Designation: D1665 – 20

Standard Test Method for Engler Specific Viscosity of Tar Products[1]

This standard is issued under the fixed designation D1665; 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 determination of specific viscosity of tars and their fluid products. It does not determine absolute viscosity, but is an empirical flow test. Only by conforming strictly to requirements of the test method are reproducible results obtained.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D140/D140M Practice for Sampling Asphalt Materials

D8055 Guide for Selecting an Appropriate Electronic Thermometer for Replacing Mercury Thermometers in D04 Road and Paving Standards

E1 Specification for ASTM Liquid-in-Glass Thermometers

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Terminology

3.1 *Definitions:*

3.1.1 *Engler specific viscosity*—the ratio obtained by dividing the time of flow, in s, of 50 mL of material using an Engler viscosimeter at a selected temperature by a factor representing the time of flow, in s, for an equal volume of water at 25 °C. The usual temperatures for determination of specific viscosity of tar materials are 25 °C, 40 °C, 50 °C, and 100 °C, and generally the temperature is so selected that the specific viscosity is not more than 45.

4. Summary of Test Method

4.1 The time, in s, is measured for a fixed volume of liquid material to flow through an efflux tube under an accurately reproducible head and at a closely controlled temperature. The Engler specific viscosity is then calculated by dividing the efflux time by the viscometer calibration factor as determined by making the same efflux measurement for water.

5. Significance and Use

5.1 This test method is useful in characterizing the consistency of tar and tar distillates by measuring their flow properties. It is applicable to materials that are readily liquid at temperatures up to 100 °C.

6. Apparatus

6.1 *Engler Viscosimeter* as shown in Fig. 1, consisting of the following:

6.1.1 *Cup*—This is a gold-plated cylindrical brass vessel of 106.0 ± 1.0 mm, *A*, inside diameter, closed at the top by a double-walled lid. To the rounded bottom is attached a metal-encased tapered platinum efflux tube 20.0 ± 0.1 mm, *H*, long with an inside diameter of 2.90 ± 0.02 mm, *E*, at the top and 2.80 ± 0.02 mm, *F*, at the bottom. The efflux tube shall project through and extend 3.0 ± 0.2 mm, *G*, below a jacket that surrounds the cup and shall have a bottom outside diameter, including its surrounding metal, of 4.5 ± 0.2 mm, *I*. Three metal measuring points, spaced equidistantly around the circumference of the cup, are fastened to the sides and extend inwardly approximately 7 mm, then turn up at a right angle and end in sharp points which are located 52.0 ± 0.5 mm, *D*, vertically above the lower end of the efflux tube and 25.0 ± 1.0 mm, *C*, above the lowest portion of the cylindrical sidewall of the cup. They serve both for indicating when the instrument is level and for measuring the charge of material, which is approximately 250 mL.

[1] This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.43 on Specifications and Test for Tar and Tar Products.

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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.

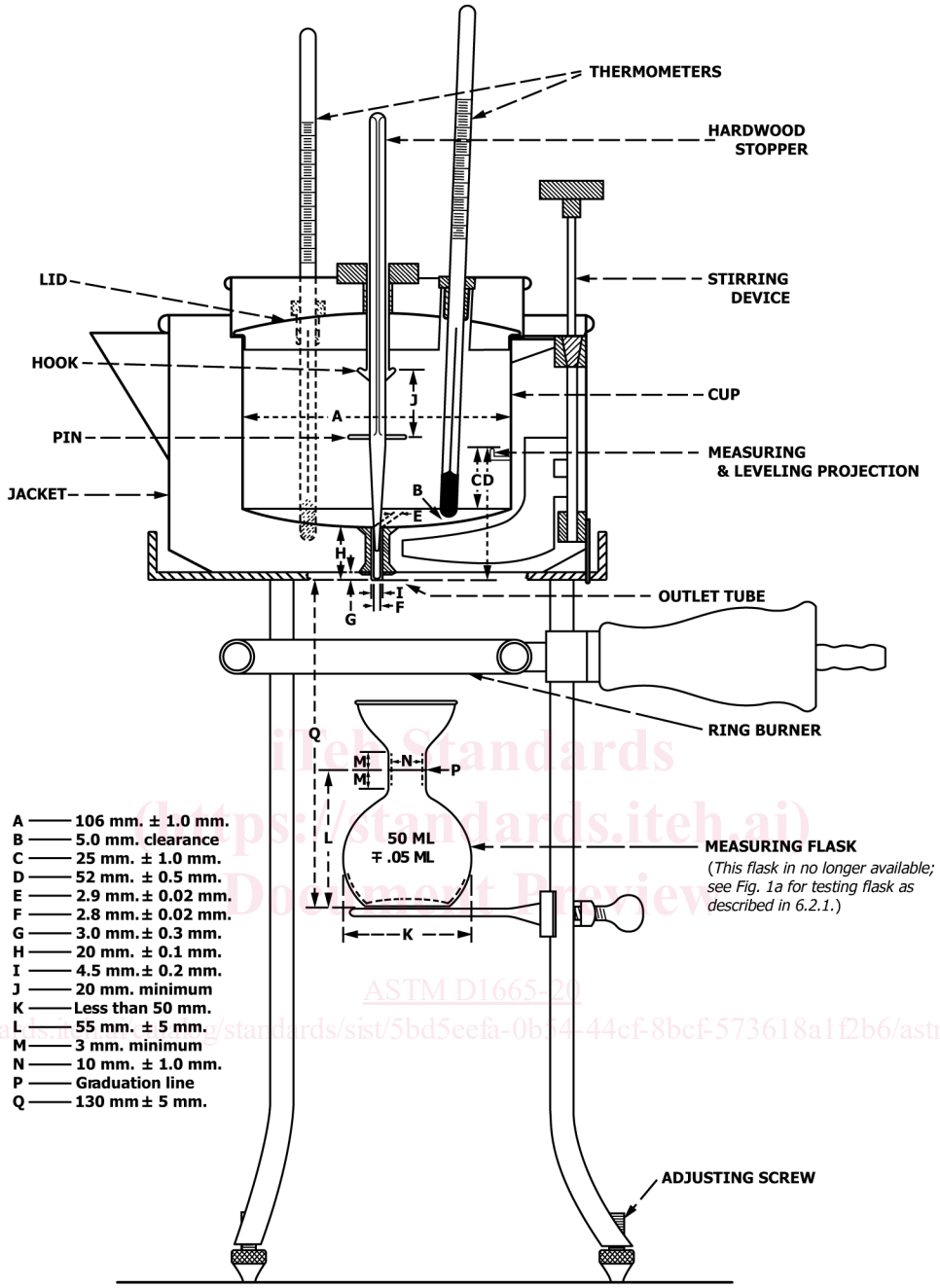

FIG. 1 Engler Viscosimeter

6.1.2 *Jacket*—The cup is surrounded by a jacket which holds water or other suitable liquid serving as a constant-temperature bath. In the type illustrated, the jacket is provided with a thermometer clamp and stirring device. A tripod supports the apparatus and also carries a ring burner by means of which the bath is heated. Adjustable legs on the tripod serve to level the instrument. Other arrangements of outer baths, supports, and stirring devices are acceptable, especially when it is desired to use more than one standardized cup in a single bath.

6.1.3 *Stopper*—The efflux tube in the cup is closed or opened by the insertion or withdrawal of a tapered hardwood stopper which, to leave the tube open, can be suspended by its brass pin from the hook on the cover. The stopper shall be a

smooth, round, wooden rod 180 mm long and 8 mm in diameter, with a brass wire pin 20 mm long and 1.83 mm in diameter inserted diametrically through the rod at a point 50 mm from the lower end, and tapered uniformly below this pin to end in a circular plane 1.6 to 2.0 mm in diameter. Above the pin, the rod shall be planed or grooved on four sides to a depth of 1 mm to prevent any possible restriction of air flow.

6.2 *Receivers*—Two types are required as follows:

6.2.1 *Testing Flask*—50 mL graduate calibrated at 20 °C (see Fig. 2).

6.2.2 *Calibration Flask*—For standardization purposes there shall be available a Kohlrausch flask, Fig. 3, with top enlarged above the graduation mark and calibrated to contain 200 ± 0.1 mL at 20 °C.

6.3 *Thermometers*—ASTM Engler Viscosity Thermometers 23C, 24C, and 25C as required, and conforming to the requirements for these thermometers as specified in Specification E1.

NOTE 1—The ASTM 23C, 24C, and 25C thermometers required for this standard have an accuracy of ±0.2 °C and cover temperature ranges from 18 °C to 105 °C. Either a Pt-100 Class AA tolerance rating with either a three or four-wire configuration, or a thermistor with a ±0.2 °C accuracy would be likely electronic temperature measurement replacement devices (Guide D8055). However, the thermometers in this standard are specialized thermometers which evaluate not only the temperature of a shallow depth of liquid but of the gases in the chamber. The impact of replacing the currently used Specification E1 thermometers with electronic temperature measurement devices (sensor and meter) on test results should be evaluated prior to making any changes.

6.4 *Timer*—Stopwatch or other timing device graduated in divisions of 0.2 s or less, and accurate to within 0.1 % when tested over a 60-min period.

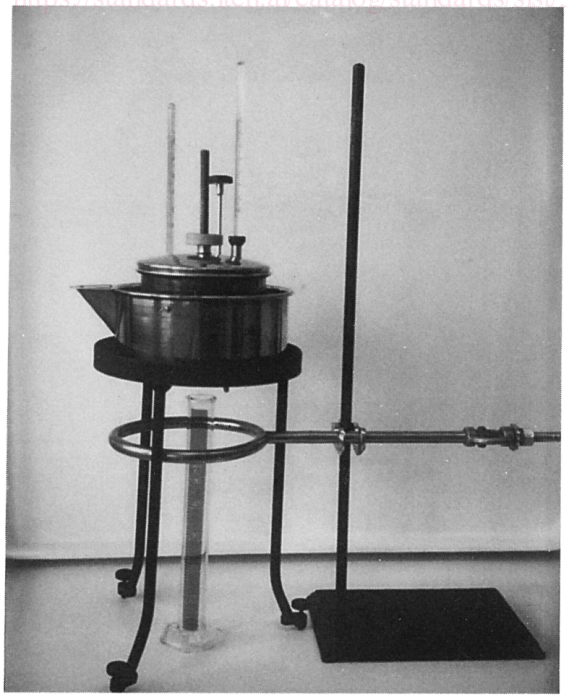

FIG. 2 Engler Viscosity Apparatus Using the 50 mL Graduate

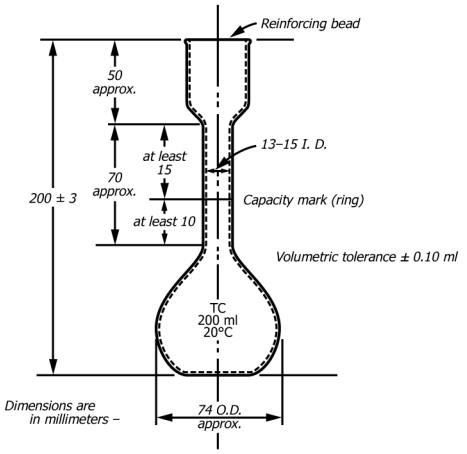

FIG. 3 Kohlrausch Sugar Flask

6.5 *Strainer*—300 mm ASTM sieve conforming to Specification E11.

7. Sampling

7.1 Samples from shipments or production vessels shall be taken in accordance with Practice D140/D140M and shall be free of foreign substances. Thoroughly heat and stir the sample before removing a representative portion for the determination.

8. Preparation of Sample

8.1 Stir the sample until it is homogeneous, using heat if necessary. Avoid inclusion of air bubbles, loss of volatile, or other effects which may influence the viscosity. Strain a representative portion of the sample through the strainer to eliminate particles and proceed in accordance with Section 10. Strain the material directly into the viscosimeter if preferred.

9. Standardization and Calibration of Viscosimeter

9.1 The efflux time for 200 mL of distilled water at 20.0 °C with an acceptable Engler viscosimeter shall be between 50.0 and 52.0 s. Determine this time and the factor representing the efflux time for 50.0 mL of water at 25.0 °C, as described in 9.1.1 – 9.1.6:

9.1.1 Clean the inner vessel and efflux tube of the viscosimeter with appropriate solvents, and finish by washing several times with pure methyl or 95 % ethyl alcohol and rinsing several times with distilled water.

NOTE 2—In cleaning the viscosimeter, take particular precautions to avoid injury to the efflux tube and measuring points. Use only a soft cloth in the cup, and soft tissue in the efflux tube. Avoid wires or similar substances and corrosive liquids. To prevent an air seal, keep the lid and lip of the cup clean at all times. After a viscosimeter has been used with bituminous materials, pay particular attention to cleaning the metal surrounding the bottom end of the efflux tube. Failure to do this may cause erratic and erroneous results.

9.1.2 Immediately after cleaning the viscosimeter, close the efflux tube with a stopper which has never been in contact with tar, oil, or similar materials. Fill the outer bath with water at slightly below or above 20 °C as found necessary to maintain the inner temperature at 20 °C. Fill the inner vessel approximately to the top of the fixed gage points with freshly boiled distilled water at 20.0 °C. Level the instrument so the tips of