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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Consistency of Paints Using the Stormer Viscometer[1]

This standard is issued under the fixed designation D 562; 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.

ε[1] NOTE—Editorial changes were made throughout in September 1997.

1. Scope

1.1 This test method covers the determination of the consistency of paints and related coatings using the Stormer viscometer.

1.2 The values stated in inch-pound 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:*

E 1 Specification for ASTM Thermometers[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *consistency*—load in grams to produce a rotational frequency of 200 r/min.

3.1.2 *Krebs units (KU)*—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 log 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.

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*, 1-pt (500-mL), 3⅜ in. (85 mm) 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 E 1.

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.

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]

$$L = (610\eta + 906.6\,\rho)/30$$

where:

η = viscosity of oil in poises and
ρ = 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

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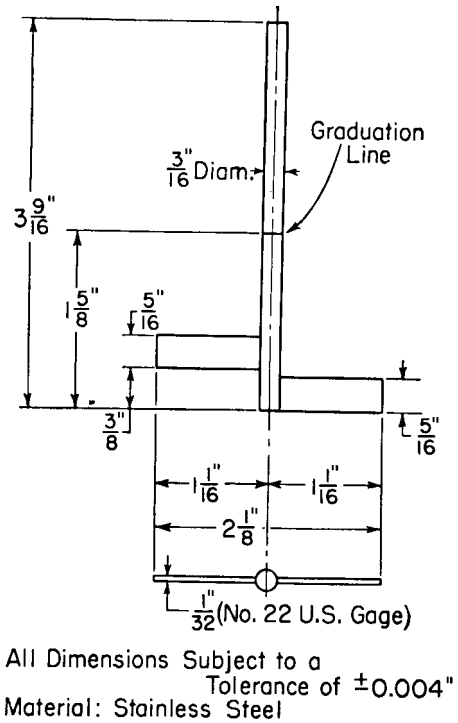
[2] *Annual Book of ASTM Standards*, Vol 14.03.

[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.

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

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 ±0.004 in. (0.1 mm) 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 1-pt (500-mL) container to within ¾ in. (20 mm) 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 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.

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:

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

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

13.1 On the basis of a study in which determinations were made on five paints (three solvent-reducible, two water-reducible) by two operators at each of six 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 Based on these coefficients, the following criteria should be used for judging the acceptability of results at the 95 % confidence level.

13.1.1.1 *Repeatability*—Two results obtained on the same material by the same operator at different times should be considered suspect if they differ by more than 9 % in load grams or 4.5 % in KU of their mean value.

13.1.1.2 *Reproducibility*—Two results, each the mean of four measurements on the same material, obtained by operators in different laboratories should be considered suspect if they differ by more than 30 % in load grams or 12 % in KU of their mean value.

14. Keywords

14.1 consistency; Krebs units (KU); Stormer viscometer; viscosity

TABLE 1 Krebs' Stormer Chart with Interpolations

Seconds for 100 Revolutions	Load, g																																					
	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	850	875	900	950	1000
	Krebs Units																																					
27	49	57	63	69	74	79	83	86	89	92	95	97	100	102	104	106	109	111	113	114	116	118	120	121	123	124	126	127	129	130	131	132	133	134	136	138
28	51	59	65	70	75	80	84	87	90	93	96	98	100	102	105	107	110	112	114	115	117	118	120	121	123	124	126	127	129	130	131	132	133	134	137	139
29	53	60	66	71	76	81	85	88	91	94	97	99	101	103	105	107	110	112	114	115	117	119	121	122	124	125	127	128	130	131	132	133	134	135	137	139
30	54	61	67	72	77	82	86	89	92	95	98	100	102	104	106	108	110	112	114	116	118	120	121	122	124	125	127	128	130	131	133	134	135	136	138	140
31	55	62	68	73	78	82	86	90	93	95	98	100	102	104	106	108	111	113	115	116	118	120	122	123	125	126	128	129	131	132	133	134	135	136	138	140
32	56	63	69	74	79	83	87	90	93	96	99	101	103	105	107	109	111	113	115	116	118	120	122	123	125	126	128	129	131	132	133	134	135	136	138	140
33	57	64	70	75	80	84	88	91	94	96	99	101	103	105	107	109	112	114	116	117	119	121	122	123	125	126	128	129	131	132	134	135	136	137	139	141

TABLE 2 Krebs Units Corresponding to Load Required to Produce 200-r/min Rotation
(For use with Stormer Viscometer equipped with Stroboscopic Timer)

Grams KU	Grams KU	Grams KU	Grams KU	Grams KU	Grams KU	Grams KU	Grams KU	Grams KU	Grams KU	Grams KU
	100 61	200 82	300 95	400 104	500 112	600 120	700 125	800 131	900 136	1000 140
	105 62	205 83								
	110 63	210 83	310 96	410 105	510 113	610 120	710 126	810 132	910 136	1010 140
	115 64	215 84								
	120 65	220 85	320 97	420 106	520 114	620 121	720 126	820 132	920 137	1020 140
	125 67	225 86								
	130 68	230 86	330 98	430 106	530 114	630 121	730 127	830 133	930 137	1030 140
	135 69	235 87								
	140 70	240 88	340 99	440 107	540 115	640 122	740 127	840 133	940 138	1040 140
	145 71	245 88								
	150 72	250 89	350 100	450 108	550 116	650 122	750 128	850 134	950 138	1050 141
	155 73	255 90								
	160 74	260 90	360 101	460 109	560 117	660 123	760 129	860 134	960 138	1060 141
	165 75	265 91								
70 53	170 76	270 91	370 102	470 110	570 118	670 123	770 129	870 135	970 139	1070 141
75 54	175 77	275 92								
80 55	180 78	280 93	380 102	480 110	580 118	680 124	780 130	880 135	980 139	1080 141
85 57	185 79	285 93								
90 58	190 80	290 94	390 103	490 111	590 119	690 124	790 131	890 136	990 140	1090 141
95 60	195 81	295 94								

APPENDIX

(Nonmandatory Information)

X1. EFFECT OF SPECIMEN TEMPERATURE ON STORMER CONSISTENCY

X1.1 For maximum accuracy in determining the effect of specimen temperature on Stormer consistency, measurements should be performed at three different specimen temperatures covering the range of interest. The change in load or KU per 1°C change can be determined from these results.

X1.2 It has been observed that the consistency of an oil is considerably more sensitive to temperature than is the consistency of a paint.

X1.3 Some typical effects of temperatures on the consistency of oils and paints are given below:

	Mean Value at 25°C		Change per 1°C Change	
	Load, g	KU value	Load, g	KU value
Hydrocarbon oil No. 1	149	72	14	2.5
Hydrocarbon oil No. 2	217	85	18	2.0
Hydrocarbon oil No. 3	286	93	11	1.5
Bodied linseed oil	195	81	8	1.0
Heavily bodied linseed oil	440	108	40	2.0
Water-based exterior paint	300	95	4	0.5
Water-based exterior paint	425	105	4	0.5