Designation: D7680 – 10 (Reapproved 2020)

Standard Practice for Preparing Prints of Paste Printing Inks by a Motor-Driven Printability Tester[1]

This standard is issued under the fixed designation D7680; 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.

1. Scope

1.1 This practice describes the procedure for preparing laboratory prints of paste printing inks using a motor-driven printability tester.

1.2 This practice covers printability testers of four different designs, referred to as Tester A, B, C, and D. These testers feature "push-button" control of printing speed and pressure and facilitate measurement of exact ink film thickness.

1.3 This practice is intended primarily for lithographic and letterpress inks that dry by oxidation or penetration. With appropriate drying or curing equipment, it is also applicable to other systems such as heat-set or energy curable.

1.4 This practice is applicable to the preparation of single-color solid-area prints by dry offset (also know as letterset) or by letterpress on any flat surface including paper, paperboard, plastic film, textiles, and metal.

1.5 The values stated in SI units are to be regarded as the standard. The only other unit of measurement used is fpm.

1.6 *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.*

1.7 *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:*[2]

D528 Test Method for Machine Direction of Paper and Paperboard (Withdrawn 2010)[3]

D1475 Test Method for Density of Liquid Coatings, Inks, and Related Products

D5039 Test Methods for Identification of Wire Side of Paper (Withdrawn 2009)[3]

D6073 Test Method for Relative Setting of Heatset Printing Inks

D7189 Test Method for Relative Mileage of News Ink on Newsprint

D7305 Test Method for Reflection Density of Printed Matter

2.2 *Other Standards:*[4]

ISO 187 Paper, board and pulps—Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples

ISO/DIS 2835–1 Graphic technology—Laboratory preparation test prints–Part 1: Paste inks

ISO 2846–1 Graphic technology—Specification for color and transparency of printing ink sets–Part 1: Inks for heat-set web offset lithographic printing

ISO 2846–2 Graphic technology—Specification for color and transparency of printing ink sets–Part 2: Inks for coldset offset lithographic printing

3. Terminology

3.1 *Symbols:*

fpm = feet per minute
(fpm ÷ 200 = m/s)

[1] This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.56 on Printing Inks.

Current edition approved June 1, 2020. Published July 2020. Originally approved in 2010. Last previous edition approved in 2019 as D7680 – 10 (2019). DOI: 10.1520/D7680-10R20.

[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

kgf = kilograms of force (kgf = 9.81 N)
kp = kilopascals of pressure (kp = 9.81 N)
m/s = meters per second (m/s × 200 = fpm)

3.2 *Symbols for Ink Film Thickness Calculations:*

A_S = printed area on the substrate, cm^2
D = density of the ink, g/cm^2
IFT_P = ink film thickness on the plate, µm
IFT_S = ink film thickness on the substrate, µm
µm = micrometers
W_A = weight of inked plate after printing, g
W_B = weight of inked plate before printing, g
W_P = weight of ink carried on the plate, g
W_{PO} = weight of the clean uninked plate, g
W_S = weight of ink on the substrate, g
W_{SA} = weight of ink on the substrate per unit area, g/m^2

4. Summary of Practice

4.1 The designated printing speed and pressure are preset on the print maker of the printability tester. A specified volume of ink is metered to the rollers of the inking system and distributed for 15 to 25 s for heatset and newsinks, 60 s or more for other inks. The printing disk is inked for the same period of time, installed on the print maker, and a print made on the designated substrate.

4.2 The prints are dried by appropriate means and measured for reflection density in order to verify that the target value has been achieved.

4.3 If required by the test, the inked disk is weighted before and after printing and the exact ink film thickness on the substrate is computed.

4.4 After a suitable lapse of time, the prints are subjected to the intended end use test(s). Results are compared to those of reference prints prepared in the identical fashion.

5. Significance and Use

5.1 It is generally recognized that the best method for evaluating printing properties of ink-substrate combinations is by actual printing. this practice provides a convenient method for preparing repeatable laboratory prints at realistic conditions of printing speed, printing pressure and ink film thickness.

5.2 This practice is useful for quality control, specification acceptance between producer and user, product development and research. Printed samples have found widespread applications for color matching, gloss-ink holdout and other appearance properties, permanency, abrasion, drying time and many other tests of interest to the printing ink, paper and allied industries.

6. Apparatus

6.1 *Printability Tester,* having the following components:

6.1.1 *Print Maker,* a motorized printing press that can be accommodated on a laboratory bench. As noted in Table 1 and Fig. 1, Testers A and C are flat-bed presses, Testers B and D are cylinder presses. Printing speed and pressure are set simply by turning appropriate dials except on Tester D, where they are computer-controlled.

6.1.2 *Inking System,* consisting of three rollers on which the ink is distributed. the bottom two rollers, at least one of which oscillates, are metal, while the top roller is of synthetic composition. A top roller of special composition is required for glycol-based and energy curable inks. As seen in Table 1 and Fig. 1a and Fig. 1c, Testers A and C contain built-in inking systems, while Fig. 2 illustrates the separate inking systems that are required for Testers B and D. Several inking systems are thermostated, an important feature for running heatset inks. All are engineered so as to provide multiple inking stations, each of which contains a device to support the disk during the inking process.

6.1.3 *Printing Disk,* to serve as the printing plate. As seen in Table 1, disks are 2 to 7 cm wide and ~ 20 cm in circumference. They are constructed of light-weight polished aluminum or rubber-covered aluminum or as a core with an aluminum or rubber covering. If rubber disks are used, it it recommended to procure two or more so as to minimize waiting time after cleanup.

NOTE 1—Disks of other sizes and surface coverings are available. For the purpose of this practice, the discussion is limited to those listed in Table 1.

6.1.4 *Carrier,* a "sled" on which flexible substrates are mounted for making prints on the two flat-bed testers, A and C. Carriers are constructed of stiff plastic with a rubber coating. Heavy cardboard and metal specimens may possibly be run without benefit of a carrier. When disks of different widths are being used with thin substrates, separate carriers are required so that indentation from the narrower disk does not mar the appearance of prints made subsequently with the wider disk.

6.2 *Ink Pipette,* consisting of a metal cylinder and plunger, 2 mL capacity, accurate to a minimum of 0.01 mL.

6.3 *Timer,* with clear 1 s divisions.

6.4 *Tongs or Rubber Gloves (optional),* for handling the disk when making gravimetric measurements.

6.5 *Analytical Balance (optional),* accurate to 0.0001 g with 150 g capacity to accommodate the printing disk described in 6.1.3.

6.6 *Accelerated Drying Equipment (optional),* such as a source of heat as in Test Method D6073, or energy-curing, as needed.

6.7 *Reflection Densitometer or Spectrodensitometer (optional),* conforming to Test Method D7305.

6.8 *Weight per Volume Cup (optional),* for measuring ink density in accordance with Test Method D1475.

7. Materials

7.1 If the test sample is a printing ink:

7.1.1 *Reference Ink,* of the same type, rheology and color as the test ink and having known printing properties.

7.1.2 *Standard Substrate,* as specified in the test method or as agreed upon between producer and user.

TABLE 1 Features of Printability Testers[A]

Component	Feature	Tester A	Tester B		Tester C[B]	Tester D
Print Maker	Printing geometry					
	Printing plate (disk)	Cylindrical	Cylindrical		Cylindrical	Cylindrical
	Impression surface	Flat	Cylindrical		Flat	Cylindrical
	Printing speed m/s	0.5-6, 10 or 12	0.2-5		0.3	0.5-3
	fpm	100-1200...or 2400	40-1000		60	100-600
	Printing pressure, N	100-1000 or 1600	50-1000		50-1000 or 200-800	30-1000
Inking Unit	Relationship to print maker	Built-in	Separate[C]	Separate[D]	Built-in	Separate
	Thermostatted	Yes	Yes	No	No	Yes
	Speed, m/s	0.7	0.2-1.2	0.3	0.3	0.16-1.16
	Number of inking stations	4	1, 2 or 4	2 × 2	1	4
	Surface area per station, cm^2	570	1537, 729 or 328	1187	700	579
Printing Disk	Dimensions, width × circumference					
	Aluminum, cm	4 × 20	3.2 or 5 × 20		2, 3.5 or 5 × 20	3.5 or 5 × 21
	Rubber, cm	4 × 20	3.2 or 5 × 20		2, 3.5, 5 or 7 × 20	3.5 or 5 × 21
	Surface area					
	Aluminum, cm^2	80	64 or 100		40, 70 or 100	74 or 105
	Rubber, cm^2	80	64 or 100		40, 70, 100 or 140	74 or 105
	Specimen size, cm	4.5 × 28	min. 5.5 × 28		5.5 or 7.5 × 28	5.5 × 28

[A] Features given in this table are restricted to single-color solid-area printing of paste inks at constant speed.
[B] Tester C comprises a range of different models. See the manufacturer's operating manual for the combination of conditions available on a particular model.
[C] this column refers to the high speed inking unit. The four station unit is depicted in Fig. 2A.
[D] This column refers to the slow speed inking unit depicted in Fig. 2B. It is no longer produced but is listed because of the many units already in the field.

Fig. 1A – Tester A

Fig. 1B – Tester B

Fig. 1C – Tester C

Fig. 1D – Tester D

FIG. 1 Printability Testers Covered in this Practice

Fig. 2A – High Speed Unit for Tester B

Fig. 2B – Slow Speed Unit for Tester B

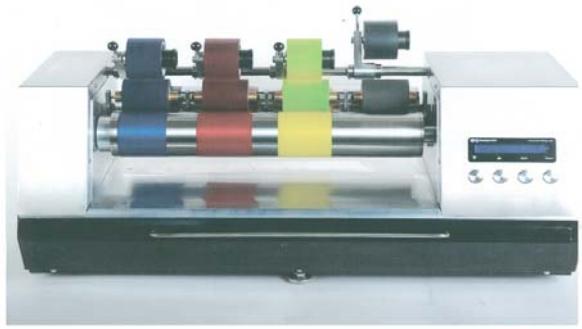

Fig. 2C – High Speed Unit for Tester D

FIG. 2 Inking Systems for Use with Testers B and D

7.2 If the test sample is a substrate:

7.2.1 *Reference Substrate,* of the same type as the test substrate and having known printing properties.

7.2.2 *Standard Ink,* as specified in the test method or as agreed upon between producer and user.

7.3 *Target Value(s),* for reflection density or gravimetric-based end result or both.

7.4 *Was up Solvent,* such as mineral spirits or other compatible with the printing ink system and the composition surfaces.

7.5 *Rags or Wipers,* clean, absorbent, lint-free.

7.6 *Plastic Sheet,* large enough to cover the instrument(s).

7.7 *Manufacturer's Operating Manual,* for the specific instrument model.

8. Hazards

8.1 **Warning—**Since solvents may be hazardous to the skin and eyes, wear rubber gloves and safety glasses during cleanup to avoid solvent contact with skin and eyes. In case of contact, wash skin and eyes for 15 min with water and call a physician. See supplier's Material Safety Data Sheets for further information on each solvent used.

8.2 Use local exhaust/ventilation during solvent cleanup.

8.3 Never let a vehicle or ink dry completely on the surface of the rollers or disks.

8.4 Be careful not to cause any damage during the cleaning process or by leaving the rollers and disks in contact when not in use.

9. Test Specimens

9.1 *Printing Ink:*

9.1.1 Printing ink samples should be press-ready. Because of the small surface areas of the inking stations shown in Table 1, and as can be surmised from the data in Table 2 (to be discussed in more detail in 12.4.2), very little ink, less than one mL, is usually sufficient to make prints of the required number of replicates.

9.1.2 Make sure the test specimen is free of bubbles, skin and other contamination. Prior to transferring to the ink pipette, it may be useful to place a small quantity on a clean glass plate and gently work up with a small spatula without aerating. Add ink to the pipette, using the spatula to force the ink in while slowly pulling back the ram. Wipe excess material off the tip of the pipette.

9.2 *Substrates:*

9.2.1 Cut the number of specimens required for both the test and reference prints. Three are recommended for most purposes; up to ten or more may be needed for special tests. Specimen sizes (4.5 to 7.5 by 28 cm) are listed at the end of Table 1.

NOTE 2—Multiple replicates are advisable because of the likelihood of nonuniformity in substrate properties. For example samples taken from a ream of commercially supplied paper can be assumed to be cut from as many as seven or more reels, each with slightly different properties. For this reason, studies of a research nature are best conducted with samples cut from a single reel.

9.2.2 Specimens should be free of wrinkles, creases, watermarks and other types of contamination and consistent as to side and direction. Mark each specimen with the side (felt or wire, which may be determined by Test Method D5039) and machine direction (in or across, as determined by Test Method D528). Handle specimens only by the edge, as touching the surface with bare fingers may cause localized changes in absorbency.

9.2.3 The side and direction used for making the prints depends on the anticipated end use. Unless otherwise specified, specimens for testing inks should be cut so that the longer direction is in the machine direction and felt side up. Papers are frequently tested on both sides and, if intended for sheet-fed printing, in both directions. Paperboard is tested only on the printing side and across the machine direction.

10. Conditioning

10.1 The transfer and absorbency properties of printing ink are highly sensitive to temperature, while those of paper and other celluloic substrates are sensitive to relative humidity. For those reasons, reproducible printing requires that the test and reference samples be conditioned. ISO 187 specifies 23 ± 1°C temperature and 50 ± 2 % relative humidity.

10.2 New composition rollers and rubber disks should be broken-in before use. For example, apply vehicle from the test ink system to the inking unit, run for about 15 min, wash up and repeat once or twice.

TABLE 2 Ink Volume[A,B] Required for a Film Thickness of One Micrometer on the Printing Disk

Tester A		Tester B		Tester C		Tester D	
Disk width cm	Ink volume mL	Disk width cm	Ink volume mL	Disk width cm	Ink volume mL	Disk width cm	Ink volume mL
4	0.065	3.2	0.039[C]	2.0	0.074	3.5	0.065
		5	0.043[C]	3.5	0.077	5	0.068
		3.2	0.125[D]	5	0.080	...	...
		5	0.129[D]	7	0.084	...	...
		3.2	0.160[E]	...	...	...	...
		5	0.164[E]	...	...	...	...

[A] The ink volume per micrometer is computed by adding the area in cm^2 of the inking station to that of the printing disk and multiplying the sum by 10^{-4}.
[B] One g/m^2 is equivalent to one micrometer for an ink having a density of 1.0 g/cm^3.
[C] Using the high speed inking unit having four inking stations.
[D] Using the slow speed inking unit.
[E] Using the high speed inking unit having one inking station.