



Standard Test Method for Kinematic Viscosity of Volatile and Reactive Liquids¹

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^{ε1} NOTE—Footnote 4 was corrected editorially in December 1996.

1. Scope

1.1 This test method covers the measurement of kinematic viscosity of transparent, Newtonian liquids which because of their reactivity, instability, or volatility cannot be used in conventional capillary kinematic viscometers. This test method is applicable up to 2×10^{-5} N/m² (2 atm) pressure and temperature range from – 53 to + 135°C (–65 to + 275° F).

1.1.1 For the measurement of the kinematic viscosity of other liquids, see Test Method D 445.

1.2 *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 precautionary statements, see 6.2, 6.3, and 6.4.

2. Referenced Documents

2.1 ASTM Standards:

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)²

D 2162 Test Method for Basic Calibration of Master Viscometers and Viscosity Oil Standards²

E 1 Specification for ASTM Thermometers³

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *viscosity*—the ratio between the applied shear stress and rate of shear.

3.1.1.1 *Discussion*—This ratio is called the coefficient of viscosity. The coefficient of viscosity (η) is thus a measure of the resistance to flow of the liquid. This is commonly called the viscosity of the liquid. The cgs unit of viscosity is the poise, P, which has the dimensions of dyne-seconds per square centimetre: the centipoise (0.01 poise) is frequently used. The SI unit of viscosity has the dimensions of newton second/metre², and is equivalent to 10 P.

3.1.2 *density*—the mass per unit volume of the liquid.

3.1.2.1 *Discussion*—The cgs unit of density (ρ) has the dimensions of grams per cubic centimetre. The SI unit of density has the dimensions of kilograms per cubic metre.

3.1.3 *kinematic viscosity*—The ratio of the viscosity to the density of the liquid.

3.1.3.1 *Discussion*—For gravity flow under a given hydrostatic head, the pressure head of a liquid is proportional to its density ρ . For any particular viscometer, the time of flow of a fixed volume of liquid is directly proportional to η/ρ . This ratio is the kinematic viscosity coefficient (ν). The cgs unit of kinematic viscosity is the stoke and has the dimensions of centimetre squared per second: the centistoke (0.01 St) is frequently used. The SI unit of kinematic viscosity has the dimensions of metre²/second, and is equivalent to 10⁴ St.

3.1.4 *vulnerable liquid*—a liquid which by reason of its volatility, instability or reactivity in the presence of air or any other specific gaseous medium may undergo physical or chemical changes that may affect its viscosity.

4. Summary of Test Method

4.1 The time is measured, in seconds, for a fixed volume of liquid to flow under gravity through the capillary of the viscometer under a reproducible driving head and at a closely controlled temperature. The kinematic viscosity is calculated from the measured flow time and the calibration constant of the viscometer.

5. Significance and Use

5.1 Kinematic viscosity is a physical property which is of importance in the design of systems in which flowing liquids are used or handled.

6. Apparatus

6.1 *Viscometer Thermostat*—Any transparent liquid or vapor bath of sufficient depth such that at no time during the measurement will any portion of the sample in the viscometer be less than 20 mm below the surface of the bath liquid or less than 20 mm above the bottom of the bath may be used. The temperature control must be such that for the range from 15 to 100°C (60 to 212°F) the temperature of the bath medium does not vary by more than 0.02°F (0.01°C) over the length of the viscometers, or between the position of each viscometer, or at the location of the thermometer. For temperatures outside this range, the variation must not exceed 0.05°F (0.03°C).

¹ This test method is under the jurisdiction of Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.11 on Engineering Science of High Performance Fluids and Solids.

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² Annual Book of ASTM Standards, Vol 05.01.

³ Annual Book of ASTM Standards, Vol 14.03.