



Designation: D387 – 00 (Reapproved 2017)

# Standard Test Method for Color and Strength of Chromatic Pigments with a Mechanical Muller<sup>1</sup>

This standard is issued under the fixed designation D387; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope

1.1 This test method is intended to be used to compare the color and strength of a pigment under test with a reference standard of the same type and grade.

1.2 This test method does not apply to white pigments.

NOTE 1—Test Method [D3022](#) is similar to this test method, but it utilizes a miniature sandmill rather than a mechanical muller, to disperse the chromatic pigment.

NOTE 2—Test Method [D332](#) and Test Method [D2745](#) are similar to this test method, but they are intended for use with white pigments, rather than chromatic pigments.

1.3 The values stated in SI units are the preferred unit of measurement. The values given in parentheses are for information only.

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.* Specific hazard statements are given in Section [8](#).

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[D332](#) Test Method for Relative Tinting Strength of White Pigments by Visual Observation

[D1729](#) Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials

[D2244](#) Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

[D2745](#) Test Method for Relative Tinting Strength of White

[Pigments by Reflectance Measurements](#)

[D3022](#) Test Method for Color and Strength of Color Pigments by Use of a Miniature Sandmill

[D3964](#) Practice for Selection of Coating Specimens for Appearance Measurements

[D4838](#) Test Method for Determining the Relative Tinting Strength of Chromatic Paints

[E284](#) Terminology of Appearance

## 3. Terminology

3.1 Definitions of appearance terms used in this test method may be found in Terminology [E284](#).

## 4. Summary of Test Method

4.1 Pigments are dispersed in a suitable vehicle with a mechanical muller. Test and standard pigments are treated identically. Opaque drawdowns are made from the dispersions and compared, either visually or instrumentally, for color and strength differences.

## 5. Significance and Use

5.1 Color and tinting strength are the most important properties of a color pigment. This test method provides a means of testing these properties for quality control.

5.2 This test method is intended as a referee method so that such matters as the vehicle for preparing the dispersions and the white for making tints have been suggested. However, other vehicles and whites may be suitable for quality control purposes, and changes in this test method are allowed by agreement between the parties to a test.

5.3 It is assumed that the most exact comparison of mass color and tinting strength occurs when the pigment is completely dispersed. By following the procedure described in [Annex A1](#), the conditions for achieving the maximum practical degree of dispersion with a mechanical muller may be determined. Color and strength tests should be carried out under these conditions.

5.4 The results obtained with a mechanical muller do not necessarily correlate directly with an industrial situation where different dispersing conditions exist. However, dispersion with

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee [D01](#) on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee [D01.26](#) on Optical Properties.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

a mechanical muller is a quick and inexpensive way of testing the color and strength of a pigment for routine quality control.

## 6. Apparatus

6.1 *Balances*—(1) A balance sensitive to 10 mg and (2) an analytical balance sensitive to 1.0 mg.

6.2 *Muller, Mechanical*, equipped with ground-glass plates to which a variable but known force may be added in 220-N (50-lbf) increments. The driven glass plate shall have a speed of rotation of between 70 and 120 r/min and the apparatus shall have an arrangement for pre-setting the number of revolutions in multiples of 50.

6.3 *Rubbing Surfaces*—The rubbing surfaces of the ground glass plates shall be kept sharp by removing them from the muller and grinding them face-to-face with No. 303 optical emery, or its equivalent, and water.

6.4 *Small Glass Slab* or other nonabsorbent material, suitable for weighing and mixing pigment pastes.

6.5 *Spatula*—A flexible spatula having a 75 to 150-mm (3 to 6-in.) blade.

6.6 *Paper Charts*, white with a black band and a surface impervious to paint liquids.

6.7 *Film Applicator*, at least 75 mm (3 in.) wide with a clearance of 100  $\mu$ m (4 mils) to produce wet films about 50  $\mu$ m (2 mils) thick.

6.8 *Color-Measuring Instrument*, meeting the requirements of Practice [D2244](#).

## 7. Materials

7.1 *Reference Standard*—A standard pigment of the same type and grade as the pigment to be tested, as agreed upon between the purchaser and the seller.

7.2 *Vehicle*—A solvent-free vehicle, such as No. 1 lithographic varnish, with 0.8 % each of cobalt and manganese driers (6 % types).

7.3 *White Tinting Paste*—A white paint compatible with the dispersion vehicle, such as 57 parts of rutile titanium dioxide dispersed in 43 parts of the vehicle described in [7.2](#).

NOTE 3—Because the choice of vehicle and white tinting pigment may affect the results, they should be agreed upon between the purchaser and the seller.

## 8. Hazards

8.1 Some pigments are potentially toxic and therefore should be handled with care. Obtain specific precautions from the manufacturer or supplier.

8.2 Many solvents and paint vehicles present explosion, fire, and toxicity hazards, so they should accordingly be handled with care. Again, obtain specific precautions from the manufacturer or supplier.

## 9. Dispersing Conditions

9.1 The conditions for dispersing the pigment on the mechanical muller should be such that the maximum tinting strength is developed. For each pigment and each dispersing

vehicle the development of tinting strength by the mechanical muller is influenced by the force applied, the number of revolutions, the mass of the pigment, and the mass of the vehicle. The conditions for obtaining the maximum tinting strength with the mechanical muller can be determined by following the procedure in [Annex A1](#).

9.2 If these conditions are known for a particular pigment with a particular vehicle, or if the purchaser and seller agree upon a particular set of conditions, there is no need to carry out the procedure in [Annex A1](#).

## 10. Dispersion Procedure

10.1 Decide, by agreement or by experimentation, as discussed in Section [9](#), the following dispersing conditions:

- 10.1.1 Force applied to the muller plates;
- 10.1.2 Number of revolutions;
- 10.1.3 Mass of the pigment; and
- 10.1.4 Mass of the vehicle.

10.2 Applying these decisions, prepare a dispersion of the reference standard pigment. Weigh onto a glass slab to within 2 mg, the appropriate quantities of the standard pigment and the dispersing vehicle. Mix the pigment and vehicle together thoroughly with the spatula and transfer the mixture to the lower plate of the muller. Spread the mixture in a path approximately 100 mm wide and halfway between the center and rim of the lower plate, and clean the spatula as much as possible by wiping it on the upper plate of the muller. Close the plates and carry out the mulling stages of 50 revolutions; after each stage collect the paste from both plates with the spatula and spread it around the 100-mm path on the lower plate, wiping the spatula on the upper plate as before. When the mulling has been carried out for the prescribed number of revolutions, collect the paste and store it. Clean the glass slab, the muller plates, and the spatula, and repeat the procedure with exactly the same quantities of the test sample and vehicle. Collect the paste from this sample and store it. Clean the glass slab, the muller plates, and the spatula.

NOTE 4—The most common sources of error in this procedure are inaccurate weighing, incomplete transfer of the pigment and vehicle mixture, and contamination of the plates by previous samples.

## 11. Masstone Color Procedure

11.1 Draw down a portion of the test and standard pastes in juxtaposition on a paper chart over a vacuum-drawdown plate or other suitable plane surface with the film applicator. Make sure that the coating is opaque.

11.2 Immediately compare the colors visually while still wet, using Practice [D1729](#), and record the results. Set the drawdowns aside in a dust-free area to dry. When dry, repeat the visual color difference evaluation and record the results. See Practice [D3964](#).

11.3 If desired, evaluate the color difference instrumentally using Practice [D2244](#), and report the color difference in units as agreed upon between the purchaser and seller.

NOTE 5—Wet color difference evaluations may not agree with dry color difference evaluations because of such phenomena as flooding and flocculation. In the case of a difference between the wet and dry