Designation: D7163 – 11

Standard Test Method for Specular Gloss of Printed Matter[1]

This standard is issued under the fixed designation D7163; 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 test method covers the procedure for determining the specular gloss of printed matter.

1.2 This test is applicable to prints on any flat substrate including paper, paperboard, metallic foil and plastic produced by any printing process, either in the laboratory or on a production printing press.

1.3 *This standard does not purport to address all of the safety concerns, is any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D523 Test Method for Specular Gloss

D528 Test Method for Machine Direction of Paper and Paperboard (Withdrawn 2010)[3]

D1223 Test Method for Specular Gloss of Paper and Paperboard at 75° (Withdrawn 2010)[3]

D5039 Test Methods for Identification of Wire Side of Paper (Withdrawn 2009)[3]

D7305 Test Method for Reflection Density of Printed Matter

E284 Terminology of Appearance

2.2 *ISO Standard:*[4]

ISO 12647 Graphic Technology—Process Control for the Manufacture of Half-Tone Colour Separations, Proofs and Production Prints

3. Terminology

3.1 *Definitions:*

3.1.1 *gloss, n*—angular selectivity of reflectance, involving surface reflected light, responsible for the degree to which reflected highlights or images of objects may be seen as superimposed on a surface (Terminology E284); surface luster or shine.

3.1.2 *specular gloss, n*—gloss when the angle of viewing is the same as that of the lighting (Terminology E284).

4. Summary of Test Method

4.1 Printed samples are selected that are the same color/shade and uniformly produced at equal reflection density or at known ink film thickness.

4.2 The specimens are placed on a flat surface atop the designated backing material.

4.3 A calibrated glossmeter is positioned on the specimen in a consistent print direction. The most prevalent glossmeter angle for printed matter is 60 degrees (30 degrees from the plane of the specimen).

4.4 Depending on the size of the print, gloss measurements are made on three to five different positions on each specimen. The mean values from three specimens are averaged for reporting purposes.

5. Significance and Use

5.1 Specular gloss is a very important appearance parameter of printed matter. High gloss may be preferred for some purposes such as magazine covers, packaging and advertising, while lower gloss is preferred for minimizing glare, for example, in reading text.

5.2 This method provides a means of determining gloss of prints produced in the laboratory, or to monitor print gloss on a production printing press.

6. Apparatus

6.1 *Specular glossmeter,* preferably a multi-angle model having 20, 60, and 85° geometry; alternatively, a single-angle model having 60° or other geometry as agreed upon between producer and user. Table 1 lists recommended angles for various purposes.

6.2 *Reflection-densitometer,* for determining reflection density.

7. Materials

[1] This test method is under the jurisdiction of ASTM Committee D01 and is the direct responsibility of Subcommittee D01.56 on Printing Inks.

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[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.

***A Summary of Changes section appears at the end of this standard**

TABLE 1 Recommended Specular Glossmeter Angles

Glossmeter Angle[A] in degrees	Test Method	Purpose
60 (30)	D523	For inter comparing most specimens or for determining when 20° or 85° geometry is more appropriate. Recommended for printed matter in general.
20 (70)	D523	For higher gloss coatings and when comparing specimens that have 60° values higher than 70.
85 (05)	D523	Used for comparing specimens for sheen or near-grazing shininess. It is most frequently used when specimens have 60° gloss values lower than 10.
75 (15)	D1223 ISO 12647	Used by the paper industry for paper gloss; found to provide the best discrimination among unprinted bond papers. Recommended by ISO for paper and print
45 (45)		Ceramics

[A] The first number refers to the nominal angle of lighting and viewing as measured from a line perpendicular to the specimen surface. The number in parenthesis refers to the angles measured from the plane of the surface.

7.1 *Unprinted substrate (optional),* identical to that used for the printed sample.

7.2 *Backing material,* for use during instrumental measurements. The backing material must be consistent for all specimens especially when conducting comparative testing. By agreement between producer and user, the backing for paper substrates may be a standard matte black or unprinted paper in a sufficient amount to eliminate any influence from the surface of the measuring table. For clear substrates, a standard matte black or standard opaque white may be used as the backing material.

8. Test Samples

8.1 This test method does not cover preparation of printed samples. When preparing prints in the laboratory, special attention must be paid to the amount of ink applied. The amount of ink applied to the substrate can be monitored by the use of a reflection densitometer.

8.2 The specimen to be measured must be large enough to accommodate the aperture of the glossmeter. Prints must be thoroughly dry and free of wrinkles, folds, fingerprints and other such defects. (**Warning**—When handling test specimens, be careful not to contaminate the surface by touching with fingers.)

9. Preparation

9.1 Calibrate the glossmeter and the densitometer according to the manufacturers' instructions.

NOTE 1—The calibration standard for gloss is a highly polished black glass with a refractive index of 1.567 and an assigned specular gloss value of 100 for each geometry. Keep the standard clean and away from any dirt or abrasive material that might mar its surface. See also Test Method D523.

9.2 If the glossmeter geometry has not been specified, determine the appropriate angle for the material being tested. As noted in Table 1, first measure the gloss with the 60º geometry; retain this geometry if the gloss reading is between 10 and 70 units. If higher than 70 units, use the 20º geometry. If lower than 10 units, use the 85º geometry.

9.3 If the substrate is paper, determine its machine direction using Test Method D528 and the side (felt or wire) by Test Method D5039. For ease of identification, the direction can be marked with an arrow and the side labeled felt or wire. Alternatively, the sides can be labeled top and bottom.

NOTE 2—The importance of side and direction, especially in the case of uncoated stock, is that they influence the pattern of surface irregularities and, in turn, measured gloss values.

9.4 If the prints are from routine laboratory printing or from a production press, measure the reflection density and select at least three prints that are within ±0.05 units.

9.5 If the prints are for research purposes, ink film thickness can be determined by weighing the printing disk before and after printing.

9.6 Optionally, the gloss of the unprinted substrate is measured before printing in the laboratory; if it is a commercial print, the non-image area can be utilized.

NOTE 3—The non-image area of specimens from a commercial press can be affected by the printing process due to moisture (from fountain solution), drying processes, residual ink, etc., which can alter the original paper gloss.

10. Procedure

10.1 Position the specimen atop the designated backing material (7.2) on a flat uniform surface.

10.2 Place the glossmeter on the specimen in a consistent direction. Take readings at three to five different positions on the print. Record readings in gloss units between 0 and 100 and compute the mean value.

10.3 If available, repeat 10.1 and 10.2 on two additional specimens such that the same locations on each specimen are measured. Compute the overall mean value.

10.4 (Optional) Measure the gloss of the unprinted substrate in the same fashion as 10.1-10.3.

10.5 (Optional) Compute the delta gloss, which is the gloss of the print minus the gloss of the unprinted substrate.

11. Report

11.1 The report should contain all the pertinent data listed below:

11.1.1 Overall mean value for specular gloss value.

11.1.2 Description of the printed sample (production or laboratory), the color, print area (solid or halftone) and the type of substrate.

11.1.3 Reflection density or ink film thickness, or both.

11.1.4 Angle of measurement.

11.1.5 Paper direction (machine or cross machine) or side (wire or top), or both, used for measurement, if known.

11.1.6 Backing material — type and quantity.

11.1.7 Delta gloss (optional).

12. Precision and Bias

12.1 *Precision*—An interlaboratory study of this test method was conducted in which one operator in each of the five laboratories made 60 degree specular gloss measurements in quadruplicate on four prints ranging in gloss from 13 to 94 units. The within laboratory pooled standard deviation was 0.6 gloss units and the between laboratory pooled standard was 2.8 gloss units. Based on these standard deviations, the following criteria should be used for judging the acceptability of the results at the 95 % confidence level:

12.1.1 *Repeatability*—Two results, each the mean of four measurements by one operator should be considered suspect if they differ by more than 1.7 gloss units.

12.1.2 *Reproducibility*—Two results, each the mean of four results obtained by operators in different laboratories should be considered suspect if they differ by more than 7.8 gloss units.

12.2 *Bias*—Specular gloss is based on the change in refractive index as light passes from the air onto the surface of a smooth, dielectric material, such as a high-gloss ink as described by Fresnel's law. Standards of specular gloss have been shown to have a combined standard uncertainty of ±1 gloss unit. While there were no accepted reference values for the materials used in inter-comparison reported in this section, it can be assumed that an upper limit on the bias will be equivalent to the reported combined uncertainty of ±1 gloss unit.

13. Keywords

13.1 paper; print gloss; printing ink; reflection density; specular gloss; substrate

SUMMARY OF CHANGES

Committee D01 has identified the location of selected changes to this standard since the last issue (D7163 - 05 (2010)) that may impact the use of this standard. (Approved June 1, 2011.)

(1) Added Referenced Documents Test Method D7305 and ISO 12647 to Section 2 and ISO 12647 to Table 1.
(2) Changed all references to "optical print density" to "refection density" in 4.1, 6.2, 8.1, 9.4, 11.1.3 and 13.1.
(3) Added more detail to the requirements for backing material in 7.2.
(4) Clarified the use of a reflection densitometer to monitor ink application in 8.1.
(5) Changed the description of "print transfer roll" to "printing disk" in 9.5.
(6) Added backing material to the Report requirements. in 11.1.16.
(7) Added a Summary of Changes.