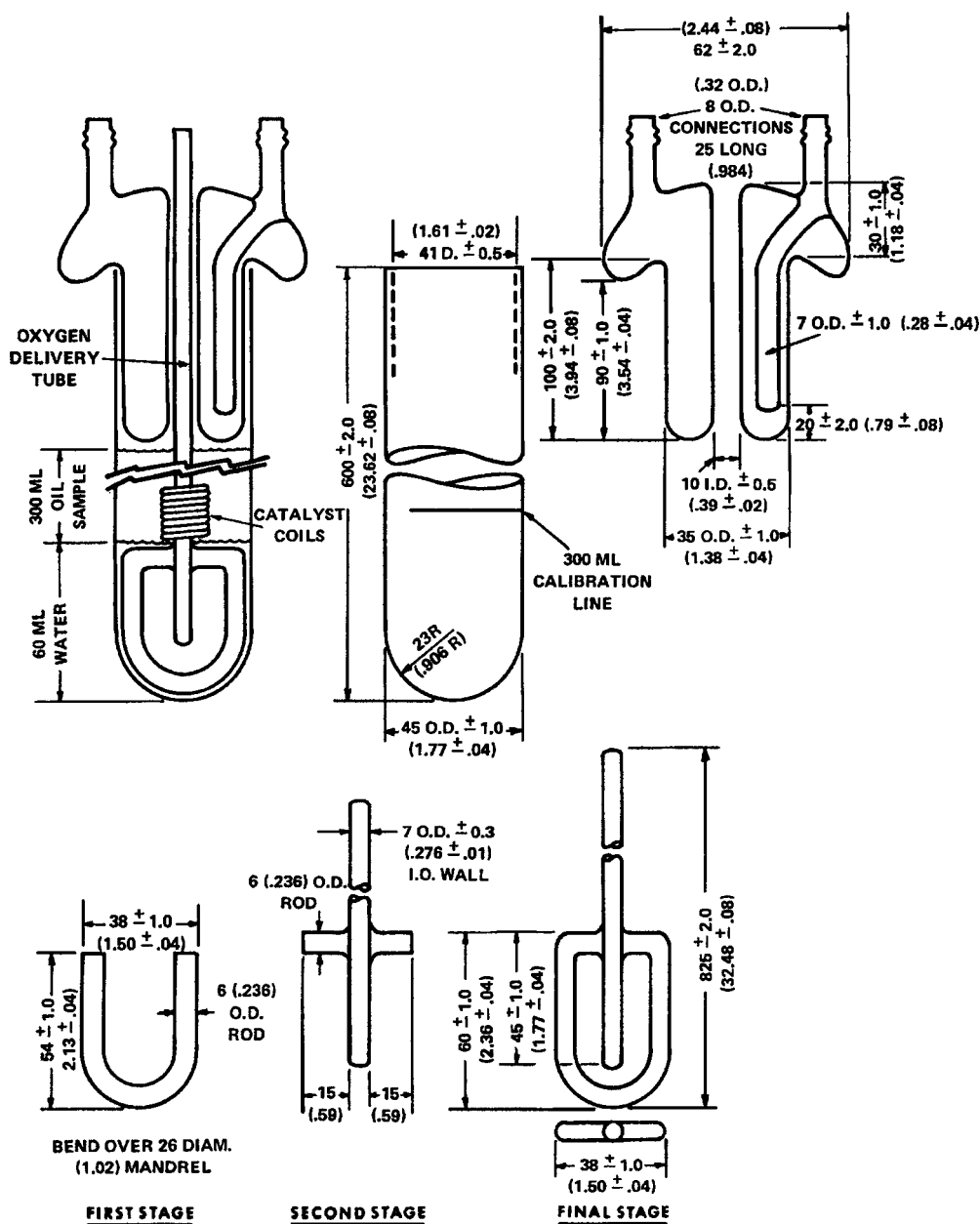
5. Apparatus

5.1 *Oxidation Cell*, of borosilicate glass, as shown in Fig. 1, consisting of a test tube, condenser, and oxygen delivery tube.

³ Available from Energy Institute, 61 New Cavendish St., London, W1G 7AR, United Kingdom.

⁴ Available from British Standards Institute, 389 Chiswick High Rd., London, W4 4AL, United Kingdom.

*A Summary of Changes section appears at the end of this standard.



NOTE 1—All dimensions are in millimetres (inches).

NOTE 2—The oxidation test tube has a calibration line at 300 mL. This calibration applies to the test tube alone at 20°C.

NOTE 3—Open tube ends to be ground and fire-polished.

FIG. 1 Oxidation Cell

The test tube has a calibration line at 300 mL (maximum error 1 mL). This calibration applies to the test tube alone at 20°C.

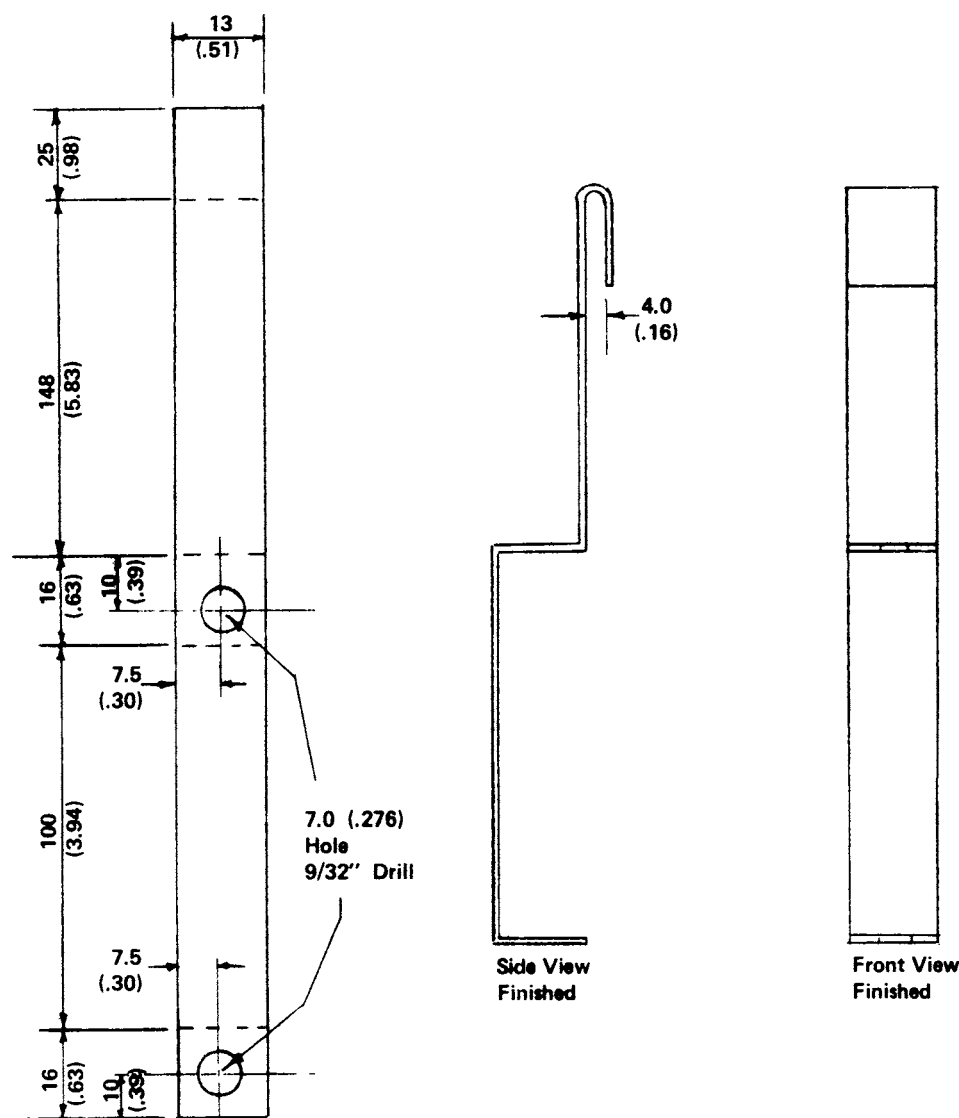
5.2 *Heating Bath*, thermostatically controlled, capable of maintaining the oil sample in the oxidation cell at a temperature of $95 \pm 0.2^\circ\text{C}$, fitted with a suitable stirring device to provide a uniform temperature throughout the bath, and large enough to hold the desired number of oxidation cells immersed in the heating bath to a depth of 390 ± 10 mm and in the heating liquid itself to a depth of 355 ± 10 mm.

NOTE 2—Metal block heaters meeting the test method requirements may also be used. It is not known what types of heating baths were used in developing the precision statement.

5.2.1 Studies have suggested that direct sunlight or artificial light may adversely influence the results of this test.⁵ To minimize effects of light exposure on the lubricant being tested, light shall be excluded from the lubricant by one or more of the following ways:

5.2.1.1 Use of heated liquid baths that are designed and constructed of metal, or combinations of metals and other suitable opaque materials, that prevent light from entering the

⁵ Supporting data (a summary of these results) have been filed at ASTM International Headquarters and may be obtained by requesting Research Report D02-1365.



NOTE 1—All dimensions are in millimetres (inches).

NOTE 2—Material: 18-8 Stainless Steel, 22 Gage (0.792 mm).

FIG. 2 Thermometer Bracket

test cell from the sides is preferred. If a *viewing window* is included in the design, this *viewing window* shall be fitted with a suitable opaque cover and be kept closed when no observation is being made.

5.2.1.2 If glass heating baths are used, the bath shall be wrapped with aluminum foil or other opaque material.

5.2.1.3 Bright light entering the test cell from directly overhead can be eliminated by use of an opaque shield.

5.3 *Flowmeter*, with a capacity of at least 3 L of oxygen/h, and an accuracy of ± 0.1 L/h.

5.4 *Heating Bath Thermometer*—ASTM Solvents Distillation Thermometer having a range from 72 to 126°C, and conforming to the requirements for Thermometer 40C as prescribed in Specification E1, or for Thermometer 70C as prescribed in Specifications for IP Standard Thermometers. Alternatively, temperature-measuring devices of equal or better accuracy may be used.

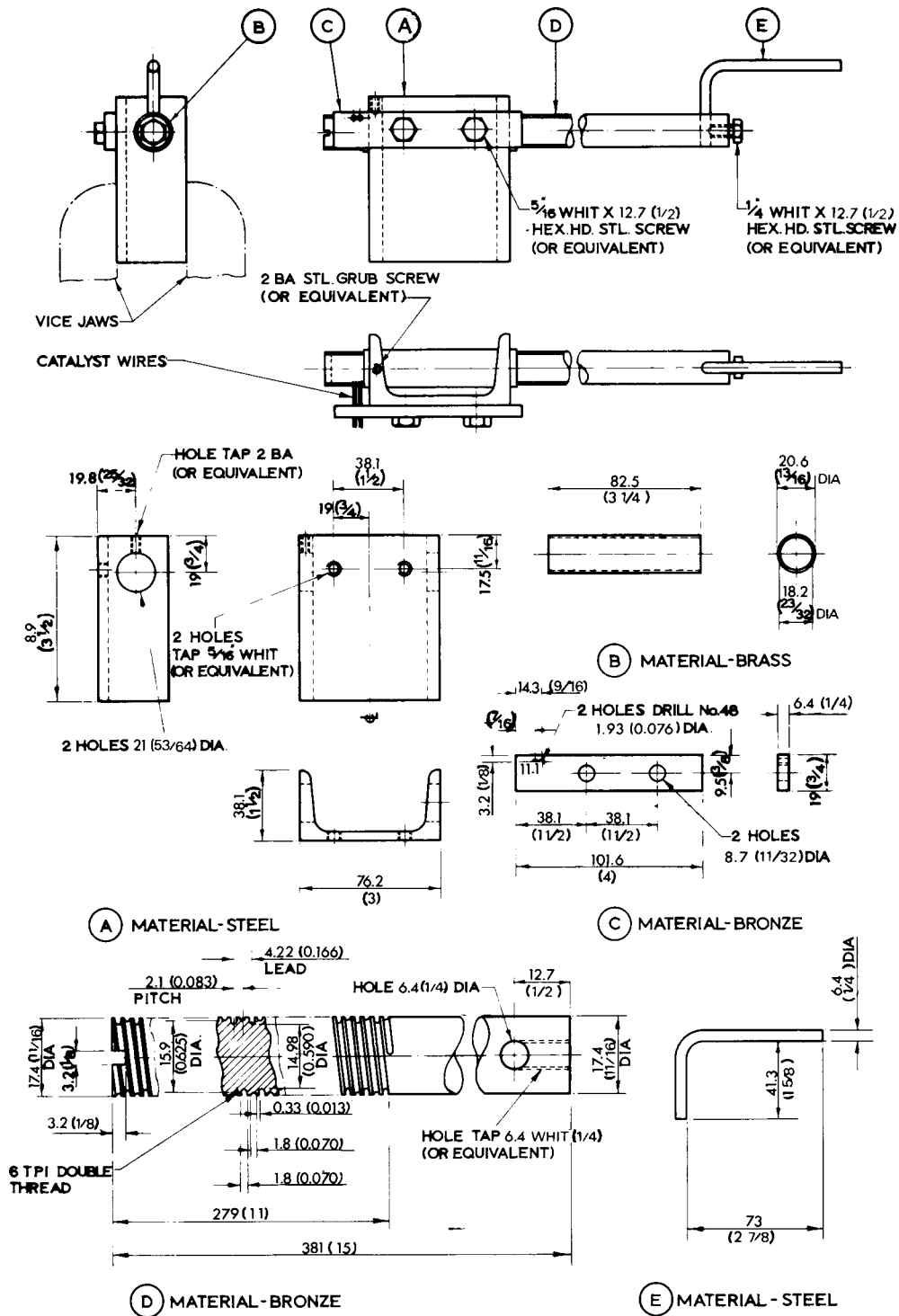
5.5 *Oxidation Cell Thermometer*,³ having a range from 80 to 100°C, graduated in 0.1°C, total length—250 mm, stem diameter—6.0 to 7.0 mm, calibrated for 76-mm immersion.^{6,7} Alternatively, temperature-measuring devices of equal or better accuracy may be used.

5.6 *Thermometer Bracket*, for holding the oxidation cell thermometer, of 18-8 stainless steel, having the dimensions shown in Fig. 2. The thermometer is held in the bracket by two fluoroelastomer O-rings of approximately 5 mm inside diameter. Alternatively, thin stainless steel wire may be used.

5.7 *Wire Coiling Mandrel*, as shown in Fig. 3.

⁶ The sole source of supply of the Brooklyn thermometer No. 21276-RM known to the committee at this time is the Brooklyn Thermometer Co., Farmingdale, NY.

⁷ If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.



NOTE—Dimensions are in millimetres (inches).
 FIG. 3 Mandrel for Winding Catalyst Coils