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Standard Test Method for Fineness of Grind of Printing Inks By the NPIRI Grindometer¹

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1. Scope

1.1 This test method describes the procedure for determining the fineness of grind of printing inks using a NPIRI grindometer. It evaluates the size of the largest particles in a finished dispersion but not average particle size or concentration of sizes.

1.2 This test method is applicable to any dispersion that is fine enough to fall within the 0–25 μm range of the specified grind gage. With a minor variation in procedure, it is applicable to both paste (nonvolatile) and liquid (volatile) inks.

NOTE 1—The 0–25 μm gage specified in this test method is similar in principle to the 0–100 μm Hegman gage described in Test Method D 1210. Sieve analysis for concentration of particles above 45 μm is covered in Test Method D 2067.

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:

D 1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems²

D 2067 Test Method for Coarse Particles in Printing Ink Dispersions³

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *fineness of grind*—a measure of the size and prevalence of oversize particles in a printing ink dispersion.

3.1.2 *scratch*—a depression at least 10 mm in length in the surface of a grind gage drawdown. A scratch develops when a particle (or agglomerate) is trapped between the blade and the

bottom of the path and is drawn along by the blade.

3.1.3 *speckle*—protuberance of particles above the surface of a grind gage drawdown. Speckles occur at gage depths greater than those at which scratches occur and are caused by oversize particles that are not hard enough or of the proper size to produce scratches.

4. Summary of Test Method

4.1 This test method utilizes a grind gage having two precision machined grooves each 1 in. (25.4 mm) wide and with a 0–1 mil (0–25 μm) taper. The test specimen is drawn down the paths slowly if a nonvolatile (paste) ink, briskly if a volatile (liquid) ink. The drawdowns are examined for the scale readings at which four and ten scratches appear and at which a preponderance of speckles disappear. The mean of readings from four paths constitutes a single determination.

5. Significance and Use

5.1 Oversize particles in a printing ink may damage a printing plate and adversely affect the appearance of printed ink films. Fineness of grind measurements are useful for deciding when to stop the dispersion process and for determining if the test material meets specifications as agreed upon between the supplier and the customer.

5.2 Speckle endpoints identify the size of the largest particles in a finished printing ink. They provide a better measure of overall dispersion quality than do scratch endpoints but, while their single-operator precision is better, their between-laboratory precision is far poorer.

5.3 Scratch endpoints indicate the size and relative number of the coarsest hard particles in a finished printing ink. They provide a measure of grittiness; the higher the 4-scratch endpoint, the grittier the ink; the smaller the difference between the 4- and 10-scratch endpoints, the larger the number of gritty particles in this range. Scratch endpoints may, however, miss gritty particles that ride in the bank ahead of the scraper; for this reason, they are not recommended for premixes or other dispersions containing a preponderance of gritty particles.

6. Apparatus

6.1 *NPIRI Grindometer*,⁵ consisting of a block of hardened

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² *Annual Book of ASTM Standards*, Vol 06.01.

³ *Annual Book of ASTM Standards*, Vol 06.02.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ The NPIRI Grindometer, developed by the National Printing Ink Research Institute, may be obtained from the Precision Gage and Tool Co., 375 Gargrave Rd., Dayton, OH 45449.

steel⁵ 25.4 mm in thickness,⁶ 89 mm in width and 240 mm in length. The top surface of the block is precision machined so as to contain two paths, each 25.4 mm in width, 165 mm in length, and tapered uniformly in depth lengthwise from 25.4 μm (1 mil) to zero depth. Depth markings are inscribed on the shoulders at each 2.5 μm (0.1 mil) change in taper. Scale inscriptions and the relationship among various scales are given in Table 1.

TABLE 1 Relation Among Grind Gage Scales

NOTE 1—gu—NPIRI grindometer unit.

NPIRI Scale, ^A gu	Depth ^B		Micrometer Scale, ^C μm	Hegman Scale ^D
	mils	μm		
0	0	0	0	8
1	0.1	2.5		
2	0.2	5	5	
3	0.3	7.5		
4	0.4	10	10	
5	0.5	12.5		7
6	0.6	15	15	
7	0.7	17.5		
8	0.8	20	20	
9	0.9	22.5		
10	1.0	25	25	6
15	1.5	38	50	5
20	2.0	50		4
25	2.5	63	75	3
30	3.0	75		2
35	3.5	88	100	1
40	4.0	100		0

^ANumbers above dashed lines are inscribed on the side or on the left shoulder of all standard NPIRI Grindometers. Numbers below dashed lines represent extended scales available on special gages.

^BNominal depth, not necessarily thickness of material deposited in paths of grind gages. Path fillage is about 80 % for a high viscosity (sheet-fed offset) ink; 60 % for a low viscosity (letterpress news) ink. Path fillage is also decreased by fast drawdowns.

^CNumbers above dashed lines are inscribed at every fifth calibration line on the right shoulder of newer NPIRI Grindometers.

^DPaint Scale in Test Method D 1210.

6.2 *Scraper*,⁷ a double edged blade conforming to Test Method D 1210.

6.3 *Ink Knife*, small.

7. Materials

7.1 *Rags or Tissues*, lint- and metal-free.

7.2 *Solvent*, naphtha or other as appropriate for the ink under test.

8. Care of Gage and Blade

8.1 *Cleanliness*—The scraper and the block must be perfectly clean prior to a drawdown. Any dirt or lint present may produce a scratch and give a false reading.

8.2 *Misuse*—The grindometer is a precision instrument and must be treated as such. Do not let any hard materials contact the gage surface or scraper in any manner that might result in

scarring or nicking. Avoid tapping or scratching with other metal. Use only soft metal-free cloths for cleanup.

8.3 *Normal Wear*—Under steady usage over an extended period of time, both scraper and block will wear but localized scraper wear is much more rapid than block wear. Periodically check the blade as follows:

8.3.1 *Method 1*—Place a small quantity of an ink across one end of a flat glass plate and make a drawdown. A uniform drawdown indicates that the particular scraper edge is in good condition. A streak of ink or a heavier film of ink at the places corresponding to the shoulders of the grindometer is evidence of blade damage or excessive wear. Repeat the drawdown with the other edge of the blade.

8.3.2 *Method 2* (from Test Method D 1210)—Face one edge of the scraper down across the bottom of the top surface of the grindometer or other smooth level surface. Place a strong light behind the scraper and examine the contact edge; any light coming through shows that the blade edge has been damaged and is not satisfactory for use. Wear and warpage can also be detected by rocking the blade back and forth. Repeat the procedure on the other edge of the blade.

8.4 *Rusting*—The grindometer is made of carbon steel and is subject to rusting. Apply a coating of grease or other rust-preventative and keep covered or encased when not in use.

NOTE 2—**Caution:** Do not use a gage or blade that exhibits damage or wear (see 8.2-8.4). Replace or return to the manufacturer for reconditioning.

9. Sampling

9.1 Approximately 2 to 3 mL of ink sample is sufficient to fill four paths of the grindometer. When taking samples either from a container or from a disperser, push aside the top layer and take the sample from below. This technique prevents skin or surface dust from being transferred to the gage.

9.2 If the sample is a liquid ink, hand stir the sample vigorously for 2 min, taking care that air bubbles are not whipped in.

10. Procedure

10.1 Place the gage on a flat, non-slippery surface so that the deep end of the grooves is farthest from the operator. Wipe clean immediately before the test. Be sure the gage surface is dry and free of lint and wipe marks.

10.2 Using the ink knife, transfer a small quantity of ink across the deep end of both grooves about 12.5 mm from the end of the block. Alternatively, different inks may be placed in the two respective paths.

10.3 Grasp the scraper in both hands and, holding in a vertical position, place it behind the ink of the gage. Apply adequate pressure to ensure positive contact of the blade with the surface of the gage and draw the ink down the length of the path. Ink remaining on the shoulders is evidence of insufficient pressure.

10.3.1 *Paste Inks*—Make the drawdown with a smooth steady stroke that takes 7 to 10 s to complete.

10.3.2 *Liquid Inks*—Make the drawdown with a brisk stroke that takes 1 to 2 s to complete. When testing fluid inks, it is essential to work quickly, as partial drying of the ink specimen or the ink film can influence test results.

⁶ Also available is a model 0.918 in. (23.3 mm) in thickness, which may serve as a type-high printing plate in a flat-bed press.

⁷ A second scraper should be procured for use while the first scraper is being reconditioned or is otherwise out of commission.