



Standard Test Method for Opacity of Paper (15°/Diffuse Illuminant A, 89 % Reflectance Backing and Paper Backing)¹

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1. Scope

1.1 This test method covers the determination of the opacity of paper.

1.2 Two different types of “white” backing are specified, leading to two different opacity values, in accordance with Section 3.

1.3 This test method employs 15° diffuse geometry, Illuminant A/2° and 89 % reflectance backing or paper backing. For the measurement of opacity with d/0° geometry, Illuminant C/2° and paper backing (see TAPPI T 519).

1.4 *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 585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, or Related Products²

D 646 Test Method for Grammage of Paper and Paperboard (Weight per Unit Area)²

D 685 Practice for Conditioning Paper and Paper Products for Testing²

D 1968 Terminology Relating to Paper and Paper Products²

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process³

E 308 Practice for Computing the Colors of Objects by Using the CIE System⁴

2.2 TAPPI Standards:

TAPPI Technical Information Sheet 0804-03—Interrelation of reflectance, R_0 ; reflectivity, R_∞ ; TAPPI opacity, $C_{0.89}$ scattering, s ; and absorption, k^5

TAPPI Technical Information Sheet 0804-06—Photometric linearity of optical properties instruments⁵

¹ This test method is under the jurisdiction of ASTM Committee D-6 on Paper and Paper Products and is the direct responsibility of Subcommittee D06.92 on Test Methods.

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² Annual Book of ASTM Standards, Vol 15.09.

³ Annual Book of ASTM Standards, Vol 14.02.

⁴ Annual Book of ASTM Standards, Vol 06.01.

⁵ Available from the Technical Association of the Pulp and Paper Industry, Technology Park/Atlanta, P.O. Box 105113, Atlanta, GA 30348.

T 519 Diffuse opacity of paper (d/0° paper backing)⁵

T 1206 Precision statement for test methods⁵

3. Terminology

3.1 Definitions: Definitions:

3.1.1 Definitions shall be in accordance with Terminology D 1968 and the *Dictionary of Paper*.⁵

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *opacity (89 % reflectance backing)*, $C_{0.89}$ —one hundred times the ratio of the diffuse reflectance, R_0 , of a specimen backed by a black body of 0.5 % reflectance or less to the diffuse reflectance, $R_{0.89}$, of the same specimen backed with a white body having an absolute reflectance of 0.89; thus, $C_{0.89} = 100 R_0 / R_{0.89}$. Accordingly, the contrast ratio is 100 % for perfectly opaque paper and is only a few percent for perfectly transparent sheets. (Sometimes called contrast ratio.)

4. Summary of Test Method

4.1 The reflectance of paper when combined with a white backing is higher than that of paper when combined with a black backing because in the former case, light transmitted through the imperfectly opaque sheet is largely reflected by the white backing, and a portion of the light thus reflected is transmitted through the paper a second time. Two types of “white” backing are used, leading to the two measurements of opacity defined in Section 3.

5. Significance and Use

5.1 Opacity is a fundamental optical property of paper as a whole, yet the measurement of opacity is empirical. The opacity of the sheet is influenced by the amount and kind of filler, degree of bleaching of the fibers, coating, and the like. The utility of bond, writing, and book papers may be enhanced by a high opacity.

5.2 The determination of opacity is of vital importance to both the manufacturer and the consumer. When white pigment is added to a sheet, it scatters more light, and thus increases opacity; however, it is also possible to increase opacity of a sheet by adding dark pigment or dye which absorbs light. This being so, it is of value to the manufacturer, in meeting an opacity specification, to be able to predict whether a sheet which does not have desired opacity can be brought up to specification by raising or, alternatively, lowering the reflectivity within permissible limits. To the consumer, opacity