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Standard Test Method for Comparing the Brightness of Fluorescent Penetrants[1]

This standard is issued under the fixed designation E1135; 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.

ε[1] NOTE—Added Note 1 and Note 3 in July 2008.

1. Scope

1.1 This test method describes the techniques for comparing the brightness of the penetrants used in the fluorescent dye penetrant process. This comparison is performed under controlled conditions which eliminate most of the variables present in actual penetrant examination. Thus, the brightness factor is isolated and is measured independently of the other factors which affect the performance of a penetrant system.

1.2 The brightness of a penetrant indication is dependent on the developer with which it is used. This test method however, measures the brightness of a penetrant on a convenient filter paper substrate which serves as a substitute for the developer.

1.3 The brightness measurement obtained is color-corrected to approximate the color response of the average human eye. Since most examination is done by human eyes, this number has more practical value than a measurement in units of energy emitted. Also, the comparisons are expressed as a percentage of some chosen standard penetrant because no absolute system of measurement exists at this time.

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:*[2]

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions of terms applicable to this test method may be found in Terminology E1316.

4. Summary of Test Method

4.1 Simulated indications are prepared by impregnating filter paper with a specified quantity of the penetrant under test. The samples and similarly prepared standards are then measured in a fluorometer equipped to excite the penetrant with near ultraviolet (black) light and respond to color approximately as does the human eye under the conditions encountered during a normal examination. The fluorometer must be equipped with a special sample holder to accept the samples employed.

4.2 The sample preparation is not indicative of the total system performance but is convenient as a lot acceptance test. A known amount of penetrant is diluted with a specified amount of a volatile solvent, pieces of filter paper are soaked in the mixture, the paper is dried under specified conditions at room temperature, placed in the sample holder, and measured with the fluorometer.

5. Significance and Use

5.1 The penetrant is one of the major components of the fluorescent penetrant process, and very influential in the degree of performance attained by a given system or group of materials. The penetrant must enter the discontinuity, be removed from the part surface but not from the discontinuity, be brought out of the discontinuity by the developer, and finally viewed and detected by the inspector. If all processing parameters are optimized for the parts being examined and the examination materials in use, the intrinsic brightness of the penetrant becomes the factor which governs the sensitivity of the system.

5.2 Because the eye responds logarithmically rather than linearly to changes of brightness, differences in brightness must be fairly large to be significant. Differences of 25 % are obvious, 12 % noticeable, and 6 % detectable by the eye. Experts may sometimes detect 3 % differences, but these are not usually significant to the average observer.

5.3 The significance of the results also depends on the deviation between readings on the same material sample. Different samples, even when prepared out of the same initial

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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.

quantity of penetrant will not exactly reproduce readings. These differences occur because of paper differences and penetrant migration on the paper samples.

5.4 To determine the confidence limits for the test results, it is necessary to perform certain statistical calculations. The confidence limits are determined by the equation:

$$CL = \bar{X} \pm ts/\sqrt{n} \quad (1)$$

where:

CL = the limits within which we can be confident the value lies,
$\bar{X}$ = the average of all readings,
t = "student's t" (values of which are given by statistical manuals),
n = the number of readings used,
s = the standard deviation determined by the equation:

$$S = \sqrt{\frac{\Sigma (X - \bar{X})^2}{n - 1}} \quad (2)$$

where:

X = the individual readings.

In this use, the 95 % confidence level (the value will lie within the limits 95 % of the time) is sufficient. At this level, t for 4 samples is 3.182.

5.4.1 If the confidence limits of two material samples overlap, the materials must be considered equal even though the measured average values are different.

6. Apparatus

6.1 *Filter Paper*, Whatman #4, a fast, open structured paper.

6.2 *Pipets*, 1-mL capacity.

6.3 *Volumetric Flasks*, with stopper, 25-mL.

6.4 *Paper Drying Holders*—"Crocodile" type battery clips 2 in. long with ½ in. opening have been found satisfactory. Set up holders to allow drying inside desiccator.

6.5 *Methylene Chloride or Acetone*, technical grade.

6.6 *Desiccator*, 250-mm diameter or larger.

6.7 *Silica Gel*, for use as desiccant.

7. Sample Preparation

FIG. 1 Turner Fluorometer, with Door Open Showing Sample Holder and Filters in Place

7.1 *Sample Preparation*—Normally a set of samples of a standard material must be prepared along with any test samples.

7.1.1 Pipet 1.0 mL of chosen penetrant into a 25-mL stoppered volumetric flask.

7.1.2 Fill flask to line with methylene chloride, stopper and mix. (If penetrant is not soluble in methylene chloride, use acetone.)

7.1.3 Pour 10 to 20 mL of mixture into a 50-mL beaker.

7.1.4 Using forceps, dip 4 papers (cut to size for sample holder in use), one at a time, into beaker, withdraw by drawing across the lip of the beaker to remove excess liquid, and clip into paper drying holder. Holder shall cover as small an area of paper as possible.

7.1.5 Hang papers in a vertical position inside desiccator until dry. This will require approximately 5 min at room temperature.

8. Procedure for Turner Fluorometer

NOTE 1—This instrument is no longer in production and can not be purchased from Turner.

NOTE 2—All available apparatus may not be suitable for these applications.

8.1 *Sample Holder*, designed for the fluorometer in use.

8.1.1 The sample holder for the Turner Fluorometers (see Fig. 1) is detailed in Fig. 2. It is designed for use in the standard