



Designation: D4305 – 98a (Reapproved 2004)^{ε1}

Standard Test Method for Filter Flow of Aviation Fuels at Low Temperatures¹

This standard is issued under the fixed designation D4305; 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.

^{ε1} NOTE—Warning notes were editorially moved into the standard text in May 2004.

INTRODUCTION

This test method describes a procedure for determining the simulated freezing point for aviation turbine fuels using an automated apparatus. The results from this test method have been found to be equivalent to Test Method D2386, except for liquids which have a viscosity of more than 5 mm²/s (cSt) at –20°C (see Test Method D445), which can give a higher (warmer) result than Test Method D2386.

The procedure can also be used to investigate the formation of wax crystals or the cold flow properties of other products.

1. Scope

1.1 This test method covers the determination of low temperature flow behavior, through a screen-type test filter, of aviation turbine fuels, which can contain separated solids as wax.

1.2 Procedure A employs a 26-μm test filter and is the recommended procedure. Some existing instruments are fitted with a 42-μm filter, and Procedure B is retained to enable their continued use.

1.3 The use of Procedure A (26-μm test filter) with fuels that have a viscosity of greater than 5.0 mm²/s (cSt) at –20°C, as determined by Test Method D445, can affect the precision and the simulated freezing point obtained on such fuels and can give a higher (warmer) result than the conventional freezing point obtained by Test Method D2386.

NOTE 1—The principle of this test method relies on flow through a fine-mesh test filter, and, hence, the result can be affected by the viscosity of the sample. When using Procedure A, a no-flow condition is reached when crystals block the test filter or the viscosity exceeds about 14 mm²/s (cSt); sample with a viscosity of greater than 5 mm²/s (cSt) at –20°C may exceed the 14-mm²/s (cSt) threshold at a temperature before crystals are formed. If viscosity affects the result before crystals are formed, then the reported value of the no-flow temperature of the sample will always be warmer than the actual freezing point, and therefore fail-safe and an indicator of possible flow anomalies at low temperature.

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.

2. Referenced Documents

2.1 *ASTM Standards*:²

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

D1655 Specification for Aviation Turbine Fuels

D2386 Test Method for Freezing Point of Aviation Fuels

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *flow point*—represents the temperature corresponding to the unblockage of a test filter that previously was blocked by separated solids.

3.1.2 *no-flow point*—represents the temperature corresponding to a specified degree of blockage of a test filter by separated solids.

4. Summary of Test Method

4.1 A 5-mL specimen of fuel is subjected to a programmed temperature cycle while a pump maintains an oscillating flow at constant rate across a metal mesh test filter. As the temperature falls, separated wax tends to restrict the test filter

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.

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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.

causing an increase in pressure. When this pressure exceeds 1.33 kPa for more than 0.95 s, the no-flow point is indicated and the cooling cycle is stopped. The pump continues to operate and exert pressure as the fuel specimen is warmed. At the point when the test filter is unplugged and pressure falls below 1.33 kPa for more than 0.95 s, the flow point is indicated and the temperature of the specimen displayed and held.

5. Significance and Use

5.1 The lowest temperature at which aviation fuels remain free of solid hydrocarbon crystals, which may restrict the flow of fuel through filters in an aircraft fuel system, is a key safety parameter in the specification and use of fuels. In Test Method **D2386**, the freezing point is defined as the temperature at which all crystals disappear following a cooling and warming cycle. In this test method, a cooling and warming cycle is also employed; however, the test result is defined as the flow point, which is the temperature of the specimen at which a test filter becomes unblocked on warming.

6. Apparatus³

6.1 A detailed description is given in **Annex A1**.

6.2 The apparatus defined in this test method comprises a cooling/warming cell, a specimen pump, pressure sensor, test filter, syringe, sample filter, and associated electronic controls and displays.

7. Reagents and Materials

7.1 *Heptane*, technical grade. (**Warning**—Extremely flammable, vapor harmful if inhaled. See **Annex A2.1**.)

7.2 *Jet A or A1*. (**Warning**—Combustible, vapor harmful. See **Annex A2.2**.)

8. Sampling

8.1 Obtain a sample in accordance with Practice **D4057**.

8.2 Store the sample in a cool place (0 to 20°C) away from direct heat or sunlight.

9. Preparation of Apparatus

9.1 If the apparatus previously contained an unknown specimen, follow the manufacturer's instructions to clean the cell, using a paraffinic solvent such as heptane; oxygenated solvents such as acetone shall not be used as they may damage the cell. If the prior specimen is similar to the test material, the latter can be used to flush the cell.

9.2 The cleaning cycle shall be repeated at least twice, the last cycle involving flushing with the test material.

9.3 The cell temperature shall be warmer than 0°C before the test specimen is injected.

9.4 The syringe shall be clean and dry before use.

10. Calibration and Quality Control Checks

10.1 Follow the manufacturer's instructions.

10.1.1 *Pressure Transducer*—This should be checked once monthly by direct comparison with a water manometer, or a traceable pressure gage.

10.1.2 *Specimen Pump*—Calibration and operation of the pump should be checked once monthly.

10.1.3 *Electronic Thermometer (PRT)*—Calibration and operation of the PRT should be checked against a traceable standard every six months.

10.1.4 *Control Sample*—Confirm the calibration of the instrument each day it is used by running a control sample of known flow point.

11. Procedures A and B

NOTE 2—Procedures A and B are identical except that Procedure A uses the 26- μ m test filter, while Procedure B uses the 42- μ m test filter.

11.1 Set the RAMP control to a temperature approximately 5°C above the expected flow point of the specimen. If the flow point is unknown, set the control to a temperature warmer than any possible flow point.

11.2 Set the cooling rate control to 1.75°C/min.

11.3 Set the instrument to determine flow. Wait until the cell temperature is above 0°C.

11.4 Fill the syringe with 5 mL of sample, taking care not to introduce any air into the syringe.

11.5 Introduce the 5-mL specimen into the instrument through the integral sample filter, using the syringe. Leave the syringe in place attached to the sample filter.

11.6 The specimen will be rapidly cooled until its temperature reaches the ramp setting.

11.7 When the ramp temperature of the sample is reached, the cooling rate will change to $1.75 \pm 0.2^\circ\text{C/min}$.

11.8 When the no-flow point is reached (pressure greater than 1.33 kPa for longer than 0.95 s), the cooling will be switched off. The specimen will then be warmed at a rate of $1.75 \pm 0.2^\circ\text{C/min}$ until the flow point is reached (pressure less than 1.33 kPa for longer than 0.95 s).

11.9 The instrument will display the flow temperature of the sample.

11.10 Follow the manufacturer's instructions to drain the sample and clean the syringe.

12. Report

12.1 Record the flow temperature to the nearest 0.1°C. When determining compliance with aviation fuel specifications, the flow temperature can be reported as the freezing point of the fuel.

12.2 Record the no-flow temperature to the nearest 0.1°C (optional).

12.3 Record whether Procedure A or Procedure B was used.

13. Precision and Bias^{4,5,6}

13.1 The precision of this test method, as determined by statistical analyses of interlaboratory results, is as follows:

³ The sole source of supply of the apparatus known to the committee at this time is Stanhope-Seta, Chertsey, Surrey KT16 8AP, England. 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 committee¹, which you may attend.

⁴ Supporting data regarding the equivalence of the Mark I, II, and III Setpoint Detector instruments (Procedure B) have been filed at ASTM International Headquarters and may be obtained by requesting Research Report E1211-06.