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**Standard Recommended Practice for
SPECIFYING LIMITS FOR FADING AND
DISCOLORATION OF NONMETALLIC MATERIALS¹**

This Standard is issued under the fixed designation G 45; 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.

1. Scope

1.1 This recommended practice establishes a procedure and limits for the following:

1.1.1 Defining fading or discoloration performance criteria for inclusion in performance specifications.

1.1.2 Demonstrating substantial compliance with such performance. Specification for the product being offered.

1.2 This recommended practice is applicable to like or unlike, opaque, nonmetallic materials tested under identical procedures without regard to the causes of, or the means by which fading and discoloration are brought about.

1.3 This recommended practice does not specify the materials to be evaluated, the conditions to which the materials are exposed, nor the test procedures to be used. Sample preparation, test conditions, and evaluation of other performance characteristics are covered in the ASTM methods or specifications designated, or in the nonstandard tests detailed in the performance specification.

2. Applicable Documents

2.1 ASTM Standards:

D 2244 Instrumental Evaluation of Color Differences of Opaque Materials²

D 2616 Evaluating Change in Color with a Gray Scale³

2.2 ISO Recommendations:

R 105/I Tests for Color Fastness of Textiles, First Series⁴

3. Summary

3.1 This recommended practice establishes three levels of fading or discoloration: End Point Level I, End Point Level II, and End Point Level III. It permits these end points to be determined by one of three noninterchangeable alternative methods, one instrumental, and two visual.

3.2 This recommended practice indicates how to specify the desired level.

4. Significance

4.1 This recommended practice provides an alternative technique for reporting color change whereby the exposure measure, usually time, becomes the dependent variable and the amount of change, expressed quantitatively, becomes an independent variable.

4.2 It is particularly applicable for comparing changes undergone by dissimilar materials during natural and artificial weathering, fade testing, and other procedures which bring about changes in color.

4.3 Selection of Method I (Instrumental), Method II (ISO Gray Scale), or Method III (Munsell Gray Scale) shall be at the discretion of the testing facility unless the govern-

¹ This recommended practice is under the jurisdiction of ASTM Committee G-3 on Deterioration of Nonmetallic Materials, and is the direct responsibility of Subcommittee G03.03 on Simulated and Controlled Environmental Tests. Current edition approved Oct. 31, 1975. Published December 1975.

² Annual Book of ASTM Standards, Parts 27 and 46.

³ Annual Book of ASTM Standards, Part 27.

⁴ Available from American National Standards Institute, 1430 Broadway, New York, N.Y. 10018. Scales with instructions for use may be obtained from the Secretary, American Association of Textile Chemists and Colorists, Box 12215, Research Triangle Park, N.C. 27709.

ing performance specification designates only one acceptable method of evaluation. Method I is to be preferred because it does not require, directly or by inference, personnel assigned to evaluation who are known to be free of color vision anomalies or to possess a given level of color aptitude.

5. Definitions

5.1 *performance characteristic*—the response of a given material or product to a specified test method, usually stated in quantitative terms.

5.2 *performance criterion*—the minimum acceptable performance characteristic for a given property as stated in quantitative terms in a performance specification.

NOTE 1—*Performance characteristics* are constants associated with specific specimens which may be assumed to be representative of a given brand or class of product, while *performance criteria* are variables with the numerical values selected by the consumer or his agent, based upon the needs of the unique situation for which the individual performance specification is prepared.

5.3 *performance specification*—a specification of end results by formulating and stating criteria for their accomplishment.

NOTE 2—The practicality of *performance specifications* is dependent upon the validity of two assumptions: (1) the needs of a situation can be expressed in numerical terms by assigning performance criteria to each of the forces or exposures acting on the product in actual use; and (2) any product having a performance characteristic equal to or better than each corresponding criterion throughout the performance specification will be functionally acceptable for use. (Final selection from among all functionally acceptable products should be based on evaluation of economic, aesthetic, and nonquantifiable aspects of the proposed usage.)

6. Procedure

6.1 *Testing or Exposure*—Prepare and test specimens or expose according to the requirements of the standard method or recommended practice. In order to facilitate comparison of data developed at different times or in different places, the performance specification shall require testing according to standard methods or recommended practices. Such methods shall incorporate a procedure for checking calibration or using reference standards to assure that the equipment is in good operating condition and is capable of yielding reproducible results. Interrupt test-

ing periodically to measure the amount of fading or discoloration that has occurred, then continue testing until the desired end point level is achieved.

6.1.1 Prepare one additional specimen for each product tested. Set the specimen aside, isolated from light or other deteriorating agents, and use as the reference specimen during color comparisons.

6.2 End Points:

6.2.1 Three commercially significant performance levels are given for each method in 6.3. The absolute values for the levels indicated for any one method are not mathematically equivalent to the levels given for the other methods, but represent only similar degrees of fading or color change.

6.2.2 The user shall determine the end point level to which exposure is to be continued. In selecting the end point level, proper weight should be given the true aesthetic needs of the usage and the performance characteristics attainable within reasonable production tolerances at the present state of the art. It is permissible to carry exposure until end point level III is attained while recording and reporting the exposures through which end point levels I and II are passed.

6.3 Comparison Methods:

6.3.1 *Method A*—Method D 2244, an instrumental method, should be followed.

6.3.1.1 This method covers the instrumental determination of the small color differences observable under daylight illumination between nonfluorescent, nonmetameric, and opaque surfaces. Visual appearance may be affected by other parameters such as texture, gloss, and adjacent surfaces. The tolerances specified here may not appear uniform to an observer because of his subjective evaluation of appearance. Transparent materials, if backed with a nonreflective black material, may be measured by reflectance but data should not be intercompared among opaque materials.

6.3.1.2 Several color scales are available. No simple factor exists to convert from one color difference to another. The choice of color scale should be by mutual agreement between the parties concerned. When no mutual agreement exists, the parties should resolve their differences by use of the Adams-Nickerson 40 (ANLAB 40) formula. If color