Designation: D7540 – 09 (Reapproved 2013)

Standard Practice for Dispersion of Chromatic Pigments with a Mechanical Muller[1]

This standard is issued under the fixed designation D7540; 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.

1. Scope

1.1 This practice is intended to be used to disperse a chromatic pigment for subsequent testing.

1.2 This practice does not apply to white pigments.

NOTE 1—The dispersion portion of Test Method D3022 is similar to this practice, but it utilizes a miniature sandmill rather than a mechanical muller, to disperse the chromatic pigment.

NOTE 2—The dispersion portions of Test Methods D332 and D2745 are similar to this practice, but they are intended for use with white pigments, rather than chromatic pigments.

1.3 The values stated in SI units are to be regarded as the standard. 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:*[2]

D332 Test Method for Relative Tinting Strength of White Pigments by Visual Observation

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

E284 Terminology of Appearance

3. Terminology

3.1 *Definitions*—Definitions of appearance terms used in this practice may be found in Terminology E284.

4. Summary of Practice

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

5. Significance and Use

5.1 The results obtained with a mechanical muller do not necessarily correlate directly with an industrial situation where different dispersing conditions exist. However, dispersion with a mechanical muller is a quick and inexpensive way to prepare specimens for testing the color and strength of a pigment for routine quality control.

5.2 By following the procedure described in Appendix X1, the conditions for achieving the maximum practical degree of dispersion with a mechanical muller may be determined. Any color and strength tests done with the dispersions should be carried out under these conditions.

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. See Fig. 1 for an example of such a device.

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.

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.

[1] This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.24 on Physical Properties of Liquid Paints and Paint Materials.

Current edition approved June 1, 2013. Published June 2013. Originally approved in 2009. Last previous edition approved in 2009 as D7540 – 09. DOI: 10.1520/D7540-09R13.

[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.

FIG. 1 A Muller-Type Laboratory Grinder/Disperser (Courtesy of Paul N. Gardner Company, Inc.)

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

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 Appendix X1.

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 Appendix X1.

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. The two pastes may be used in tests for color and strength.

NOTE 3—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 specimens.

11. Keywords

11.1 chromatic pigments; dispersions; mullers

APPENDIX

(Nonmandatory Information)

X1. DISPERSING CONDITIONS FOR MAXIMUM TINTING STRENGTH

X1.1 The following describes a test method for determining the conditions for achieving the maximum level of tinting strength with the mechanical muller.

X1.1.1 Determine the appropriate ratio of color pigment to dispersing vehicle by performing the following operations: Tare off the weight of a glass slab on a balance. Weigh 1.00 ± 0.01 g of the standard pigment on to the glass slab. Add dispersing vehicle to the pigment in small amounts and mix them together with the spatula. Keep adding the vehicle and mixing the paste until the pigment is completely wetted and a workable paste is obtained. At this point the consistency of the paste should be such that a dab of the paste will drop from the spatula when it is gently tapped with the finger. Weigh the paste, and subtract the mass of the pigment to determine the mass of the vehicle. Calculate the pigment to vehicle mass ratio. Repeat the operations described above for the test pigment.

X1.1.2 Determine the appropriate amount of pigment to use by estimating, to within 0.2 mL, the volume of that paste prepared in X1.1.1 that has the smallest pigment-to-vehicle mass ratio. Calculate the masses of pigment and vehicle needed to give a paste having a volume of about 2.0 mL. Round the amount of pigment down and the amount of vehicle up to the nearest 0.1 g.

X1.1.3 Apply 440 N (100 lbf) to the muller plates and prepare a tint of the standard pigment. Use the amounts of the color pigment and dispersing vehicle determined in X1.1.2 and mull the paste for 100 revolutions in two stages of 50 revolutions each.

X1.1.4 Prepare three more specimens from the same sample following the procedure described in X1.1.3, but mull these specimens, in stages of 50 revolutions, for 200, 300, and 400 revolutions, respectively.

X1.1.5 Compare each of the four specimens, one to the other, for tinting strength and determine the minimum number of revolutions necessary to achieve full tinting strength. If the tinting strength is still developing after 400 revolutions, repeat X1.1.3-X1.1.5 with 220 N (50 lbf) more force on the mechanical muller plates.

X1.1.6 Record the appropriate amounts of pigment and vehicle (by X1.1.2), the force applied to the mechanical muller plates and the minimum number of revolutions required for maximum tinting strength.

X1.1.7 Table X1.1 lists, as examples, the dispersing conditions used in one interlaboratory study. The vehicle used was No. 1 lithographic varnish with 0.8 % each of cobalt and manganese driers (6 % types).

TABLE X1.1 Dispersing Conditions Used in an Interlaboratory Study

Pigment Type	Pthalocyanine Green	Yellow Iron Oxide	BON Red	Molybdate Orange
Force applied to the muller plates, N (lb)	440 (100)	440 (100)	440 (100)	440 (100)
Total number of revolutions	400 (8 × 50)	100 (2 × 50)	200 (4 × 50)	100 (2 × 50)
Mas of color pigment, g	0.75	1.0	0.6	2.0
Mass of dispersing vehicle, g	1.8	1.7	1.4	1.0