Designation: D5534 – 94 (Reapproved 2018)

Standard Test Method for Vapor-Phase Rust-Preventing Characteristics of Hydraulic Fluids[1]

This standard is issued under the fixed designation D5534; 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 the ability of hydraulic fluids to prevent the rusting of steel in the vapor phase over the hydraulic fluid and water.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.3 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website—http://www.epa.gov/mercury/faq.htm—for additional information. Users should be aware that selling mercury and/or mercury containing products into your state or country may be prohibited by law.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A108 Specification for Steel Bar, Carbon and Alloy, Cold-Finished

A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

D91 Test Method for Precipitation Number of Lubricating Oils

D665 Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water

D1193 Specification for Reagent Water

D3603 Test Method for Rust-Preventing Characteristics of Steam Turbine Oil in the Presence of Water (Horizontal Disk Method)

E1 Specification for ASTM Liquid-in-Glass Thermometers

2.2 *Other Standards:*

IP 60/80 Specification for Petroleum Spirit[3]

BS 970: 1955–EN3B Specification for wrought steels[4]

3. Summary of Test Method

3.1 This test method is divided into two parts:

3.1.1 *Part A*—Used only for fluids where water is the continuous phase. Examples of such fluids include water-glycol hydraulic fluids and high-water-content hydraulic fluids. Do not use Part A to evaluate invert emulsion hydraulic fluids.

3.1.2 *Part B*—Used for both water-containing fluids and completely water-free fluids such as petroleum based hydraulic fluids, except phosphate esters. In Part B a small beaker of water is present to provide water vapor to cause corrosion in the absence of a vapor-phase inhibitor in the fluid. Part B is the appropriate procedure for evaluating invert emulsion hydraulic fluids.

3.2 In both Part A and Part B, a steel specimen is attached to the underside of the cover of a beaker containing the fluid under test. The apparatus and specimen are identical to those of Test Method D3603. The fluid is brought to a test temperature of 60 °C (140 °F).

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.N0 on Hydraulic Fluids.

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[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.

[3] Available from Energy Institute, 61 New Cavendish St., London, WIG 7AR, U.K., http://www.energyinst.org.

[4] Available from IHS, 15 Inverness Way East, Englewood, CO 80112, http://www.global.ihs.com.

3.3 In Part B, the test specimen is exposed to the vapor from the fluid for 30 min prior to the introduction of water. A beaker of water is then placed in the undercarriage of the cover.

3.4 After 6 h, the apparatus is disassembled and the specimen is rated visually for the presence of rust.

3.5 Since the apparatus and test conditions are identical, Part A can be completed simultaneously with Test Method D3603 by adding the vapor-phase specimen to that procedure.

4. Significance and Use

4.1 Procedures such as Test Methods D665 and D3603 assess the ability of new or unused hydraulic fluid to prevent rusting on wetted steel surfaces but do not address the prevention of rusting in the vapor space above the fluid. This procedure addresses the latter question under one set of test conditions and need not be applicable to some service conditions. Since used fluids have not been cooperatively tested in this procedure, its utility for in-service monitoring has not been established.

5. Apparatus

5.1 *Oil Bath*—Thermostatically controlled liquid bath capable of maintaining a temperature in the oil sample of 60 °C ± 1 °C (140 °F ± 2 °F). The bath shall have holes to accommodate the test beakers.

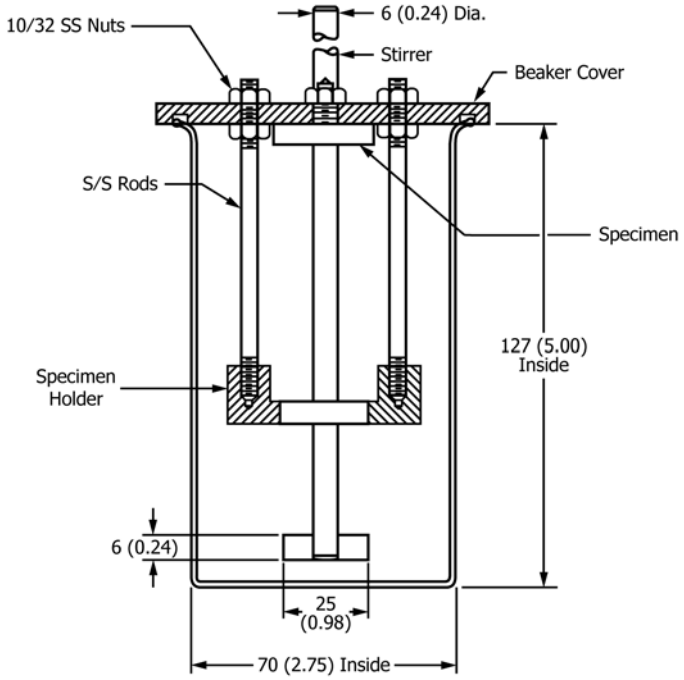
NOTE 1—The bath used for Test Method D665 can be used with a slight modification, that is, the centers of the beaker holes are moved from 6.4 mm to 18.3 mm (¼ in. to 23⁄32 in.) from the axis of the stirrers.

NOTE 2—To indicate the temperature, a thermometric device such as, resistance temperature detectors (RTDs), thermistors, or liquid-in-glass thermometers with equivalent or better requirements of ASTM Thermometer 9C or 9F, or IP Thermometer 21C, as prescribed in Specification E1 may be used.

5.2 *Beaker*—400 mL, Berzelius-type, tall-form heat resistant glass beaker,[5] approximately 127 mm (5 in.) in height measured from the inside bottom center and approximately 70 mm (2¾ in.) in inside diameter measured at the middle, and without pourout (see Fig. 1).

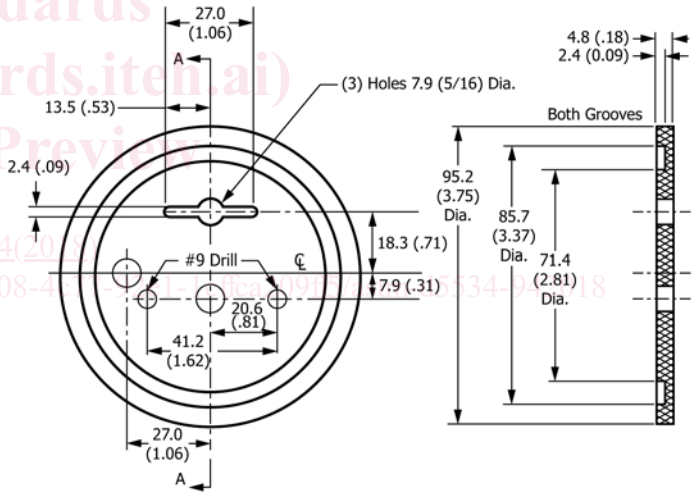
5.3 *Beaker Cover (Fig. 2) and Specimen Holder (Fig. 3)*—Flat beaker cover of 4.8 mm (3⁄16 in.) methyl methacrylate resin or other fluid-resistant material, kept in position by a suitable groove. Three holes, 7.9 mm (5⁄16 in.) in diameter, shall be provided. Two are located on any diameter of the cover, one for a stirrer 18.3 mm (23⁄32 in.) from the cover's center, and the other for the vapor-phase test specimen 7.9 mm (5⁄16 in.) from the center on the opposite side. The third hole, for a thermometer, is located 27 mm (1 1⁄16 in.) from the center on a diameter perpendicular to that of the other two holes. The undercarriage is a Test Method D3603 specimen holder suitably attached to the beaker cover, used here to support the water beaker (see 5.7) used in Part B. One suitable undercarriage (the one used in the round-robin) is shown in Fig. 1. An undercarriage must be present even for Part A, to prevent vortexing. The holding rod, appropriate for this apparatus, is depicted in Fig. 4.

[5] British Standard 2, 1965 Section 5, or equivalent, may be used.



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

FIG. 1 Rusting Test Apparatus



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

FIG. 2 Beaker Cover

NOTE 3—Other holders suitable for supporting the specimen in Test Method D3603 are also suitable for supporting the water beaker in this test method. The undercarriage design is not considered to be critical.

5.4 *Stirrer*—Constructed entirely from stainless steel in the form of an inverted T (Fig. 5). A flat blade 25.4 mm by 6.1 mm by 0.6 mm (1 in. by 0.24 in. by 0.024 in.) shall be attached to a 6.1 mm (0.24 in.) rod in such a way that the blade is symmetrical with the rod and has its flat surface in the vertical pane.

NOTE 4—A suitable material is an 18 % chromium, 8 % nickel alloy steel conforming to Type 304 of Specification A240/A240M, or SAE No. 30304, or BS 970: Part 1: 1983: 302531.

NOTE 5—If stainless steel is not available, stirrers made of heat resistant