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Standard Guide for Selection of Tests for Traffic Paints[1]

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1. Scope

1.1 This guide covers the selection and use of procedures for testing traffic paints in the laboratory and in the field.

1.2 This guide covers the testing of a ready-mixed paint product of sprayable consistency that shall be suitable for use as a reflecting traffic guide on paved roadways.

1.3 The values stated in inch-pound 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.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 219 Terminology Relating to Hydraulic Cement[2]

D 8 Terminology Relating to Materials for Roads and Pavements[3]

D 16 Terminology for Paint, Related Coatings, Materials, and Applications[4]

D 154 Guide for Testing Varnishes[5]

D 185 Test Methods for Coarse Particles in Pigments, Pastes, and Paints[5]

D 215 Practice for Chemical Analysis of White Linseed Oil Paints[4]

D 562 Test Method for Consistency of Paints Using the Stormer Viscometer[4]

D 711 Test Method for No-Pick-Up Time of Traffic Paint[6]

D 713 Practice for Conducting Road Service Tests on Fluid Traffic Marking Materials[6]

D 868 Test Method for Evaluating Degree of Bleeding of Traffic Paint[6]

D 869 Test Method for Evaluating Degree of Settling of Paint[6]

D 870 Practice for Testing Water Resistance of Coatings Using Water Immersion[4]

D 913 Test Method for Evaluating Degree of Resistance to Wear of Traffic Paint[6]

D 968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive[4]

D 969 Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint[6]

D 1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage[4]

D 1309 Test Method for Settling Properties of Traffic Paints During Storage[6]

D 1475 Test Method for Density of Liquid Coatings, Inks, and Related Products[4]

D 1644 Test Methods for Nonvolatile Content of Varnishes[7]

D 1647 Test Methods for Resistance of Dried Films of Varnishes to Water and Alkali[5]

D 1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials[4]

D 1737 Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus[8]

D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates[4]

D 2371 Test Method for Pigment Content of Solvent-Reducible Paints[4]

D 2372 Practice for Separation of Vehicle from Solvent-Reducible Paints[4]

D 4061 Test Method for Retroreflectance of Horizontal Coatings[4]

E 97 Test Method for Directional Reflectance Factor, 45-deg 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry[9]

E 308 Practice for Computing the Colors of Objects by Using the CIE System[4]

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[2] *Annual Book of ASTM Standards*, Vol 04.01.

[3] *Annual Book of ASTM Standards*, Vol 04.03.

[4] *Annual Book of ASTM Standards*, Vol 06.01.

[5] *Annual Book of ASTM Standards*, Vol 06.03.

[6] *Annual Book of ASTM Standards*, Vol 06.02.

[7] Discontinued; see *1998 Annual Book of ASTM Standards*, Vol 06.01.

[8] Discontinued; see *1988 Annual Book of ASTM Standards*, Vol 06.01.

[9] Discontinued; see *1991 Annual Book of ASTM Standards*, Vol 06.01.

2.2 *U.S. Federal Test Methods Standard 141B:*[10]
4121 Dry Opacity

3. Terminology

3.1 Definitions—For definitions used in this guide, refer to Terminology C 219, D 8, and D 16.

4. Summary of Guide

4.1 This guide consists of the following tests that, although not exhaustive, cover the areas normally of concern in traffic paint testing:

	Sections
Liquid Paint Properties	6 through 11
Application and Appearance Properties	12 through 17
Properties of the Dried Film	18 through 20
Analysis of Paint	21 through 24
Field Evaluations	25 through 29

5. Conditions Affecting Traffic Paint

5.1 Practical requirements for traffic paint may vary with:

5.1.1 Substrate type, such as portland cement and asphaltic concretes, and the various coarse aggregates used therein.

5.1.2 Climatic conditions, both generally and specifically, at the time of paint application.

5.1.3 Service density, such as heavy traffic areas in cities versus lightly traveled rural highways and parking lots.

5.1.4 Traffic type, whether light passenger cars or heavy trucks and airplanes.

5.1.5 Presence of foreign matter on the road surface, such as oil, old paint, skid marks, sand, salt, concrete curing compound, etc.

5.2 New portland cement concrete surfaces have a greater degree of moisture and alkalinity than older surfaces and thereby adversely affect paint adhesion. Paint adhesion is also affected by the ratio of cement to fine aggregate, coarse aggregate, and mixing water, as well as by the surface character of the aggregate that can range from impervious smooth quartz to irregular, porous slag.

LIQUID PAINT PROPERTIES

6. Skinning

6.1 Paints containing a binder that dries by oxidation are subject to skin formation in a partially filled can or by diffusion of air into a filled can. Since skins are insoluble in the paint they must be removed before use. The referenced test employs a partially filled container to indicate the tendency of a paint to skin. A typical minimum time for skinning is 18 to 24 h.

6.2 Examine the original sample for skins both on the surface and in the mass. Using a well-mixed, skin-free portion of the sample, perform a skinning test in accordance with Guide D 154, except use a 1-pt (0.5-L) friction-top can instead of an 8-oz (0.25-L) jar.

7. Coarse Particles

7.1 Paints must be free of oversize particles and foreign matter to avoid clogging application equipment, a typical maximum being 1 % by weight of total paint. The referenced test with a 325-mesh (45-µm) screen gives the percent of this material in the paint.

7.2 Determine coarse particles in accordance with Test Methods D 185.

NOTE 1—This test is not used for traffic paint containing pre-mixed glass beads.

8. Fineness of Dispersion

8.1 The more finely a pigment is dispersed, the more efficiently it is being used. One method for measuring the degree of dispersion (commonly referred to as "fineness of grind") is to draw the material down a calibrated, tapered groove in a hardened steel block with the groove varying in depth from 4 to 0 mils (100 to 0 µm). The point at which continuous groupings of particles or agglomerates, or both, protrude through the surface of the liquid is taken as the fineness reading. Lower readings in mils or micrometres or higher reading in Hegman units indicate better fineness of dispersion.

8.2 Fineness of grind is not generally specified for traffic paint but some application equipment may require a limit of 1 to 2 Hegman units (3 to 3.5 mils, 75 to 90 µm). If additional assurance is needed that the paint will not clog application equipment, determine the fineness in accordance with Test Method D 1210 after reducing the traffic paint with mineral spirits, or compatible aromatic solvent with a similar evaporation rate, to keep the film wet long enough to determine the end point more easily. When a premix traffic paint is being tested, conduct the test on the paint before addition of the beads.

9. Density or Weight per Gallon

9.1 Density as measured by weight per unit volume is not a performance characteristic but is used to check product uniformity from batch to batch. A calibrated weight per gallon cup is used.

9.2 For an unbeaded paint, determine the density in accordance with Test Method D 1475.

9.3 For beaded paints, use a special weight-per-gallon cup[11] having a modified cap so that the beads do not interfere with a snug fit of the cap to the cup. Proceed in accordance with Test Method D 1475.

10. Consistency

10.1 Paints of a given type should fall within a stated consistency range as agreed upon between the purchaser and the seller. Consistency is used mainly to ensure product uniformity. Improper consistency, however, can adversely affect application properties, and in turn, paint performance.

10.2 Determine consistency using the Stormer viscometer in accordance with Test Method D 562. If the requirement is in Krebs units, Table 1 of Test Method D 562 permits changing seconds to KU.

[10] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094.

[11] The sole source of supply of the satisfactory modified cup known to the committee at this time is BYK-Gardner, Inc., Gardner Laboratory, 2435 Linden Lane, Silver Spring, MD 20910. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible techincal committee,[1] which you may attend.

11. Package Stability

11.1 Since paints are not normally used immediately after manufacture, they must remain stable in the can for some time, which for traffic paints does not generally exceed 6 months. Although package stability can usually be determined by alternatively heating and cooling a specimen, occasionally the results do not coincide with storage at normal temperature. The referenced methods determine the degree of pigment settling after 2 weeks cycling or after 6 months storage at room temperature. These are usually sufficient as it is difficult to rate numerically the ease of redispersing an aged traffic paint.

11.2 Determine the degree of pigment settling in the accelerated test in accordance with Test Method D 1309. Determine the degree of pigment settling and ease of remixing a shelf-aged specimen in accordance with Test Method D 869.

APPLICATION AND APPEARANCE PROPERTIES

12. Drying Time

12.1 The drying time of a traffic paint is particularly important because it determines how quickly a lane can be opened to free flow of traffic without the paint being transferred to adjacent pavement.

12.2 Though no-pick-up time as determined by Test Method D 711 has no direct correlation with field application, it is employed as a quality control test.

13. Bleeding

13.1 Bleeding refers to the passage of colored matter such as bitumen from an asphalt pavement through the traffic paint film. It is a function of the age of the asphalt, its compatability with the paint, and the speed of drying of the paint. Typical traffic paints give results of 6 to 10 on an arbitrary scale of photographic standards where 10 is no bleeding and 2 is considerable bleeding. Determine bleeding in accordance with Test Methods D 868 and D 969.

14. Hiding Power

14.1 Hiding power or opacity is a measure of the ability of a paint to hide the substrate. It varies, naturally, with the thickness of the applied film that may be influenced by the flow and application properties of the paint.

14.2 Determine the dry hiding power of traffic paints in accordance with Procedure A, Method 4121 of U.S. Federal Test Method Standard 141B. (This method is being rewritten in ASTM form.)

15. Color and Color Difference

15.1 The color of a paint may be determined precisely by means of a spectrophotometer. However, the exact color is not usually as important as how closely a paint matches a standard. Color difference between a product and a standard can be determined visually or with less elaborate instruments than for color measurement. Visual comparison of color is fast and often acceptable although numerical values are not obtained. Color difference instruments, while not more sensitive than the eye, provide numerical values that can be subsequently compared to later measurements.

15.2 If required, determine the color in terms of tristimulus values or chromaticity coordinates in accordance with Practice E 308.

15.3 Determine color difference by visual comparison against standard color chips[12] in accordance with Practice D 1729. This practice covers the spectral photometric, and geometric characteristics of light source, illuminating and viewing conditions, size of specimens, and general procedures to be used in the visual evaluation of color differences of opaque materials.

15.4 Determine color difference instrumentally in accordance with Test Method D 2244. The method covers the instrumental measurement of small color differences observable in daylight illumination between nonfluorescent, nonmetameric, opaque surfaces.

16. Reflectance

16.1 Reflectance is a measure of the light reflected from the surface of a paint. It determines which of two specimens appears lighter when viewed in average daylight at an angle that eliminates gloss effects.

16.2 Determine the green filter reflectance in accordance with Test Method E 97.

17. Night Visibility or Retroreflectance of Beaded Paints at Low Angles

17.1 This property is important to traffic paint but visibility at night is not related to daylight reflectance. The retroreflectance evaluation of test panels coated with traffic paint should be in accordance with Test Method D 4061. Such panels can serve as controls in monitoring the application of traffic paint and can be helpful in correlating visual ratings with absolute values.

PROPERTIES OF THE DRIED FILM

18. Resistance to Wear

18.1 Resistance to wear is a measure of the ability of the dried film to withstand wear from traffic and from objects rolled or pulled across the surface. In the referenced method abrasive is poured onto a dry film on a glass panel until the paint is removed. A typical value for traffic paint is 65 L of sand for removal of a 3-mil (75-μm) dry film. Determine resistance to wear in accordance with Test Method D 913.

18.2 Using unbeaded traffic paint, determine the abrasion resistance to falling sand or silicon carbide in accordance with Test Methods D 968.

19. Elongation

19.1 Elongation is a measure of the flexibility of a paint film. Traffic paints may have difficulty in meeting the referenced test if they are over-pigmented to obtain high reflectance.

19.2 Using unbeaded traffic paint, determine the flexibility in accordance with Test Method D 1737 but using 30-gage

[12] The sole source of supply of the standard yellow color chips known to the committee at this time is Traffic Control Systems Div., HTO-20, Office of Traffic Operations, Federal Highway Administration, Washington, DC 20590. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible techincal committee,[1] which you may attend.

(0.32-mm) tin plate in place of the specified steel panel.

19.2.1 As the thickness and curing conditions are not specified in Test Method D 1737, one of the following alternatives should be used for testing traffic paint:

19.2.1.1 Apply a 15-mil (380-µm) wet film, allow to air dry 18 h, bake 2 h at 50°C, and let cool before conducting the test with a ½-in. (12.7-mm) mandrel.

19.2.1.2 Apply a 10-mil (250-µm) wet film, allow to air dry 24 h, bake 1 h at 65°C, cool, and use a ¼-in. (6.4-mm) mandrel.

19.2.1.3 Apply a 6-mil (150-µm) wet film, bake 6 h at 100°C, cool, and use a ¼-in. (6.4-mm) mandrel.

20. Water Resistance

20.1 This property is important to traffic paints because they are frequently exposed to rain or condensation on bridges. The immersion test time is quite short in relation to actual exposure so that the test detects only paints with poor water resistance.

20.2 Using unbeaded paint, determine water resistance in accordance with either Practice D 870 or Test Methods D 1647.

20.3 As Practice D 870 specifies steel panels but not the immersion time, while Test Methods D 1647 requires tin plate and an immersion of 18 h, the following should be used for testing traffic paint: apply a 5-mil (130-µm) wet film to a clean glass panel, allow to air dry for 72 h, immerse in reagent water for 24 h, and allow a recovery period of 2 h before examining.

ANALYSIS OF PAINT

21. Chemical Analysis

21.1 If a specification requires certain raw materials or certain components in a given amount, then chemical analysis is necessary to determine whether the specified materials are present in the required amounts. Analysis does not necessarily establish paint quality that can also be greatly affected by manufacturing techniques. Select test procedures from Practice D 215 and other ASTM methods that are pertinent to the components of traffic paints.

NOTE 2—No single schematic analysis is comprehensive enough to cover the wide variety of traffic paint compositions.

22. Nonvolatile Content (Paint)

22.1 The percent nonvolatile matter indicates the amount of material remaining after the solvent evaporates and is a measure of the film solids. Determine the nonvolatile content in accordance with Test Methods D 1644 using a larger specimen size in the case of beaded paint. It is suggested that the methods be selected as follows:

22.1.1 *Test Method A*—3 h at 105°C for paints where the nonsolvent components decompose at 149°C, and

22.1.2 *Test Method B*—10 min at 149°C for most paints where the nonsolvent components are reasonably stable at 149°C.

23. Pigment Content

23.1 Pigment gives paint its hiding and color and influences many other properties. Determine the percent pigment in accordance with Test Method D 2371.

24. Binder Content

24.1 The nonvolatile vehicle is that portion of the film-forming solids in a paint other than the pigment. It is not to be confused with the nonvolatile portion of the vehicle. Subtract the pigment content from the nonvolatile content to obtain the nonvolatile vehicle content. If desired, separate the vehicle for further analysis in accordance with Method D 2372.

FIELD EVALUATIONS

25. Road Service Test

25.1 Whereas numerous laboratory tests in the previous sections indicate general suitability of traffic paint, and also batch-to-batch uniformity, these tests cannot predict performance under all possible end uses. Accordingly, the test paint should be applied in a repeatable manner under carefully stated conditions of end use and then tested, observed, and evaluated at stated times throughout the useful life of the paint.

25.2 Proceed in accordance with Practice D 713, being careful to record the value of each variable stated.

26. Retroreflectance

26.1 Since there is no acceptable instrumental method of evaluating the retroreflectance in the field of the glass spheres on (in) the traffic paint stripe (Note 4), the following two visual methods are extensively used: (*1*) rating longitudinal stripes from a car traveling at approximately 20 to 35 mph and requiring a test line 50 ft (15 m) long, and (*2*) rating transverse test stripes in the wheel tracks with tungsten illumination from the side of the road with eye and light source (held chest high) and separated by a distance that corresponds to the observation angle of a driver viewing the stripes on a highway.

26.1.1 These ratings are based on a scale of 10 (complete (100 %) retroreflectance) to 0 (no retroreflectance).

NOTE 3—The wheel track is the area extending 9 in. (230 mm) to each side of the point of greatest wear.

NOTE 4—An instrumental method with much greater precision is being developed.

27. Durability

27.1 The test line rating is based on the paint film remaining at the time of inspection when estimated by close observation with the unaided eye. The rating is on the scale from 0 to 10, the latter representing 100 % remaining, a rating of 9 representing 90 % remaining, etc.

28. Appearance

28.1 This is the complete impression conveyed when the test stripe is viewed at a distance of at least 10 ft (3 m). Any discoloration of the surface due to bleeding, dirt collection, darkening, fading, mold growth, etc. will affect the rating that is also on the scale from 10 to 0.

29. Length of Useful Life

29.1 The length of useful life is the length of time (in days) between application of the test lines and when the weighted rating first reaches a value of 4, or when any specific quality (appearance, durability, or night visibility) first reaches the numerical rating of 3, whichever is the lesser number of days.

29.2 When it is necessary to calculate the "length of useful life," calculate as follows (Practice D 713):

$$L = D \times (10 - 4)/(10 - R) = 6D/(10 - R) \quad (1)$$

where:

L = length of useful life,
D = number of days the test stripe has been on the road, and
R = weighted rating at time of calculation.

30. Keywords

30.1 coatings; paints; traffic paint