



Designation: **D1200–10 (Reapproved 2018) D1200 – 23**

## Standard Test Method for Viscosity by Ford Viscosity Cup<sup>1</sup>

This standard is issued under the fixed designation D1200; 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 U.S. Department of Defense.*

### 1. Scope

1.1 This test method covers the determination of the viscosity of Newtonian or near-Newtonian paints, varnishes, lacquers, and related liquid materials with the Ford-type efflux viscosity cup. If the material is non-Newtonian, that is, shear-thinning or thixotropic, Test Method **D2196** should be used.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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:*<sup>2</sup>

**D2196** Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational Viscometer

**E1** Specification for ASTM Liquid-in-Glass Thermometers

### 3. Terminology

3.1 *Definitions:*

3.1.1 *Newtonian liquid, n*—a liquid in which the viscosity is independent of the shear stress or shear rate. If the ratio of shear stress to shear rate is not constant, the liquid is non-Newtonian.

3.1.2 *Near-Newtonian liquid, n*—a liquid in which the variation of viscosity with shear rate is small and the effect on viscosity of mechanical disturbances such as stirring is negligible.

### 4. Summary of Test Method

4.1 The Ford viscosity cup is filled level full with the liquid under test, and the time for the material to flow through one of the standard orifices is measured.

<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 & Paint Materials.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

5. Significance and Use

5.1 This test method is useful for the determination of package and application viscosities of a number of paints and other coatings and in the thinning of these materials, but is limited to Newtonian or near-Newtonian liquids.

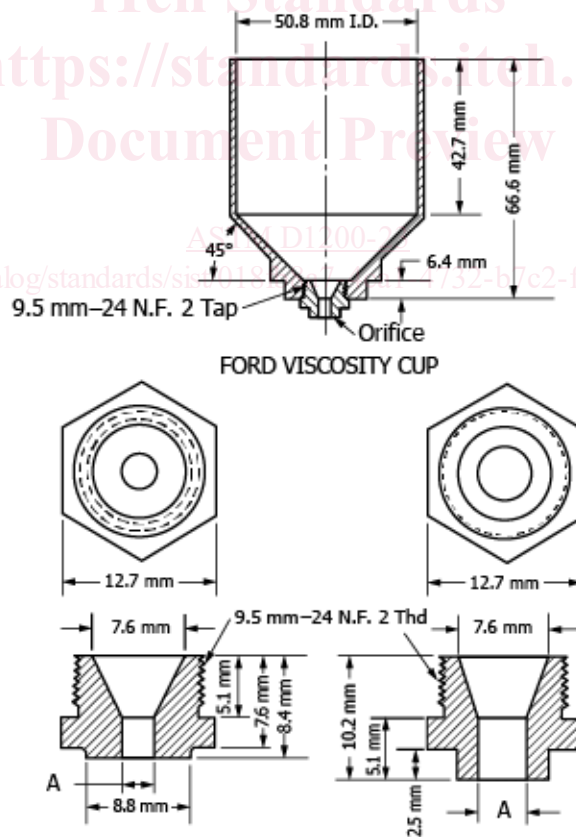
5.2 There are other types of apparatus for measuring viscosity in the laboratory that produce more accurate results.

6. Apparatus

6.1 *Ford Viscosity Cups*—Nos. 1, 2, 3, 4, and 5 Ford viscosity cups made of corrosion- and solvent-resistant materials assembled as complete units (Note 1), and conforming to the dimensional requirements shown in Fig. 1. The orifice dimensions are considered as a guide only as the combination of cup and orifice dimensions must permit conformance to the flow formula for each cup as listed in the Appendix.

NOTE 1—If the orifice is removed from the cup for any reason the cup should be recalibrated before use as described in the Appendix.

6.2 *Thermometer*—Saybolt Viscosity Thermometer conforming to the requirements for Thermometer 17C (19 to 27°C) or 17F (66 to 80°F) as prescribed in Specification E1. In addition, temperature measuring devices such as non-mercury liquid-in-glass thermometers, thermocouples, or platinum resistance thermometers that provide equivalent or better accuracy and precision, that cover the temperature range for thermometer 17C and 17F, may be used.



Orifice	A, mm	Orifice	A, mm
No. 1	1.90	No. 3	3.40
No. 2	2.53	No. 4	4.12
		No. 5	5.20

FIG. 1 Ford Viscosity Cup and Orifices

6.3 *Timing Device*—Any timing device may be used providing that the readings can be taken with a discrimination of 0.2 s or better.

**7. Test Specimen**

7.1 The specimen of the material to be tested shall be visibly homogeneous and free of any foreign material or air bubbles.

**8. Temperature of Testing**

8.1 All measurements with the Ford viscosity cups shall be made at ~~25°C (77°F)~~ 25 °C (77 °F) or a temperature agreed upon between producer and user. Temperature drift during the test should be kept to a minimum and should not exceed ~~±0.2°C (±0.4°F)~~; ±0.2 °C (±0.4 °F).

NOTE 2— It is impossible to predict the effect of temperature change on each material with which the apparatus may be used. This factor may be less than 1 % per degree Celsius for some liquids whereas others may be as high as 88 % to 10 % per degree Celsius.

**9. Calibration**

9.1 Cups should be calibrated in accordance with the procedure described in **Appendix X1**. The frequency of this calibration check depends upon the amount of use and the care that the individual cup receives. If the cup varies more than 10 % from standard, it should not be used.

**10. Conditioning**

10.1 Bring the material to a temperature a few degrees below that desired and then agitate vigorously for 10 min on a reciprocating shaker in a pint can two-thirds full. Allow to stand undisturbed for 10 min while adjusting further to the desired temperature. Make the viscosity determination at the end of the ~~10-min~~ 10 min period.

**11. Procedure**

11.1 Make viscosity determinations in a room free of drafts and rapid changes in temperature. For the highest degree of precision the room temperature should be between ~~22 and 28°C (72 and 82°F)~~; 22 °C and 28 °C (72 °F and 82 °F). Determinations should be made at a temperature above the dew point of the atmosphere surrounding the apparatus.

11.2 Choose the proper cup so that the time of efflux will be between ~~20~~ 20 s and 100 s (preferably between ~~30~~ 30 s and 100 s) for cup Nos. 3, 4, and 5; between ~~55~~ 55 s and 100 s for cup No. 1; and between ~~40~~ 40 s and 100 s for cup No. 2 (**Fig. 2**).

11.3 Level the instrument so that a cup may be filled level full without a meniscus or overflow at one side.

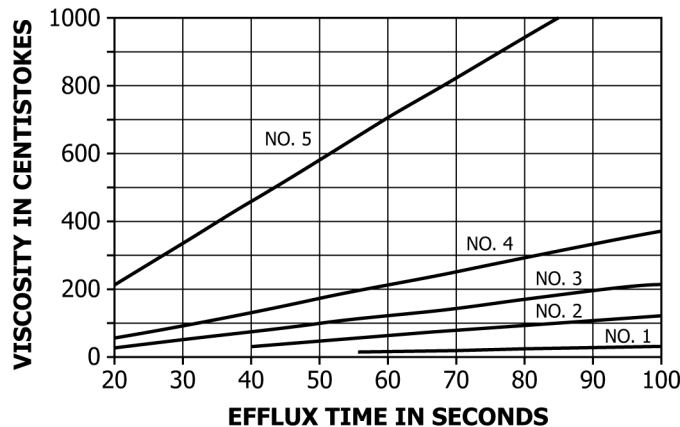


FIG. 2 Approximate Viscosity Curves for Ford Cups

11.4 Determine the time in seconds of efflux as follows: Close the orifice, for example, by holding a rubber stopper against it. Fill the cup with the prepared specimen. The preferred method is to overfill the cup and scrape off the excess with a straightedge. Pull the stopper away and simultaneously start the timing device. Measure the time until the first break in the stream.

11.5 Measure the temperature of the fluid in the efflux stream.

11.6 If the cup has been established to be nonstandard when calibrated as described in the Appendix, apply the percent difference to the measured seconds to get the corrected viscosity in Ford-cup seconds.

## **12. Care of Cup**

12.1 Following each determination, clean the cup by the use of a suitable solvent and a soft brush. Under no conditions should metal cleaning tools be brought into contact with the instrument. Particular care must be exercised in cleaning the orifice to avoid any film deposit or nicks on the inside walls.

## **13. Report**

13.1 Report the following information:

13.1.1 The efflux time to the nearest 0.2 s for the cup orifice combination (for example, viscosity 33.2 s with No. 4 Ford cup), the temperature of the test specimen (as in the efflux stream), and the immediate history of agitation and rest prior to the measurement.

## **14. Precision and Bias**

14.1 *Precision*—On the basis of an interlaboratory test of this test method in which eight cooperators from four different laboratories made measurements on five different paints, the within-laboratory coefficient of variation was found to be 2.8 % with 35 df and the between-laboratory coefficient of variation was found to be 6.9 % with 30 df. Based on these coefficients, the following criteria should be used for judging the acceptability of results at the 95 % confidence level:

14.1.1 *Repeatability*—Two results obtained by the same operator on different days should be considered suspect if they differ by more than 8 %.

14.1.2 *Reproducibility*—Two results obtained by operators in different laboratories should be considered suspect if they differ by more than 20 %.

14.2 *Bias*—Since there is no accepted reference material suitable for determining bias for the procedure in this test method, bias cannot be determined.

## **15. Keywords**

15.1 flow cup; Ford cup; viscometers—Ford