Designation: ~~D2070 – 91 (Reapproved 2010)~~ D2070 – 16

Standard Test Method for Thermal Stability of Hydraulic Oils[1]

This standard is issued under the fixed designation D2070; 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~~ Scope*

1.1 This test method[2] is designed primarily to evaluate the thermal stability of hydrocarbon based hydraulic oils although oxidation may occur during the test.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]
D4057 Practice for Manual Sampling of Petroleum and Petroleum Products
2.2 *Copper Development Association Standard*[4]
UNS C11000 Electrolytic Tough Pitch Copper
2.3 *American Iron and Steel Institute Standard (AISI)*[5]
W-1 Carbon Tool Steel

3. Summary of Test Method

3.1 A beaker containing test oil, copper and iron rods is placed in an aluminum block in an electric gravity convection oven for 168 h at a test temperature of 135 °C. At the completion of the test, the copper and steel rods are rated visually for discoloration and the oil is analyzed for the quantity of sludge.

4. Significance and Use

4.1 Thermal stability characterizes physical and chemical property changes which may adversely affect an oil's lubricating performance. This test method evaluates the thermal stability of a hydraulic oil in the presence of copper and steel at ~~135°C.~~135 °C. Rod colors are the evaluation criteria. Sludge values are reported for informational purposes. No correlation of the test to field service has been made.

5. Apparatus

5.1 An aluminum block with equally spaced holes is used. An example is described in Fig. A1.1 of Annex A1.

5.2 Electric gravity convection oven capable of maintaining the aluminum block at a test temperature of 135 °C ± 1 °C.
5.2.1 Calibrated thermocouple and temperature indicator centered in aluminum block.

5.3 250 mL Griffin beakers of borosilicate glass.

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[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] This procedure was adopted from the Fives Cincinnati ~~Milacron~~ Thermal Stability ~~Test, Cincinnati Milacron~~ Test Procedure "A", Fives Cincinnati Manual 10-SP-89050.

[3] 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.

[4] Available from Copper Development Assoc., ~~2 Greenwich Office Park, Box 1840, Greenwich, CT 06836.~~Inc., 260 Madison Ave., New York, NY 10016, http://www.copper.org..

[5] Available from American Iron and Steel Institute (AISI), ~~1140 Connecticut~~25 Massachusetts Ave., NW, Suite ~~705,~~800, Washington, DC ~~20036,~~20001, http://www.steel.org.

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

5.4 Copper test specimens are to be UNS C11000, 99.9 % pure electrolytic tough pitch copper, 6.35 mm in diameter by 7.6 cm in length (0.25 in. by 3.0 in.).[6,7]

5.5 Steel test specimens are to be AISI W-1 1 % carbon steel, 6.35 mm in diameter 7.6 cm in length (0.25 in. by 3.0 in.).[6,7]

5.6 Silicon carbide abrasive 320 grit with cloth backing.

5.7 Crocus cloth.

5.8 ~~No.~~ 41 Whatman filter paper,[8,7] 47 mm diameter.

5.9 Millipore filter,[9,7] ~~8 micron~~ 8 µm Type SC, ~~47 mm~~ 47 mm diameter.

5.10 Millipore glass filter holder, ~~47 mm,~~ 47 mm, Cat #XX10.04700 or equivalent.

5.11 ~~Cincinnati Milacron color chart.~~Fives Cincinnati Lubricant Heat Test Standards Color Chart.[10,7]

5.12 25 mL pipette.

6. Reagents

6.1 *Reagent Grade Heptane*—(**Warning—**Flammable. Health hazard.)

6.2 *Reagent Grade Acetone*—(**Warning—**Flammable. Health hazard.)

7. Preparation of Apparatus

7.1 Handle the rods at all times using forceps or clean cotton gloves.

7.2 *Catalyst Preparation*—Clean the iron and copper catalyst rods, whether new or previously used, prior to use. Clean the rods with the 320 silicon carbide abrasive cloth while rotating the rods in a drill chuck at 1700 r/min to 1800 r/min. Clean the surface until it has a bright copper or steel appearance. Discard rods when diameter is less than ~~6.2 mm.~~6.2 mm.

7.3 Prepare surface finally with a crocus cloth. Remove all grind marks. Finish the rods to a lightly polished surface finish.

7.4 Wash the rods individually with acetone and air dry on completion of the polishing operation.

8. Procedure

8.1 Place a representative 200 mL sample of test oil obtained per D4057 sampling procedure in a clean 250 mL Griffin beaker containing one each of the cleaned and polished iron and copper rods.

8.2 Place the rods totally below the surface of the oil and crossed. Place them in contact with each other at one point only.

8.3 Place the beaker and its contents in the pre-heated aluminum block test fixture in the oven.

8.4 Maintain the test fixture at 135 °C ± 1 °C for 168 h. Start the time when the test sample is placed in the oven.

8.5 Keep the oven doors closed during the entire test period. Monitor the temperature continuously via thermocouple in the center of the test block.

8.6 At the completion of 168 h, remove the beakers from the oven and allow to cool to room temperature before proceeding. Individually remove the rods from the oil sample. Remove any loose sludge clinging to the rods with a plastic or rubber policeman and return the sludge to the oil.

8.7 *Copper Rod Analysis*—Wash the rod with heptane to remove all oil and allow to air dry. Discard the heptane wash. Make a visual evaluation of the condition of the rod against the Fives Cincinnati ~~Milacron~~ color chart (available from ~~Cincinnati Milacron~~Fives Cincinnati[9]) and record.

8.8 *Steel Rod Analysis*—Wash the steel rod with heptane to remove all oil and allow to air dry. Discard the heptane wash. Make a visual evaluation of the rod against the Fives Cincinnati ~~Milacron~~ color chart and record.

[6] The sole source of supply of the apparatus known to the committee at this time is ~~Whatman Int. Ltd., Maidstone, England.~~Metaspec LLC, 790 W. Mayfield Blvd., San Antonio, TX 78211, metaspec@earthlink.net.

[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,[1] which you may attend.

[8] The sole source of supply of the apparatus known to the committee at this time is ~~Millipore Filter Corp., Bedford, MA.~~Whatman Ltd., part of GE Healthcare, http://www.whatman.com.

[9] The sole source of supply of the apparatus known to the committee at this time is ~~Cincinnati Milacron, 4701 Marburg Ave., Dept 97B Lubricants and Tribology, Cincinnati, OH 45209.~~EMD Millipore Corp., 290 Concord Rd., Billerica, MA 01821; http://www.EMDmillipore.com.

[10] The sole source of supply of the apparatus known to the committee at this time is Fives Cincinnati, 2200 Litton Ln., Hebron, KY 41048; http://www.fivesmsi.com..