Designation: D2532 – 10

Standard Test Method for Viscosity and Viscosity Change After Standing at Low Temperature of Aircraft Turbine Lubricants[1]

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 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.

1.2 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 units for Kinematic Viscosity are mm^2/s. For user reference, 1 mm^2/s = 10^{-6} m^2/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 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]

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

E1 Specification for ASTM Liquid-in-Glass Thermometers

3. Summary of Test Method

3.1 Kinematic viscosity is measured at low temperature in accordance with Test Method D445 and at time intervals of 3 h and 72 h.

NOTE 1—This test method was developed and the precision established on tests at −53.9°C (−65°F). It is also applied at −40°C (−40°F) and may be used at other temperatures. Viscosities may be measured and reported at other intervals as agreed by the contracting parties.

4. Significance and Use

4.1 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.

5. Apparatus

5.1 Viscometers, drying tubes, low-temperature bath, thermometer, timer, secondary viscosity standard, filter, and cleaning supplies are described in detail in Test Method D445.

5.2 *Viscometer*—The viscometer shall meet the requirements of Test Method D445 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 and 1000 s.

5.3 *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

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.07 on Flow Properties.

Current edition approved July 1, 2010. Published July 2010. Originally approved in 1966. Last previous edition approved in 2003 as D2532–03. DOI: 10.1520/D2532-10.

[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.

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

flow will not cause error. Replace the silica gel when a lavender color is noticeable.

5.4 *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 (±0.05°F).

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

5.5 *Low-Temperature Storage Cabinet*—If it is desired to exercise the option described in Note 3 (7.4), a low-temperature storage cabinet or bath shall be provided which is capable of holding the required temperature with a variation not to exceed ±0.3°C (±0.5°F).

5.6 *Bath Thermometer*—Calibrated ASTM Kinematic Viscosity Test Thermometer such as 73F or 74F conforming to the requirements as prescribed in Specification E1. Other calibrated thermometric devices are permissible provided their accuracy, precision, and sensitivity are equal to or better than the above thermometers.

5.7 *Secondary Viscosity Standards.*[3]

6. Procedure for Cleaning Viscometers and Filter Screen

6.1 Apply air pressure or suction to the viscometer to remove any previous test specimen. Allow the viscometer to drain for 5 min.

6.1.1 Wash the viscometer four times, inside and out, with fresh toluene (**Warning—**Flammable) using suction as required. Allow the viscometer to drain.

6.1.2 Wash the viscometer four times, inside and out, with acetone, and allow to drain for 5 min. Then dry with suction.

6.1.3 Clean the viscometer thoroughly by filling it completely with glass cleaning solution. Allow to drain for 5 min.

6.1.4 Rinse viscometer inside and out with distilled water until all traces of the cleaning solution are completely removed. Allow to drain for 5 min.

6.1.5 Dry in oven at approximately 100°C (212°F).

6.2 Clean the filter screen by first disassembling the screen (if practicable).

6.2.1 Rinse thoroughly with fresh toluene (**Warning—**Flammable).

6.2.2 Rinse thoroughly with fresh acetone (**Warning—**Flammable).

6.2.3 Dry in oven at approximately 100°C (212°F).

7. Procedure

7.1 For the duration of the test, maintain the bath temperature at the required temperature ±0.03°C (±0.05°F).

7.2 Charge the clean, dry viscometer as prescribed in Test Method D445.

7.2.1 Affix the drying tubes and carefully flush the moist room air from the viscometer by placing vacuum to the drying tubes. Draw the sample into the working capillary and timing bulb so as to preclude the possibility of any traces of residue moisture condensing on the walls of the capillary and timing bulb while the sample cools to test temperature. Moisture must not be allowed to condense on the walls of the working capillary and efflux bulb.

7.2.2 Place the viscometer in the constant-temperature bath, and vertically align the viscometer if a self-aligning holder has not been used.

7.2.3 Make the first determination of kinematic viscosity 35 ± 1 min after the viscometer is placed in the bath. Measure the efflux time as specified in Test Method D445. Be careful that the stopcock or pinch clamp joining each arm of the viscometer has been opened to ensure that there is no effect of the drying tubes on the efflux time.

7.3 Measure the kinematic viscosity after standing 3 h at the required temperature. Without removal of the viscometer from the constant-temperature bath, repeat the viscosity determination (7.2.3) at 3 h ± 5 min after the completion of the initial viscosity determination.

7.4 Measure the kinematic viscosity after standing 72 h at the required temperature. Without removal of the viscometer from the constant-temperature bath (Note 3), repeat the viscosity determination (7.2.3) at 72 h ± 5 min after the completion of the initial viscosity measurement (Note 1).

NOTE 3—If for some reason, such as unavailability of operator attention, it becomes difficult or impractical to maintain the temperature of the bath within the specified ±0.03°C (±0.05°F) variations for the entire time required for completion of the 72-h test, the bath may be put on automatic control capable of holding the required temperature at ±0.3°C (±0.5°F). Optionally, the viscometer may be removed from the bath and placed in the low-temperature storage cabinet or bath described in 5.5. In either case, the viscometer shall be returned to conditions of 0.03°C (±0.05°F) and held there for at least 35 min before the viscosity is to be measured again.

8. Calculation

8.1 Calculate the kinematic viscosity as follows:

$$\text{Kinematic viscosity, mm}^2\text{/s} = C \cdot t \quad (1)$$

where:

C = calibration constant of the viscometer at the required temperature, mm^2/s^2, and

t = efflux time, s.

8.2 Report the viscosity in mm^2/s at 35 min, 3 h, and 72 h.

8.3 Calculate the percent viscosity change as follows:

$$\text{Viscosity change, percent} = [100(B - A)/A], \text{ or } [100(C - A)/A] \quad (2)$$

where:

A = viscosity at 35 min,

B = viscosity at 3 h, and

C = viscosity at 72 h.

9. Precision and Bias

NOTE 4—This precision statement is under review by ASTM Committee D02.07. An interlaboratory study (ILS) is underway to study the precision and bias for 10 commercial aviation turbine lubricants at -40°C and -51°C. This ILS is expected to be completed in 2010 with a ballot generated to revise this precision statement no later than 2011.

9.1 *Precision*—The following criteria should be used for judging the acceptability of results at a 95 % confidence level.

[3] Viscosity standards for calibration of viscometers may be purchased at the Cannon Instrument Co., State College, PA. Calibrated viscometers are also commercially available.

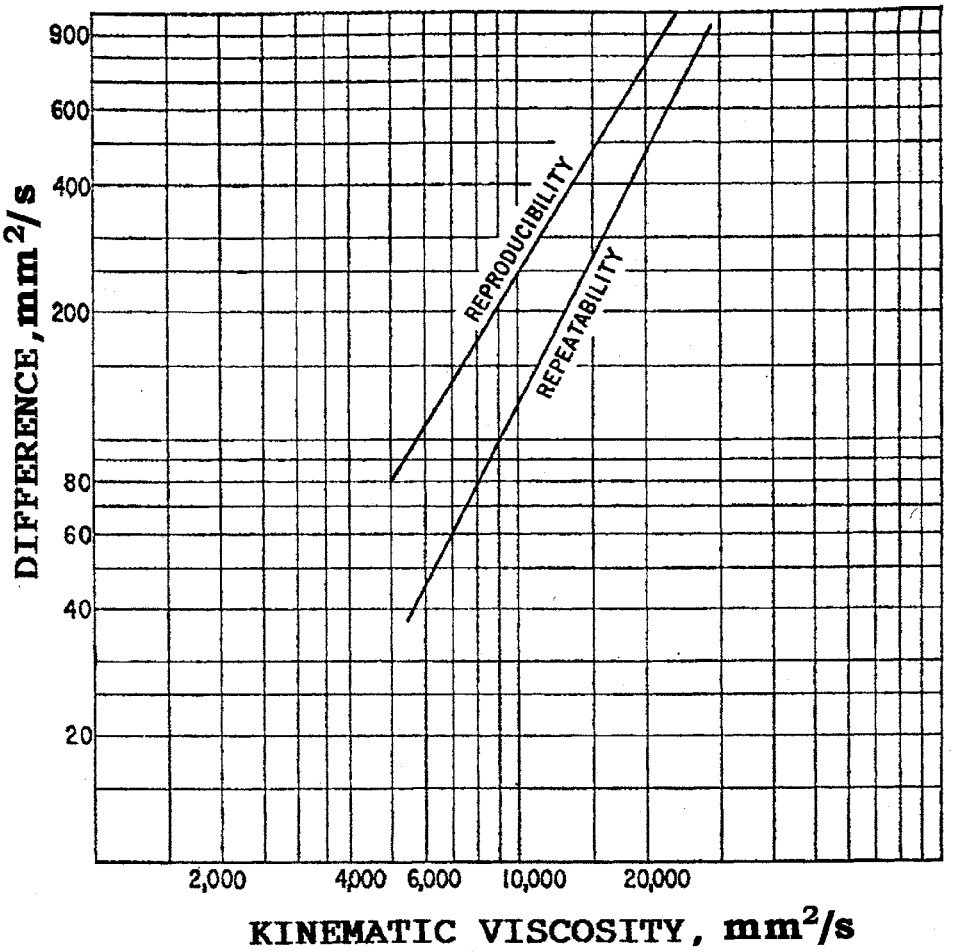

FIG. 1 Repeatability and Reproducibility

9.1.1 *Repeatability*—The difference between successive test results obtained by the same apparatus under constant operating conditions on identical test material would, in the long run, in the normal and correct operation of this test method exceed, after the 35-min period, the values shown on the repeatability curve in Fig. 1 only in one case in twenty. Differences greater than this should be considered suspect.

9.1.2 *Reproducibility*—The difference between two single and independent test results, obtained by different operators working in different laboratories on identical test material would, in the long run, in the normal and correct operation of this test method exceed, after the 35-min period, the values shown on the reproducibility curve in Fig. 1 only in one case in twenty. Differences greater than this should be considered suspect.

9.1.3 The precision of kinematic viscosity determinations after standing times in excess of 35 min has not been calculated because it has been found that certain oils, while held in storage at −53.9°C (−65°F), develop characteristics that cause wide variations in observed kinematic viscosities.

9.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for this test method, no statement on bias is being made.

10. Keywords

10.1 aircraft turbine lubricants; kinematic viscosity; viscosity

SUMMARY OF CHANGES

Subcommittee D02.07 has identified the location of selected changes to this standard since the last issue (D2532–03) that may impact the use of this standard.

(*1*) Deleted original 1.2 and revised 1.2 to clarify SI units in the standard.
(*2*) Revised 8.1 and Eq 1 to remove non-SI units.
(*3*) Added Note 4 regarding pending update to Precision and Bias.