



Designation: C979/C979M – 16

Standard Specification for Pigments for Integrally Colored Concrete¹

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1. Scope

1.1 This specification covers the basic requirement for colored and white pigments in powder form to be used as admixtures in concrete for the purpose of producing integrally colored concrete. Where the pigments are a constituent of a multicomponent admixture, this specification applies to the pigment constituent of the admixture. This specification is not intended to establish compatibility of pigments with any other concrete admixtures unless they are tested in combination in accordance with 4.7.

1.2 This specification does not include the determination of pigment stability when elevated temperature using low-pressure (atmospheric) or high-pressure (autoclave) steam is used to accelerate the curing process.

1.3 In addition to tests defining the pigments themselves, a limited number of tests on concrete are included to define the effects on setting times, air content, and compressive strength. If more extensive information is required for a particular job, additional testing criteria and procedures should be agreed upon between the seller and user.

1.4 The maximum prescribed dosage rate of a pigment, established in accordance with 4.7, shall be equal to or less than 10 mass % of cement. When a combination of pigments is used to produce the desired color and color intensity, the total dosage rate of all pigments combined shall not exceed any of the individual maximum dosage rates of the component pigments.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. Some values have only SI units because inch-pound equivalents are not used in practice.

¹ This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.23 on Chemical Admixtures.

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2. Referenced Documents

2.1 ASTM Standards:²

- C33/C33M Specification for Concrete Aggregates
- C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C125 Terminology Relating to Concrete and Concrete Aggregates
- C143/C143M Test Method for Slump of Hydraulic-Cement Concrete
- C150/C150M Specification for Portland Cement
- C173/C173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory
- C231/C231M Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C260/C260M Specification for Air-Entraining Admixtures for Concrete
- C403/C403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
- D50 Test Methods for Chemical Analysis of Yellow, Orange, Red, and Brown Pigments Containing Iron and Manganese
- D1208 Test Methods for Common Properties of Certain Pigments
- D1535 Practice for Specifying Color by the Munsell System
- G23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (Withdrawn 2000)³

2.2 ACI Standards:⁴

- 211.1-91 (Reapproved 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

3. Terminology

3.1 Definitions:

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.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, <http://www.concrete.org>.

3.2 For definitions of terms used in this specification, refer to Terminology C125.

4. General Requirements

4.1 *Water Wettability*—The pigment shall be water wettable when tested in accordance with 8.1.

4.2 *Alkali Resistance*—The pigment treated with sodium hydroxide shall not show any significant (Note 1) change of color when tested in accordance with 8.2.

4.3 *Total Sulfates*—Calculated as SO_3 , the sulfates shall not exceed 5.0 mass % of the original pigment sample when tested in accordance with 8.3.

4.4 *Water Solubility*—The total matter soluble in water shall not exceed 2.0 mass % of the original pigment sample when tested in accordance with 8.4.

4.5 *Atmospheric Curing Stability*—The magnitude of color differences between pigmented concrete specimens cured in dry air and those cured at high relative humidity when tested in accordance with 8.5 shall not be greater than the magnitude of the color difference between two unpigmented specimens cured under the same conditions.

4.6 *Light Resistance*—The exposed portions of the specimens shall show no significant differences (Note 1) in color from the unexposed portions when tested in accordance with 8.6. While a pigment that fails this test shall not be considered light resistant, a pigment that passes this test may still be subject to fading when exposed to natural weathering conditions.

NOTE 1—A significant difference is defined as one that is readily perceptible by visual observation without close examination. The section on Lighting and Viewing Conditions in Practice D1535 may be used.

4.7 Effects on Concrete:

4.7.1 When compared with the control mixture, the concrete that is pigmented at the maximum prescribed dosage rate shall have a 28-day compressive strength of not less than 90 % and a water-cement ratio of not greater than 110 % of that of the control mixture when prepared and tested in accordance with 8.7 (Note 2).

4.7.2 The pigment, when added to a concrete mixture at the maximum prescribed dosage rate, shall neither accelerate the initial or final set by more than 1 h nor retard the initial or final set by more than 1½ h, as compared to the uncolored concrete control mixture when tested in accordance with 8.7 (Note 2).

4.7.3 Using the same quantity of air-entraining admixture, the pigments, when added to a concrete mixture at the maximum prescribed dosage rate, shall not change the air content by more than 1.0 %, as compared to the uncolored control mixture when tested in accordance with 8.7.

NOTE 2—These values include allowance for normal variations in test results. The object of the 90 % compressive-strength requirement is to require a level of performance of the pigmented concrete comparable to that of the reference concrete when tested in accordance with 8.7.

4.8 *Color Match of Shipment*—The color produced by the shipment of pigment shall not be significantly different (Note 1) from the color produced by the standard supplied by the pigment manufacturer when samples of both the shipment and

the standard are tested in accordance with 8.8. New concrete specimens containing the standard sample of the particular pigment must be prepared whenever a new shipment is evaluated. This is necessary to eliminate color variations caused by any of the other mortar ingredients, specimen preparation, or curing.

5. Rejection

5.1 The purchaser has the right to reject material that does not conform to the requirements of this specification. Rejection shall be reported to the producer or supplier in writing.

5.2 Individual packages or containers varying more than 5 % from the stated mass may be rejected. If the average weight of 50 packages taken at random is less than that stated, the entire shipment may be rejected.

6. Packaging

6.1 Packages or containers shall be clearly marked as to color designation and the net mass.

6.2 The package or container for the pigment, only when so designated by the manufacturer, shall be added to the concrete batch, provided that it is composed of disintegrating paper or soluble material which, when tested as a unit (pigment and packaging), conforms to all requirements of this specification.

7. Materials for Tests

7.1 *Cement*—For the atmospheric curing stability and the light resistance tests, using white cement is suggested. The cement used in all other tests shall be either a Type I or Type II cement conforming to Specification C150/C150M or the cement proposed for specific work.

7.2 *Aggregates*—The aggregates used in all tests shall conform to Specification C33/C33M or shall be the aggregates proposed for specific work. For the atmospheric curing stability and the light resistance tests, clean silica sand shall be used. For both the reference and the pigmented mixtures, the aggregate grading shall be controlled by determining the mass of separate fractions.

7.3 *Admixtures*—If any of the test mixtures contain any admixtures in addition to pigment other than an air-entraining admixture complying with Specification C260/C260M, the pigment shall be considered to comply with this specification only when used in conjunction with such other admixture(s).

8. Test Methods

8.1 *Water Wettability*—Add 10.0 g of the pigment to 150 mL of deionized water in a 250-mL beaker. If the pigment does not readily mix with the water when stirred with a spatula, but instead a substantial portion of the pigment floats on the surface of the water, the pigment is repellent and not water wettable.

8.2 *Alkali Resistance*—Add two 10.0 g-portions of the pigment to separate 250-mL beakers, each containing 150 mL of deionized water. Stir until thoroughly mixed. Add 10 mL of 10 mass % sodium hydroxide solution to one beaker, and stir thoroughly once more. Let the slurries stand 1 h, then remix