Designation: D562 – 10

StandardTest Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer[1]

This standard is issued under the fixed designation D562; 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 U.S. Department of Defense.

1. Scope

1.1 This test method covers the measurement of Krebs Unit (KU) viscosity to evaluate the consistency of paints and related coatings using the Stormer-type viscometer.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1 Specification for ASTM Liquid-in-Glass Thermometers

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *consistency, n*—load in grams to produce a rotational frequency of 200 r/min (Stormer Viscometer).

3.1.2 *Krebs units (KU), n*—values of a scale commonly used to express the consistency of paints generally applied by brush or roller.

3.1.2.1 *Discussion*—This scale is a function of the "load to produce 200-r/min" scale.

4. Summary of Test Method

4.1 The load required to produce a rotational frequency of 200 r/min for an offset paddle rotor immersed in a paint is determined.

5. Significance and Use

5.1 This test method provides values that are useful in specifying and controlling the consistency of paints, such as consumer or trade sales products.

METHOD A

6. Apparatus

6.1 *Viscometer,* Stormer, with the paddle-type rotor as illustrated in Fig. 1 and Fig. 2. The stroboscopic timer attachment in Fig. 1 can be removed and the instrument used without it but with a sacrifice of speed and accuracy. The stroboscopic timer gives the 200 r/min reading directly.

6.2 *Container,* 500-mL (1-pt), 85 mm (3⅜ in.) in diameter.

6.3 *Thermometer*—An ASTM Stormer Viscosity thermometer having a range from 20 to 70°C and conforming to the requirements for Thermometer 49C, 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 49C, may be used.

6.4 *Stopwatch,* or suitable timer measuring to 0.2 s.

6.5 *Weights,* a set covering the range from 5 to 1000 g.

7. Materials

7.1 Two standard oils, calibrated in absolute viscosity (poise), that are within the viscosity range of the coatings to be measured. These oils should differ in viscosity by at least 5 P.

NOTE 1—The normal range of the Stormer is covered by oils having viscosities of 4 P (70 KU), 10 P (85 KU), and 14 P (95 KU).

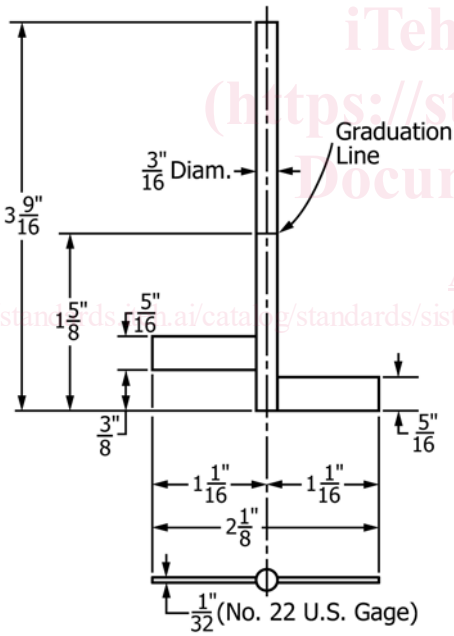
7.1.1 Suitable standards are silicone, hydrocarbon, linseed, and castor oils. Silicone and hydrocarbon oils calibrated in poises are commercially available. Uncalibrated linseed and castor oils may be calibrated with any apparatus that provides measurements of absolute viscosity.

[1] 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.

Current edition approved July 1, 2010. Published July 2010. Originally approved in 1947. Last previous edition approved in 2005 as D562 – 01 (2005). DOI: 10.1520/D0562-10.

[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 Stormer Viscometer with Paddle-Type Rotor and Stroboscopic Timer



NOTE 1—1 in. = 25.4 mm.

FIG. 2 Paddle-Type Rotor for Use With Stormer Viscometer

7.1.2 Assign a value of load to produce 200 r/min to each oil by converting its viscosity value in poises to load in grams by the following equation:[3]

$$L = (610O + 906.6\,D)/30$$

where:

O = viscosity of oil in poises and
D = density of oil.

8. Calibration[4]

8.1 Remove the rotor and weight carrier from the viscometer. Make sure the string is wound evenly on the drum and does not overlap itself.

8.2 Attach a 5-g weight onto the string and then release the brake. If the viscometer starts to run from this dead start and continues to run through several revolutions of the string drum, it is satisfactory for use. If it does not start unaided when the 5-g weight is applied, the instrument should be reconditioned.

8.3 Check the dimensions of the paddle-type rotor. They should be within 0.1 mm (±0.004 in.) of the dimensions shown in Fig. 2.

8.4 Select two standard oils having assigned values of load to produce 200 r/min within the range of the values expected for the coatings to be measured (see 7.1).

8.5 Adjust the temperature of the standard oils to 25 ± 0.2°C. The temperature of the Stormer apparatus should be the same. If the specified temperature cannot be obtained, record the temperature of the oil at the beginning and end of test to 0.2°C.

8.6 Determine the load in grams to produce 200 r/min with each of the two oils, using either Procedure A described in Section 9 or Procedure B described in Section 10.

8.6.1 If the oil temperature was not at 25 ± 0.2°C during the test, correct the measured load in grams for the deviation from that temperature.

NOTE 2—Load corrections for deviations of oil temperature from the specified temperature can be made by means of a previously established plot of load versus oil temperature (see Appendix X1).

8.7 If the measured load (corrected for any temperature deviation from standard) is within ±15 % of the assigned load values for the oils, the Stormer apparatus can be considered to be in satisfactory calibration.

9. Procedure A (Without Stroboscopic Attachment)

9.1 Thoroughly mix the sample and strain it into a 500-mL (1-pt) container to within 20 mm (¾ in.) of the top.

9.2 Bring the temperature of the specimen to 25 ± 0.2°C and maintain it at that temperature during the test. The temperature of the Stormer apparatus should be the same.

9.2.1 If the specified temperature cannot be obtained, record the temperature of the specimen at the beginning and end of test to 0.2°C.

9.3 When the temperature of the specimen has reached equilibrium, stir it vigorously, being careful to avoid entrapping air, and place the container immediately on the platform

[3] Geddes, J. A., and Dawson, D. H., "Calculation of Viscosity From Stormer Viscosity Data," *Industrial and Engineering Chemistry*, Vol 34, 1942, p. 163.

[4] Jackson, C. F., and Madson, W. H., "A Method for the Standardization of Krebs Modified Stormer Viscometers," *ASTM Bulletin*, No. 161, 1949.

of the viscometer so that the paddle-type rotor is immersed in the material to the mark on the shaft of the rotor.

9.4 Place weights on the hanger of the viscometer and determine a load that will produce 100 revolutions in the range of 25 to 35 s.

9.5 Using the information gained in 9.4, select two loads that will provide two different readings (time to give 100 revolutions) within the range of 27 to 33 s. Make these measurements from a running start, that is, permit the rotor to make at least 10 revolutions before starting the timing for 100 revolutions.

9.6 Repeat the measurements outlined in 9.5 until two readings for each load are obtained that agree within 0.5 s.

10. Procedure B (With Stroboscopic Timer)

10.1 Follow Procedure A (9.1 – 9.3) for the preparation of the specimen.

10.2 Connect the lamp circuit of the stroboscopic attachment to an electrical power source.

10.3 Place weights on the hanger of the viscometer and determine a load that will produce 100 revolutions in the range from 25 to 35 s.

10.4 Using the information gained in 10.3, select a weight (to the nearest 5 g) that will produce the 200-r/min pattern (Fig. 3) on the stroboscopic timer, that is, where the lines appear to be stationary.

10.4.1 Lines moving in the direction of paddle rotation indicate a speed greater than 200 r/min and therefore, weight should be removed from the hanger. Conversely, lines moving opposite to direction of paddle rotation indicate a speed less than 200 r/min and weight should be added.

NOTE 3—There are other patterns that appear at speeds other than 200 r/min (See Fig. 4). The pattern for 200 r/min should be determined before running any tests.

10.5 Repeat the determination in 10.4 until a consistent value of load is obtained (that is, to within 5 g).

11. Calculation

11.1 *Procedure A:*

11.1.1 Calculate the load to within 5 g, to produce 100 revolutions in 30 s by interpolating between the load weights recorded for the readings made between 27 and 33 s for 100 revolutions.

11.1.2 Correct the load determined for any deviation of the specimen temperature from the specified temperature (see Appendix X1).

11.1.3 If desired, determine from Table 1 the KU corresponding to the load to produce 100 revolutions in 30 s.

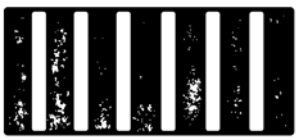


FIG. 3 Stroboscopic Lines Opening When Timer is Adjusted to Exactly 200 r/min

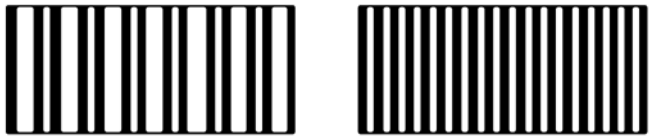


FIG. 4 Stroboscopic Lines Appearing as Multiples that May be Observed Before 200-r/min Reached

NOTE 4—Table 1 has been constructed so that it is not necessary to interpolate between loads to obtain the KU corresponding to the load to produce 100 revolutions in 30 s. The table provides KU values computed for a range of 27 to 33 s for 100 revolutions.

11.2 *Procedure B:*

11.2.1 If desired, determine from Table 2 the KU value corresponding to the load to produce 200 r/min.

12. Report

12.1 Report the following information:

12.1.1 The load in grams to produce 200 r/min (100 revolutions in 30 s),

12.1.2 The calculated KU,

12.1.3 The temperature of the specimen during the test and whether a correction was applied for any deviation from 25°C, and

12.1.4 Whether Procedure A or Procedure B was used.

13. Precision and Bias

13.1 *Precision*—On the basis of a study in which determinations were made on five paints by two operators at each of five laboratories on each of two different days; the within-laboratory coefficient of variation was found to be 3 % in load grams or 1.5 % in KU, and the between-laboratory coefficient of variation was found to be 10 % in load grams or 4 % in KU.

13.1.1 The following criteria should be used for judging the acceptability of results at the 95 % confidence level.

13.1.1.1 *Repeatability*—Two results each the mean of two measurements, obtained on the same material by the same operator at different times should be considered suspect if they differ by more than 1.7 % in KU.

13.1.1.2 *Reproducibility*—Two results, each the mean of two measurements on the same material, obtained by operators in different laboratories should be considered suspect if they differ by more than 5.1 % in KU.

METHOD B (Digital Display Stormer-Type Viscometer)

14. Apparatus

14.1 *Viscometer, Digital Display,* with the paddle-type rotor as illustrated in Fig. 1 and Fig. 5.

14.2 *Container,* 500 mL (1 pt), 85 mm (3 ⅜ in. in diameter.

14.3 *Thermometer,* ASTM Stormer viscosity thermometer having a range from 20 to 70°C and conforming to the requirements for Thermometer 49C as prescribed in Specification E1.

15. Materials

15.1 *Standard Oils,* two, calibrated in absolute viscosity that are within the viscosity range of the coatings to be measured. These oils should differ in viscosity by at least 25 KU.