ASTM INTERNATIONAL

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Standard Test Method for
Viscosity of Transparent Liquids by Bubble Time Method[1]

This standard is issued under the fixed designation D 1545; 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 viscosity in bubble seconds by timing. The bubble seconds are approximately equal to stokes for most liquids.

1.2 The test method is applicable to transparent liquids that are free from crystalline or gel particles.

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

2. Terminology

2.1 *Definitions:*

2.1.1 *viscosity*—the resistance experienced by one portion of a liquid moving over another portion of the liquid. The absolute unit of viscosity in the cgs system is the poise which is expressed as dyne-seconds per square centimetre. Stokes are equal to poises divided by density. The absolute SI viscosity unit is the pascal-second.

3. Apparatus

3.1 *Constant-Temperature Bath*—Any suitable bath capable of maintaining temperature at 25 ± 0.1°C with water as the bath medium.

3.2 *Standard Viscosity Tubes,*[2] of clear glass and with flat bottoms, 10.65 ± 0.025 mm in inside diameter; 114 ± 1 mm in outside length. Plainly legible lines shall be located as follows (Note 1):

$$27 ± 0.5 \text{ mm}$$
$$100 ± 0.5 \text{ mm}$$
$$108 ± 0.5 \text{ mm}$$

The distance between the first and second lines shall be 73 ± 0.5 mm.

NOTE 1—All distances shall be measured from the outside bottom of the tube.

3.3 *Reference Standards*—A series of standard viscosity tubes (3.2) filled with transparent liquids having predetermined viscosities in stokes and bubble seconds and spaced in logarithmically even increments of about 26 % (log 1.260 = 0.100), as listed in Table 1. The standards shall be marked alphabetically or numerically as shown in Table 1 without reference to stokes or bubble time (Note 2). Also listed in Table 1, for general and historical reference only, is the long established series of Gardner-Holdt letter standards, in tubes that do not have the three lines and are shorter than the standard viscosity tubes described in 3.2.

NOTE 2—For convenience, the reference standards can be divided in three series: light series, 15 tubes marked 0.22 to 8.0; heavy series, 14 tubes marked 10 to 200; and very heavy series, 7 tubes, marked 250 to 1000.

3.4 *Timing Device*—Stopwatch or electric stop clock capable of being read to a precision of 0.1 s.

3.5 *Tube Racks*, capable of inverting one or more viscosity tubes 180° to within 1° of a vertical position while rack and tubes are immersed in the constant temperature bath.

3.6 *Viscosity Tube Corks*, No. 2 short.

4. Procedure

4.1 Fill a standard viscosity tube with the material to be tested to approximately level with the 108-mm line.

4.2 Transfer the tube to a constant 25°C temperature bath with the cork loosely inserted. Hold at this temperature for 10 min.

NOTE 3—Adequate control of the temperature bath is essential. A variation of 0.1°C in the temperature of the bath will cause a 1 % variation in the timed bubble travel.

4.3 At the end of 10 min adjust the level of the liquid so that the bottom meniscus will be level with the 100-mm line. Insert the cork so that the bottom of the cork is on the level with the 108-mm line. This will ensure a bubble of suitable and uniform size.

4.4 Insert the tube in the rack and immerse in the 25°C water bath. Allow the tube(s) to stand with cork down in the bath a minimum of 20 min before determining the viscosity.

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[1] This test method is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.33 on Polymers and Resins.
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[2] Empty standard viscosity tubes are available from the R. P. Cargille Laboratories, Inc., 55 Commerce Rd., Cedar Grove, NJ, 07009, or Byk-Gardner Inc., Gardner Laboratory, 2435 Linden Lane, Silver Spring, MD 20910.

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