



# Standard Test Methods for U.S. Postal Service Optical Measurements for Small Areas<sup>1</sup>

This standard is issued under the fixed designation D 5626; 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 approval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 These test methods deal with the measurement of optical properties important to automatic equipment used by the United States Postal Service, such as optical character recognition (OCR) readers and barcode readers. These test methods can be used to examine finished mailpieces bearing address information, as well as the unconverted materials intended to be subsequently used in mailpiece construction. These test methods are limited to the use of a single instrument, the U.S. Postal Service Envelope Reflectance Meter Model 2 (ERM-2),<sup>2</sup> designed for use with mailpieces and materials intended for mailpiece construction such as paper and paper-like synthetics and inks.

1.2 These test methods cover examination of small areas, measuring 0.152 by 0.254 mm (0.006 by 0.010 in.). This enables measurement of the reflectance characteristics of regions as small as the inked portion of a single printed character or a single bar in a barcode pattern.

1.3 These test methods deal with the measurement of four different optical properties important to automatic mail handling, as follows:

1.3.1 *Background Reflectance* (see 11.1)—These test methods cover the determination of the relative reflectance factor of small areas of a specimen that do not contain printing or apparent show-through of printing, and so are representative of the base material.

1.3.2 *Print Reflectance Difference and Print Contrast Ratio* (see 11.2)—These test methods characterize the difference in reflectance between the envelope material and the characters printed upon the envelope with ink.

1.3.3 *Print Show Through* (see 11.3)—These test methods characterize the difference in reflectance between the envelope material backed with an unprinted insert and the envelope material examined in a region where it covers a printed character on the insert or a character printed on the back side of the envelope material itself.

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 Products<sup>3</sup>
- E 284 Terminology of Appearance<sup>4</sup>
- E 1347 Test Method for Color and Color Difference Measurements by Tristimulus (Filter) Colorimetry<sup>4</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 The definitions contained in Terminology E 284 are applicable to these test methods.

3.1.2 Relative reflectance factor is defined in Test Method E 1347.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *background reflectance (BR), n*—the relative directional reflectance factor, expressed as a percent, obtained from a portion of the material under any test which has not been printed on either side and does not show printing from any backing material. Also referred to as paper reflectance.

3.2.2 *bar code reader (BCR), n*—as used by the United States Postal Service (USPS) in the automatic processing of mail.

3.2.3 *bar code sorter (BCS), n*—as used by the USPS in the automatic processing of mail.

3.2.4 *directional, adj*—descriptor for the optical geometry employed in the ERM-2 for which illumination is from two sources disposed at +50° and –50° from the vertical, and detection is at 0° from the vertical.

3.2.5 *Envelope Reflectance Meter, Model 2 (ERM-2), n*—manufactured by Chamberlain MRC.

NOTE 1—This instrument renders ERM-1 obsolete. The ERM-1 cannot be used to implement these test methods.

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee D06 on Paper and Paper Products and are the direct responsibility of Subcommittee D06.92 on Test Methods.

Current edition approved Oct. 15, 1994. Published December 1994.

<sup>2</sup> The ERM-2 is available from Chamberlain MRC, Division of Duchossois Industries, Inc., 336 Clubhouse Road, Hunt Valley, MD 21031-1325.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 15.09.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 06.01.

3.2.6 *optical character reader (OCR), n*—as used by the USPS in the automated processing of mail.

3.2.7 *print contrast ratio (PCR), n*—the ratio between print reflectance difference and background reflectance, defined as  $PCR = (BR - PR)/BR = PRD/BR$ .

3.2.8 *print reflectance (PR), n*—the relative directional reflectance factor, expressed as a percent, obtained from a portion of the material under test which has been printed; also referred to as ink reflectance.

3.2.9 *print reflectance difference (PRD), n*—the difference between background reflectance and print reflectance, defined as  $PRD = BR - PR$ .

3.2.10 *print show-through (PS), n*—the print contrast ratio associated with printed or contrasting material on the reverse side of the material under test or on a backing that shows through the material under test, defined as  $PS = (BR - SR)/BR$ .

3.2.11 *show-through reflectance (SR), n*—the relative directional reflectance factor, expressed as a percent, obtained from a portion of the material under test which shows printing from a backing material or a pattern printed on the opposite side.

**4. Summary of Test Methods**

4.1 Measurements of background reflectance, show-through, print reflectance difference, and print contrast ratio are used for mailpieces or materials to be used for mailpieces that will be read on United States Postal Service OCRs and BCRs/BCSs. Test results can be compared with the requirements of the USPS as listed in the Domestic Mail Manual (DMM)<sup>5</sup> to let paper manufacturers, printers, envelope manufacturers, form manufacturers, ink manufacturers, mailers, etc. have a way to determine whether their materials or products, or both, will function correctly in the postal automation system.

**5. Significance and Use**

5.1 These test methods are to be used to determine the suitability of mailpieces for processing on automation equipment such as optical character readers and bar code readers and sorters. These test methods can be used to test finished mailpieces bearing address information or POSTNET bar codes, or both, as well as materials to be used in mailpiece construction.

5.2 The test methods to be described will measure parameters relevant to machine readability such as the reflectance of the mailpiece background and printed areas. Specifically these parameters will be measured to determine acceptability in accordance with postal requirements for mailpieces submitted for automation discounts in accordance with the Domestic Mail Manual (DMM).

**6. Apparatus**

6.1 The ERM-2 is a microprocessor-based instrument used to measure the reflectance of printed characters or bar codes, or both, as well as the envelope or envelope-representative surface on which they appear.

6.1.1 The ERM-2 measures a printed specimen of unknown reflectance in two different spectral bands, and in both a printed and unprinted location. It makes an indirect comparison against its attached reflectance standards, and it automatically calculates and displays the paper reflectance (BR), ink reflectance (PR), print contrast ratio (PCR), and print reflectance difference (PRD) of the printed specimen. If the specimen is unprinted, the instrument outputs can be related to paper reflectance (BR) and print show-through (PS) of the specimen.

6.2 The ERM-2 optical system is comprised of eight basic components (Fig. 1). These are, in order of light-path sequence, the illuminator, measurement window, objective lens, mirror, view plate, beam splitter, red and green filters, and photodetectors.

6.2.1 The illuminator focuses light on the specimen surface under test. The level of illumination is sufficient to project a visible image on the view plate and to activate the photovoltaic detectors behind it. It consists of two lamps focused directly beneath an objective lens. The lamps are positioned in the plane of incidence so the light is incident upon the specimen surface at 50° from the vertical. This eliminates specular reflection and leaves diffused light (0°) to be captured by the objective lens. The rated color temperature of the lamps is 2490 K.

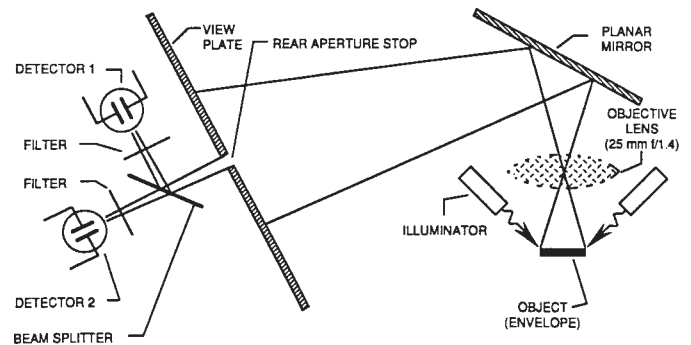
6.2.2 The measurement window defines the focal plane of the optical system. The specimen is held flat against the measurement window by a spring-loaded base.

6.2.3 The objective lens (24.02 mm, f/1.4 variable focus) collects diffusely reflected light from the specimen surface and images it on the view plate. A magnification of 10× is achieved by placing the specimen against the measurement window when the view plate is 290 mm (11.44 in.) from the lens.

6.2.4 A planar mirror, mounted approximately 60 mm (2.4 in.) from the objective lens, reflects light from the objective lens onto the view plate.

6.2.5 The view plate is a reflective porcelain surface for viewing the magnified image of the envelope (Fig. 2). It also serves as the information display for the specimen's reflectance characteristics.

6.2.5.1 The view plate contains a rectangular reticule pattern near its center to highlight the area of the specimen surface under test. (The shape of this reticule pattern is designed to gage the dimensions of POSTNET bar codes, an application of the ERM-2 beyond the scope of these test methods.) Centered in the pattern is a 1.5 by 2.5-mm (0.06 by 0.10-in.) aperture



**FIG. 1 Optical Schematic of the ERM-2**

<sup>5</sup> United States Postal Service Domestic Mail Manual (DMM), available from the Government Printing Office, Washington, DC 20402.