Designation: D6351 – 99 (Reapproved 2005)

Standard Test Method for Determination of Low Temperature Fluidity and Appearance of Hydraulic Fluids[1]

This standard is issued under the fixed designation D6351; 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 fluidity and appearance of hydraulic fluids after storage at low temperature.

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.* For specific hazard statements, see Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D97 Test Method for Pour Point of Petroleum Products

D2500 Test Method for Cloud Point of Petroleum Products

D6080 Practice for Defining the Viscosity Characteristics of Hydraulic Fluids

E1 Specification for ASTM Liquid-in-Glass Thermometers

3. Summary of Test Method

3.1 After preliminary drying to remove trace amounts of water, the sample is cooled to a specified temperature. After seven consecutive days, the sample is examined for its ability to flow and observed for homogeneity.

4. Significance and Use

4.1 The temperature at which a lubricant remains fluid and homogeneous after seven days is an index of its ability to withstand prolonged exposure to cold temperature. With vegetable oils and some synthetic esters, it is necessary to do extended cold storage testing. Quick cool, short-term tests, such as Test Methods D97 and D2500, do not adequately predict the tendency to solidify over longer time spans at cold temperatures.

4.2 This test method is not intended to indicate cold temperature pumpability performance. A separate assessment of viscometric performance should be made in order to assess cold flow properties, which are important in order to avoid system damage in cold temperature applications. Suitable guidelines for such testing and test temperatures for various viscosity grades can be found in Practice D6080.

4.3 No specific temperature of measurement is given in this test method because fluids with different viscosity grades have different cold temperature performance expectations. For guidance on temperature selection relative to an intended low temperature viscosity grade or ISO VG, consult Practice D6080. As an example of using Practice D 6080D6080, a L22 viscosity grade would be evaluated at the lowest temperature for that grade, namely -22.9°C. Alternatively, a fluid can be evaluated at the lowest temperature expected for field service.

5. Apparatus

5.1 *Test Jar*, cylindrical, of clear glass, flat bottom, 115 to 125 mm in height. The inside diameter of the jar can range from 30.0 to 32.4 mm, with a wall thickness of 1.6 mm maximum. The jar shall have a line to indicate a sample height 54 ± 3 mm above the inside bottom.

5.2 *Thermometers*, having ranges shown below and conforming to the requirements prescribed in Specification E1.

Thermometer	Temperature Range	Thermometer Number	
		ASTM	IP
High cloud and pour	-38 to +50°C	5C	1C
Low cloud and pour	-80 to +20°C	6C	2C
Melting Point	+32 to 127°C	61C	63C

5.2.1 Since separation of liquid column thermometers occasionally occurs, thermometers should be checked visually immediately prior to the test.

5.3 *Cork*, to fit the test jar.

[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.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.

5.4 *Bath*, either an air or liquid bath maintained at the prescribed temperature with a firm support to hold the sample jars vertical. The required bath temperature shall be maintained by refrigeration to within ±1°C of the prescribed temperature.

6. Reagents and Materials

6.1 Liquid for temperature reference jar. The following materials are examples of suitable media that remain clear liquids at low temperature and in which the thermometer can be placed.

6.1.1 2 cSt Polyalphaolefin.

6.1.2 Alcohol, Ethanol. (**Warning—**Flammable.)

7. Procedure

7.1 Pour the specimen into the test jar to the level mark.

7.2 To remove trace amounts of water, preheat the sample to 100°C for 30 min, then cover loosely and allow the sample to cool for 30 min. If the hydraulic fluid is water based, for example a water-glycol fluid, this drying step is to be omitted.

7.3 Close the test jar with the cork.

7.4 Prepare a temperature reference jar in accordance with 7.1 with a liquid that will remain fluid at the selected test temperature. Insert a thermometer through a centrally bored cork so that it fits tightly and is coaxial and the bulb is immersed so that the beginning of the capillary is 3 mm below the surface of the liquid.

7.5 Place the test jar and temperature reference jar in the bath. Be sure the sample is totally immersed in the cooling bath, paying particular attention if a liquid bath is used.

7.6 Keep the samples in the bath for 168 consecutive h.

7.7 Record the temperature of the thermometer in the reference jar prepared in accordance with 7.4 just before examining the samples per 7.8.

7.8 After 168 h, immediately examine the samples. Hold the jar in a horizontal position for 5 s and observe whether the sample flows. Note the presence of any crystals, particles, or separation and the appearance of the specimen.

8. Report

8.1 Report the fluidity and condition of the sample at the end of the test period as follows:

8.1.1 If the sample flows under the condition in 7.8, report fluidity as: *Fluid at (temperature of test)*.

8.1.2 If the sample does not flow under the conditions in 7.8, report fluidity as: *Not fluid at (temperature of test)*.

8.1.3 Report the presence of any crystals or particles in the sample or separation of the sample.

8.1.4 Report the appearance of the sample at the test temperature as: *Clear*, *Haze Present*, or *Opaque*.

9. Precision and Bias

9.1 No statement can be made yet about the precision of this test method for measuring the fluidity or particle forming tendency of a lubricant specimen since a round robin is currently being conducted.

9.2 There are no criteria for measuring bias in these test-product combinations, so no statement of bias can be made.

10. Keywords

10.1 hydraulic fluid; low temperature appearance; low temperature fluidity; vegetable oil