



Designation: D2532 – 16

Standard Test Method for Viscosity and Viscosity Change After Standing at Low Temperature of Aircraft Turbine Lubricants¹

This standard is issued under the fixed designation D2532; 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 U.S. Department of Defense.

1. Scope*

1.1 This test method covers the determination of the kinematic viscosity of aircraft turbine lubricants at low temperature, and the percent change of viscosity after a 3 h and a 72 h standing period at low temperature.

1.1.1 The range of kinematic viscosities covered by this test method is from 7700 mm²/s to 14 000 mm²/s at –40 °C and from 7000 mm²/s to 17 500 mm²/s at –51 °C. The precision has only been determined for those materials, kinematic viscosity ranges, and temperatures as shown in the precision section. Kinematic viscosities and percent change of viscosity may be measured and reported at other temperatures and other thermal soak period intervals as agreed by the contracting parties.

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

1.2.1 The SI unit used in this test method for Kinematic Viscosity is mm²/s. For user reference, 1 mm²/s = 10^{–6} m²/s = 1 cSt.

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 appro-*

priate safety and health practices and determine the applicability of regulatory limitations prior to use. For specific hazard statements, see Section 7.

2. Referenced Documents

2.1 ASTM Standards:²

D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

D446 Specifications and Operating Instructions for Glass Capillary Kinematic Viscometers

D6300 Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products and Lubricants

E1 Specification for ASTM Liquid-in-Glass Thermometers

E563 Practice for Preparation and Use of an Ice-Point Bath as a Reference Temperature

E644 Test Methods for Testing Industrial Resistance Thermometers

E1137 Specification for Industrial Platinum Resistance Thermometers

E1750 Guide for Use of Water Triple Point Cells

E2593 Guide for Accuracy Verification of Industrial Platinum Resistance Thermometers

E2877 Guide for Digital Contact Thermometers

2.2 Other Documents:

MIL-PRF-7808 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base³

MIL-PRF-23699 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number O-156³

3. Terminology

3.1 Definitions:

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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

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 D02.07 on Flow Properties.

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

3.1.1 *digital contact thermometer (DCT), n*—an electronic device consisting of a digital display and associated temperature sensing probe.

4. Summary of Test Method

4.1 Kinematic viscosity and percent change is determined at low temperature using apparatus defined in Test Method [D445](#) and Specifications [D446](#) at time intervals of 3 h and 72 h following an initial measurement at 35 min.

5. Significance and Use

5.1 Aircraft turbine lubricants, upon standing at low temperatures for prolonged periods of time, may show an increase in kinematic viscosity. This increase may cause lubrication problems in aircraft engines. Thus, this test method is used to ensure that the kinematic viscosity does not exceed the maximum kinematic viscosity in certain specifications for aircraft turbine lubricants.

6. Apparatus

6.1 Viscometers, drying tubes, low-temperature bath, thermometer, timer, secondary viscosity standard, filter, and cleaning supplies are described in detail in Test Method [D445](#).

6.2 *Viscometer*—The viscometer shall meet the requirements of Test Method [D445](#) and Specifications [D446](#) and be of the type in which the sample can be rerun without cleaning the viscometer. Suitable holders should be used. For convenience it is recommended that the viscometer size be chosen to keep the efflux time between 200 s and 1000 s.

NOTE 1—Consult Specifications [D446](#) regarding calibration constant correction for the actual test temperature when using Specifications [D446](#) viscometers that are not suspended level types.

6.3 *Drying Tubes*—Fit the viscometer openings with drying tubes filled with indicating silica gel, using cotton at top and bottom to hold the loosely packed desiccant in place. Provide a cross-connection on the viscometer side of the drying tubes (which can be closed by a pinch clamp or stopcock while liquid is being drawn into the efflux bulb) so that the restriction to air flow will not cause error. Replace the silica gel when a lavender color is noticeable.

6.4 *Viscosity Temperature Bath*—The constant-temperature bath must be capable of holding several viscometers at once. It must have adequate stirring of the liquid medium ([Note 2](#)) and balance between heat losses such that the bath temperature can be maintained at the required temperature ± 0.03 °C.

NOTE 2—Isopropanol or other clear, low-freezing point liquid may be used as a bath liquid.

6.5 *Temperature Measuring Device*—Use either a digital contact thermometer as described in [6.5.2](#) with equal or better accuracy or a calibrated ASTM Kinematic Viscosity Test Thermometer such as 73C (−40 °C) or 74C or 43C (−51 °C) conforming to the requirements as prescribed in Specification [E1](#) which have an accuracy after correction of ± 0.03 °C or better. The ASTM 74C thermometer has a specification between −55.4 °C and −52.6 °C but is available from some suppliers with the scale expanded to cover −51 °C. The 43C thermometer is only graduated in 0.1 °C increments so interpretation at midpoints between the lines may be required.

6.5.1 When using liquid-in-glass thermometers, use a magnifying device to read the thermometer to the nearest $\frac{1}{2}$ division (for example, 0.02 °C on thermometers graduated in 0.1 °C increments) to ensure that the required test temperature and temperature control capabilities are met.

6.5.1.1 Check the thermometer's ice point at least annually using an ice bath or a constant temperature bath against a reference thermometer. If the corrected temperature reading error is greater than the temperature tolerance, then the thermometer must be recalibrated.

6.5.2 When using a digital contact thermometer (DCT), the following requirements shall apply:

Criteria	Minimum Requirements
DCT	E2877 Class A
Display resolution	0.01 °C, recommended 0.001 °C
Display accuracy	± 30 mK (± 0.03 °C) for combined probe and sensor
Sensor type	RTD, such as a PRT or thermistor
Drift	less than 10 mK (0.01 °C) per year
Response time	less than or equal to 6 s as defined in Specification E1137
Linearity	10 mK over range of intended use
Calibration Report	The DCT shall have a report of temperature calibration traceable to a national calibration or metrology standards body issued by a competent calibration laboratory with demonstrated competency in temperature calibration. An ISO 17025 accredited laboratory with temperature calibration in its accreditation scope would meet this requirement.
Calibration Data	The calibration report shall include at least 3 calibration temperatures at least 5 °C apart which are appropriate for its intended use.

6.5.2.1 For a constant temperature bath employed, the DCT probe shall be immersed by more than its minimum immersion depth in a constant temperature bath so that the center of the probe's sensing region is at the same level as the lower half of the working capillary provided the probe's minimum immersion depth is met and is no less than indicated on the calibration certificate. The end of the probe sheath shall not extend past the bottom of the viscometer. It is preferable for the center of the sensing element to be located at the same level as the lower half of the working capillary as long as the minimum immersion requirements are met.

NOTE 3—With respect to DCT probe immersion depth, a procedure is available in Test Methods [E644](#), Section 7 (Minimum Immersion Length Test), for determining the minimum depth. With respect to an ice bath, Practice [E563](#) provides guidance on the preparation of an ice bath, however variance from the specific steps is permitted provided preparation is consistent as it is being used to track change in calibration.

6.5.2.2 Verify the DCT calibration at least annually. The probe shall be recalibrated when the check value differs by more than 0.01 °C from the last probe calibration. Verification can be accomplished with the use of a water triple point cell, an ice bath, or other suitable constant temperature device which has a known temperature value of suitable precision. See Practice [E563](#), Guide [E1750](#), and Guide [E2593](#) for more information regarding checking calibrations.

6.5.2.3 In the case of constant temperature baths used in instruments for automatic viscosity determinations, the user is to contact the instrument manufacturer for the correct DCT that has performance equivalence to that described here.