



Designation: D1545 – 13

## Standard Test Method for Viscosity of Transparent Liquids by Bubble Time Method<sup>1</sup>

This standard is issued under the fixed designation D1545; 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 ( $\epsilon$ ) 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 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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. Terminology

#### 2.1 Definitions:

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

### 3. Apparatus

3.1 *Constant-Temperature Bath*—Any suitable bath capable of maintaining temperature at  $25 \pm 0.1^\circ\text{C}$  with water as the bath medium.

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

$27 \pm 0.5$  mm

$100 \pm 0.5$  mm

$108 \pm 0.5$  mm

The distance between the first and second lines shall be  $73 \pm 0.5$  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 centistokes and bubble seconds as listed in Table 1. The standards are listed alphabetically from the lowest viscosity to the highest viscosity standard.

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  $180^\circ$  to within  $1^\circ$  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  $25^\circ\text{C}$  temperature bath with the cork loosely inserted. Hold at this temperature for 10 min.

NOTE 2—Adequate control of the temperature bath is essential. A variation of  $0.1^\circ\text{C}$  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  $25^\circ\text{C}$  water bath. Allow the tube(s) to stand with cork down in the bath a minimum of 20 min before determining the viscosity.

NOTE 3—For viscosities of liquids that have a timed bubble travel of 4 s or less, more precise results can be obtained by comparison against reference standards having a predetermined viscosity or timed bubble travel.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.24 on Physical Properties of Liquid Paints and Paint Materials.

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