Designation: D2218 – 67 (Reapproved 2012)

Standard Specification for Molybdate Orange Pigments[1]

This standard is issued under the fixed designation D2218; 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 specification covers the pigment known as molybdate orange.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.3 The following hazard caveat applies to the test method portion of this specification only. *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:*[2]

D126 Test Methods for Analysis of Yellow, Orange, and Green Pigments Containing Lead Chromate and Chromium Oxide Green

D185 Test Methods for Coarse Particles in Pigments

D235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)

D387 Test Method for Color and Strength of Chromatic Pigments with a Mechanical Muller

D523 Test Method for Specular Gloss

D600 Specification for Liquid Paint Driers

D822 Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings

D1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage

E97 Method of Test for Directional Reflectance Factor, 45-Deg 0-Deg, of Opaque Specimens by Broad-Band Filter Reflectometry (Withdrawn 1991)[3]

2.2 *Federal Specification:*

TT-R-266 Resin, Alkyd; Solutions[4]

3. Composition and Properties

3.1 *Dry Pigment*—The pigment shall be a product made by the chemical coprecipitation of lead chromate and lead molybdate, with or without admixtures of other insoluble compounds of lead or other materials used in manufacture to control certain properties. The pigment shall conform to the requirements for chemical composition as prescribed in Table 1.

3.2 The mass color and character of the tint formed by a mixture with a white pigment shall be the same as, and the strength shall be within mutually agreed upon limits of a standard acceptable to both the purchaser and the seller.

3.3 When mutually agreed upon between the purchaser and the seller as being essential to the end use of the pigment, resistance to loss of gloss, chalking, and color change shall be tested as specified in 5.1.6 The exposed panel shall show no chalking, a loss of not more than 10 % of the original gloss, and a color change difference of not more than three units.

4. Sampling

4.1 Two samples shall be taken at random from different packages from each lot, batch, day's pack, or other unit of production in a shipment. When no markings distinguishing between units of production appear, samples shall be taken from different packages in the ratio of two samples for each 4540 kg (10 000 lb), except that for shipments of less than 10 000 lb two samples shall be taken. At the option of the purchaser, the samples may be tested separately, or samples from the same production unit may be blended in equal quantities to form a composite sample.

5. Test Methods

5.1 Tests shall be conducted in accordance with the following ASTM test methods:

[1] This specification is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.31 on Pigment Specifications.

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[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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

TABLE 1 Requirements for Chemical Composition

	%	
	Min	Max
Chromium (calculated as $PbCrO_4$)	70	...
Molybdenum (calculated as $PbMoO_4$)	8	...
Total of all substances (including moisture and water soluble compounds) other than insoluble compounds of lead	...	12
Moisture and other volatile matter	...	1.5
Coarse particles (total residue retained on a 45-μm (No. 325) sieve	...	1.0
Matter soluble in water	...	1.0

5.1.1 *Chemical Analysis of Lead Chromate*—Proceed in accordance with the Lead Chromate section of Test Methods D126. The alternative procedure is not applicable.

5.1.2 *Chemical Analysis of Lead Molybdate and Total Molybdenum*—Weigh to 1 mg about 1-g sample of pigment into a 250-mL beaker. Add 20 mL of sulfuric acid (H_2SO_4, 1+1) and heat to light fumes. Cool the solution, dilute to 150 mL, filter, and wash with water. To reduce chromate, add freshly prepared sulfurous acid (H_2SO_3) until the solution turns green, and then add several millilitres in excess. Boil the solution until excess H_2SO_3 is removed. Cool the solution to 5 to 10°C, and add 30 mL of a 2 % solution of alphabenzoinoxime in alcohol slowly, with stirring. Add sufficient bromine water to tint the solution a pale yellow, and then add a few more millilitres of the alphabenzoinoxime reagent. After 15 min at 5 to 10°C, filter the solution through very thin, medium paper. Then wash the solution with cold H_2SO_4 (1+100) containing 25 to 50 mL of prepared alphabenzoinoxime reagent per litre. Place the precipitate in a platinum crucible, char cautiously, then ignite to constant weight at 500°C, and weigh as molybdenum oxide (MoO_3). Calculate weight percent lead molybdate ($PbMoO_4$), M, as follows:

$$M = (A \times 255)/S \quad (1)$$

where:

A = weight of MoO_3 obtained, g and
S = specimen weight, g.

5.1.3 *Coarse Particles*—Test Methods D185.

5.1.4 *Mass Color and Tinting Strength*—Test Method D387.

5.1.5 *Moisture and Other Volatile Matter*—Test Methods D126.

5.1.6 *Resistance to Loss of Gloss, Chalking, and Color Change:*

5.1.6.1 Prepare a test enamel consisting of ingredients conforming to the applicable specifications in the following proportions:

Ingredient	Weight %
Molybdate orange sample	29.51
Alkyd resin solution[A]	61.72
Mineral spirits[B]	8.37
Lead naphthenate[C]	0.25
Cobalt naphthenate[C]	0.15
Total	100.0

[A] Conforming to Type III of U.S. Federal Specification TT-R-266.
[B] See Specification D235.
[C] See Class B of Specification D600.

5.1.6.2 Give the enamel three passes through a moderately tight roller mill setting to give a fineness of grind, as determined following Test Method D1210, of 1.5 mils (40 μm) or less. Apply the enamel to duplicate flat metal panels by spray or applicator to complete hiding, and allow to dry 72 h. Measure the gloss at 60° in accordance with Test Method D523. Measure the directional reflectance of the coating in accordance with Test Method E97. Subject the coated panels for 168 h to accelerated weathering under the conditions prescribed in Practice D822. Examine the exposed coating for chalking. Wash the exposed panel under running water with a thoroughly degreased lamb's wool pad to remove scum or dirt. Wipe off the water with clean cheesecloth and dry the panel for 2 h. Calculate the loss of gloss from gloss measurements made before and after exposure. After exposure, determine the directional reflectance for each panel as described in Test Method E97. Estimate the color change or lightness-difference estimate (ΔL) as follows:

$$\Delta L = K\left(Y_2^{\frac{1}{2}} - Y_1^{\frac{1}{2}}\right) \quad (2)$$

where:

Y_1 = luminous directional reflectance of the panel measured before exposure,
Y_2 = reflectance measured after exposure, and
K = 100 when the reflectances are expressed in decimal fractions or 10 if reflectances are expressed in percent.

The color change for the coating shall be the mean obtained for the two panels.[5]

6. Keywords

6.1 lead; molybdate chrome/molybdate; molybdate orange; pigment

[5] The method of determining the lightness-difference estimate is described in detail in example 4, "Photoelectric Tristimulus Colorimetry with Three Filters," *Circular C429*, NBSCA, Nat. Bureau Standards.