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Standard Specification for Artists' Acrylic Emulsion Paints[1]

This standard is issued under the fixed designation D 5098; 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 establishes requirements for composition, physical properties, performance, and labeling of artists' acrylic emulsion paints.

1.2 This specification covers pigments, vehicles, and additives. Requirements are included for pigment identification, lightfastness, bleeding, consistency, and drying time.

1.3 Table 1 lists some pigments meeting the lightfastness requirements in this specification. In order to identify other pigments that meet these requirements, instructions are given for test specimen preparation. Test methods for determining relative lightfastness are referenced.

1.4 The values stated in inch-pound units are to be regarded as standard. The SI units given in parentheses are for information only.

1.5 This pertains only to the test method section found in Sections 6 and 7, and Appendix X2. *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:*

D 185 Test Methods for Coarse Particles in Pigments, Pastes, and Paints[2]

D 279 Test Methods for Bleeding of Pigments[2]

D 387 Test Method for Color and Strength of Color Pigments with a Mechanical Muller[3]

D 476 Specification for Titanium Dioxide Pigments[2]

D 602 Specification for Barium Sulfate Pigments[2]

D 1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems[3]

D 1640 Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature[3]

D 3168 Practice for Qualitative Identification of Polymers in Emulsion Paints[3]

D 4236 Practice for Labeling Art Materials for Chronic Health Hazards[4]

D 4303 Test Methods for Lightfastness of Pigments Used in Artists' Paints[4]

D 4838 Test Method for Determining the Relative Tinting Strength of Chromatic Paints[4]

D 4941 Practice for Preparing Drawdowns of Artists' Paste Paints[4]

E 284 Terminology of Appearance[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *colour index name*—consists of the category (type of dye or pigment), general hue, and an assigned number given to a colorant in the Colour Index[5] as an international identification system.

3.1.1.1 *Discussion*—For example, the Colour Index Name of one phthalocyanine blue pigment is Pigment Blue 15 (PB 15).

3.1.2 *Colour Index Number*—a five-digit number given in the Colour Index that describes the chemical constitution of a colorant.

3.1.2.1 *Discussion*—For example, the Colour Index Number of one phthalocyanine blue pigment is 74160.

3.1.3 Appearance terms used in this specification are defined in Terminology E 284.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *acrylic emulsion paint*—paint containing a stable aqueous dispersion of polymers or copolymers of acrylic acid, methacrylic acid, esters of these acids, or acrylonitrile; sometimes termed latex, acrylic latex, or polymer emulsion paint.

3.2.2 *glycols*—general term for dihydric alcohols used to provide freeze-thaw stability in acrylic and other water-based vehicle systems.

4. Significance and Use

4.1 This specification establishes quality requirements and provides a basis for common understanding among producers, distributors, and users.

4.2 It is not intended that all paints meeting the requirements be identical nor of uniform excellence in all respects.

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[1] This specification is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applicationsand is the direct responsibility of Subcommittee D01.57 on Artist Paints and Related Materials.

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

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

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

[5] *Colour Index*, 3rd ed., 5 Vols and Revisions. The Society of Dyers and Colourists, London, 1971–75. Available from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

Variations in manufacture, not covered by this specification, may cause some artists to prefer one brand over another, either of which may be acceptable under this specification.

5. Labeling Requirements

5.1 *Pigment(s) Identification*:

5.1.1 Every label shall include for each pigment contained in the paint the information underlined in Table 1 which includes the Common Name, Colour Index Name, and any additional terms necessary to identify the form of the pigment.

5.1.2 The complete pigment identification given in Table 1, which also includes the Colour Index Number and a simple chemical description, shall be given in an appropriate producer publication. Manufacturers are encouraged to put this complete identification on the container label when label size permits.

5.1.3 The Common Name shall be placed on the front of the label and shall be the name of the paint except as described in 5.1.5 and 5.1.6. Other identification may be placed elsewhere on the container.

5.1.4 The Colour Index Name may be spelled out in full or abbreviated depending on the size of the label. Example: Pigment Blue 15, or Pig. Blue 15 or PB 15.

5.1.5 *Substituted Pigments*—In the case of substituted pigments, the word "Hue" in equal size letters shall follow in the title, on the front of the tube, immediately after the name of the pigment that has been simulated. Directly below the title, the Common Name from Table 1 of the pigment(s) used shall be given in letters no less than the next type size smaller than the title; or if more than one pigment is used, then 5.1.7 covering mixed pigments, can be followed. For example:

CADMIUM RED MEDIUM HUE (Naphthol Red AS-OL)	COBALT BLUE HUE (mixture)

5.1.6 Proprietary names or optional names may be used provided the Common Name(s) given in Table 1 appears on the front of the label directly under the proprietary or optional name in letters no less than the next type size smaller than the proprietary or optional name; or if more than one pigment is used, then 5.1.7 covering mixed pigments, can be followed.

5.1.7 *Mixed Pigments*—Artists' paints containing more than one pigment comply with this specification if all colored pigments included in the mixture are on the suitable pigment list (Table 1) and provided the mixture itself has passed all other test requirements in this specification. The Common Names for the pigments in the mixture, or the word "Mixture," must appear under the title in letters no less than the next type size smaller than the title. For example:

PERMANENT GREEN LIGHT (Cadmium Yellow Light, Phthalocyanine Blue)	PERMANENT GREEN LIGHT (Mixture)

If the word "Mixture" is used under the title, the Common Names of the pigments in the mixture, as given in Table 1, must be listed along with their Colour Index Names and the Lightfastness Category of the mixture somewhere on the label. The lightfastness category shall be that of the least lightfast pigment. This lightfastness category may be changed if the mixture is tested for lightfastness in accordance with Test Methods D 4303 and results indicating a different category are submitted to ASTM Subcommittee D01.57 for evaluation.

5.2 Provide on the label identification of polymer used in the paint.

NOTE 1—The type of polymer can be identified by using Practice D 3168.

5.3 *Lightfastness*—The label shall contain the word "Lightfastness" followed by the appropriate rating, I or II, as given for each pigment in Table 1.

5.3.1 Lightfastness I pigments, when made into paint specimens as described in Section 7 and exposed, tested, and rated in accordance with Test Method D 4303, shall have a color difference (ΔE^*_{ab}) of 4 or less CIELAB units between the specimens measured before and after exposure.

5.3.2 Lightfastness II pigments, when made into paint specimens as described in Section 7 and exposed, tested, and rated in accordance with Test Methods D 4303, shall have a color difference (ΔE^*_{ab}) of more than 4.0 but not more than 8.0 CIELAB units between the specimens measured before and after exposure.

5.3.3 Pigments were placed in a lightfastness category on the basis of either known historical performance in art works or the ratings from four lightfastness tests conducted as described in Test Methods D 4303. Results from further tests on these, or other pigments, are solicited by ASTM Subcommittee D01.57.

5.3.3.1 The lightfastness category of a pigment shall be changed if results from several further tests conducted in accordance with Test Methods D 4303 and approved by ASTM Subcommittee D01.57, establish a different lightfastness category than the one given in Table 1.

5.3.3.2 Additional pigments shall be placed in Table 1 after they have been tested for lightfastness in accordance with Test Methods D 4303 and the test results submitted to ASTM Subcommittee D01.57 for evaluation, provided the results demonstrate that the pigments have the lightfastness ratings required for Lightfastness I or Lightfastness II, as described in 5.3.1 and 5.3.2.

5.3.4 For information and to establish nomenclature, pigments in Lightfastness III, IV, and V categories are given in Table X1.1 in Appendix X1. However, such pigments are not to be used in paint conforming to this specification.

5.4 *Toxicity*—All products and labeling must conform to the Federal Hazardous Substances Act and to Practice D 4236.

5.5 *Statement of Conformance*—"Conforms to ASTM Specification D 5098," or "Conforms to ASTM D5098," or "Conforms to the quality requirements of ASTM D5098." This statement may be combined with other conformance statements, such as, "Conforms to the quality and health requirements of ASTM Specification D 5098 and Practice D 4236."

5.6 *Address*—Include on the label (*1*) the name and address of the manufacturer or importer and (*2*) the country of manufacture.

6. Quality Assurance for Artists' Acrylic Emulsion Paints

6.1 *Conditions not Covered in This Specification that Affect the Quality of Artists' Acrylic Emulsion Paints* :

6.1.1 *Substrate*—Factors such as the texture, gloss, effective pH, porosity, chemical composition, and condition of the substrate will affect gloss, gloss uniformity, drying time, adhesion, and the flexibility of the dried film.

6.1.2 *Environmental Conditions*—Factors such as temperature, humidity, air flow, and light conditions affect application properties, film formation, drying time, and adhesion.

6.1.3 *Storage*—Factors such as aging, and high and low temperatures may cause changes in consistency.

6.2 *Vehicles*—Only acrylic polymer emulsions or acrylic copolymer emulsions may be used (see Note 1).

6.3 *Pigments*—The pigments shall be limited to those recommended for use in acrylic emulsion paints in the list of suitable pigments in Table 1. Their lightfastness rating shall be the numeral given in the same row.

6.4 *Additives*—Surfactants, preservatives, defoamers, glycols, solvents, and thickeners may be used to achieve aging stability, to control foaming, to ensure freeze-thaw stability and film coalescence, and to obtain a desired consistency.

6.5 *Inerts*—Inerts shall be included only to adjust product gloss or sheen, or to produce desirable working qualities.

6.6 *Preparation of Sample*—Empty the contents of a previously unopened container onto a glass slab and mix thoroughly with a spatula to a homogeneous sample.

6.7 *Coarse Particles*—Paints shall be free of oversize particles and shall form a uniform film. The maximum content of coarse particles shall be 1 weight % as determined by Test Methods D 185.

6.8 *Fineness of Dispersion*—Determine the fineness of dispersion by Test Method D 1210. For paste paint: on a glass plate, using a spatula, mix the paint with an equal volume of water until homogeneous. The maximum allowable grind reading is 1.5 mils (40 µm).

6.9 *Consistency*—Paints shall be smooth and creamy. The paste type of paint shall not flow or level when applied with a palette knife.

6.10 *Freeze-Thaw Stability*—Using a freezer that has a temperature of 20°F (−7°C) or lower, subject the paint to five freeze-thaw cycles. A freeze-thaw cycle shall consist of freezing the paint to a solid state (minimum of 18 h) and then thawing the paint to room temperature (minimum of 5 h). The paint shall then meet the requirements of 6.7, 6.8, and 6.9.

6.11 *Drying*—Use a 6-mil (150-µm) clearance film applicator to make a uniform drawdown on a lacquer-sealed panel. At a relative humidity of 50 to 75 % and a temperature of 65 to 80°F (18 to 27°C), the dust-free drying time, determined in accordance with Test Method D 1640, shall be not less than 10 min.

6.12 Tinting strength requirements will be included in this specification as appropriate tinting strength standards for individual pigments are established. Test Method D 387 may be used to determine the tinting strength of pigments or paints when all ingredients are known. Test Method D 4838 can be used to determine the relative tinting strength of chromatic paints containing a single pigment and the same vehicle but where other ingredients are unknown.

6.13 *Bleeding of Pigments*—Determine the bleeding characteristics of the dry paint film by Test Method D 279, Test Method B. The film of the paint to be tested shall be applied with a 3-in. (7.6-cm) wide, 6-mil (150-µm) clearance film applicator, following Practice D 4941. The overstripe of paint used shall meet the specifications of the white described in 7.4.1 of this standard. Apply the overstripe in one application as a drawdown at an angle perpendicular to that of the paint being tested. Extend this second paint layer off the first film and over the region where black and white meet on the chart, in order to determine if the thickness is great enough to achieve opacity as determined by 7.6 of Practice D 4941 (see Note 2). If opacity is insufficient, increase the thickness of the overstrip layer. The extent of color migration shall be no greater than moderate, as determined by the procedure in 4.3 of Test Methods D 279.

NOTE 2—Depending on the particular white paint used, a 10-mil (250-µm) application may be sufficient. The 6- and 10-mil multiple clearance applicator,[6] has been found suitable. If the 10-mil clearance provides insufficient opacity, an adjustable clearance film casting knife[7] 0-250 mils (0-6250 µm) will allow controlled increases in film thickness.

7. Lightfastness Determination

7.1 If a pigment is not listed in Table 1, test specimens of a paint containing the pigment shall be prepared. These test specimens shall be tested in conformance with the requirements for exposure and evaluation given in Test Methods D 4303.

NOTE 3—A report of the results of these tests may be submitted to ASTM Subcommittee D01.57 for inclusion of the pigments in Table 1. The report shall include information on test conditions, instruments used, and be accompanied by the test specimens, which will be returned.

7.2 *Materials*:

7.2.1 *Aluminum Exposure Panels*, [8] 3 by 6 in. (75 by 150 mm).

7.2.2 *Posterboard*, lightweight, approximately 20 mils (0.5 mm) thick, having a glossy finish on one side.

7.2.3 *Titanium Dioxide Acrylic Emulsion Paint*.

7.2.4 *Spray Apparatus*, for applying ground coats.

7.2.5 *Paint Brush*, 2.5-in. (60-mm) wide for applying ground coats if spray apparatus is not available.

7.2.6 *Soft Hair Brush*, 1-in. (25-mm) wide for applying ground coats to aluminum panels. An oxhair artist's "stroke" brush is suitable.

7.3 *Specimen Preparation*:

7.3.1 *Ground Coats*:

7.3.1.1 For the first ground coat under acrylic emulsion paints, prepare the following enamel:

	Weight %
Medium oil length soya alkyd, 50 % nonvolatile	20
Rutile titanium dioxide[9] (conforming to Type II of Specification D 476)	40
Blanc fixe (conforming to Specification D 602)	40

[6] The sole source of supply of the multiple clearance applicator known to the committee at this time is BYK-Gardner, Inc., 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 technical committee,[1] which you may attend.

[7] The sole source of supply of the film casting knife known to the committee at this time is BYK-Gardner, Inc., 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 technical committee,[1] which you may attend.

[8] The sole source of supply of the aluminum panel, No. A-36 known to the committee at this time is The Q-Panel Co., 26200 First St., Cleveland, OH 44145.

Driers: 0.15 % zinc and 0.15 % zirconium as metal on the alkyd nonvolatile	
Sufficient mineral spirits for milling	

7.3.1.2 Mill to a Hegman fineness of 7 as measured by Test Method D 1210. Thin with mineral spirits to appropriate viscosity for spraying or for flow coating by brush.

NOTE 4—These soya alkyd enamels are used for the ground coats because of their color stability, nonabsorbency, adhesion of the specimen coats under humid conditions, and freedom from blistering that can occur with an acrylic ground coat under high humidity.

7.3.2 *Application of Ground Coats*:

7.3.2.1 Degrease aluminum substrates before applying the ground coat.

7.3.2.2 Apply two coats of the enamel described in 7.3.1.1, followed by one coat of the enamel described in 7.3.2. To flow coat the aluminum panels for sun exposure use a 1-in. (25-mm) soft hair brush. Coat the posterboard to be used for laboratory exposure on the less absorbent, glossy side.

NOTE 5—Coating the posterboard is most conveniently done on the whole sheet before cutting to size.

7.3.2.3 Allow a minimum of five days drying time following the first coat and two weeks or more after applying the second coat and before applying the paint to be tested.

7.4 *Mixing Whites for Dilution of Colors*:

7.4.1 Use a white containing the same emulsion and additives as the formulation in which the pigment is incorporated if possible. The following basic composition has been found satisfactory:

	Weight %
Acrylic emulsion nonvolatile	23 to 24
Rutile titanium dioxide[9] (conforming to Type II of Specification D 476)	34.6

7.4.1.1 Keep the viscosity of the mixing white to 250 P or slightly lower.

7.5 *Preparation of Test Paints*:

7.5.1 The pigment to be tested may be milled in a compatible paste for acrylic emulsion. If a prepared artists' paint of known composition is available, it may be used for this test instead of preparing a dispersion.

7.5.2 Dilute the pigment paste or paint with the white containing the same type of vehicle until the spectrophotometric measurement of the dried film shows 35 to 45 % relative reflectance at the wavelength of maximum absorption for that pigment. The wavelength of maximum absorption is located at the point of lowest reflectance on the spectral curve between 420 and 620 nm. If using a tristimulus filter colorimeter, the lowest of the three filter readings is the region of maximum absorption and the dilution should be adjusted so that a reading of 35 to 45 % reflectance is obtained with this filter. The diffuse white reference standard for all measurements should have an absolute reflectance between 97 and 100 %.

7.5.2.1 To obtain this reflectance, use the Kubelka-Munk Single Constant Method described in Appendix X2 or use a trial and error method.

7.5.3 Make instrumental readings with the specular reflectance included to minimize the effect on readings of any change in gloss and to minimize the effect of brush strokes.

7.5.4 Use an applicator with a 6-mil (150-µm) aperture to make a minimum size drawdown, 1½by 1½ in. (40 by 40 mm), or other minimum size appropriate for the viewing area of the instrument used. Return all recoverable paint to the batch to allow for repeat mixes and measurements.

7.5.5 For acrylic emulsion paints, 80 g of white paint is needed since paint used in the drawdown is lost.

7.5.6 For the initial weights of white stated in 7.5.4 and 7.5.5, the weighing must be accurate to 0.05 g.

7.6 *Application of Paints to Panels*:

7.6.1 Prepare four specimen panels on appropriate substrates for each pigment under test. Two are used in the first lightfastness tests and two are retained in subdued light, one for visual comparisons with the exposed panels and one in case a third test is needed to supplement results from the first two tests, as described in Test Methods D 4303.

7.6.2 Apply the test paints by brush to the aluminum panel if exposure is to be under glass to the sun or by brush to the posterboard panel if exposure is to be to laboratory apparatus.

7.6.3 Using the No. 12 artist's flat bristle brush, brush the panels lengthwise, then crosswise, and again lengthwise, this time with a light touch to produce a film as smooth as possible. The mixing whites must be fluid enough to facilitate leveling, but not have excess vehicle that can affect the test. Do not use thinners. Apply two coats to all specimen panels to achieve complete opacity.

7.6.4 Allow specimens to dry between coats as described in the Procedure section (Dry-Through or Dry-to-Handle Time) of Test Methods D 1640. After recoating, allow specimens to dry hard, as described in the Procedure section (Dry-Hard Time) of Test Methods D 1640, before measuring them prior to exposure. Acrylic paints can be recoated the next day and read two days after recoating.

8. Exposure

8.1 Conduct exposure tests, calculate mean color difference, and assign pigments to lightfastness categories as described in Test Methods D 4303.

9. Keywords

9.1 artists' acrylic paints; lightfastness; quality requirements; test specimens

[9] The sole source of supply of the material, DuPont R900 known to the committee at this time is E. I DuPont de Nemours & Co., 1007 Market St., Wilmington, DE 19898. 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 technical committee,[1] which you may attend.

TABLE 1 Suitable Pigment List

NOTE 1—Underlined information and the lightfastness rating in the table shall be included on every label.

Key:
Lightfastness Category:
Lightfastness I Excellent Lightfastness
Lightfastness II Very Good Lightfastness
Abbreviations used in Colour Index Names:

PB	Pigment Blue
PBk	Pigment Black
PBr	Pigment Brown
PG	Pigment Green
PO	Pigment Orange
PR	Pigment Red
PV	Pigment Violet
PW	Pigment White
PY	Pigment Yellow

Pigment Notations:

(AR)	Alkali Resistant
(CC)	Concentrated cadmium pigments may contain up to 15 % barium sulfate for color control. Cadmium-barium pigments contain a much higher amount of barium sulfate.
(DL)	May darken in strong light
(LF)	Lightfast type
(NA)	Colour index name or number not assigned
(RS)	Red shade
(SM)	Sensitive to moisture in direct sunlight
(SS)	Sensitive to hydrogen sulfide

Colour Index Name	Lightfastness Category Acrylic	Common Name and Chemical Class	Colour Index Number
		YELLOWS	
PY 3	II	Arylide Yellow 10G, with option of adding the name Hansa Yellow Light, arylide yellow	11710
PY 35	I	Cadmium (hue designation), concentrated cadmium zinc sulfide (CC) (SM)	77205
PY 35:1	I	Cadmium-(hue designation), cadmium zinc sulfide coprecipitated with barium sulfate (SM)	77205:1
PY 37	I	Cadmium (hue designation), concentrated cadmium sulfate (CC) (SM)	77199
PY 37:1	I	Cadmium-Barium (hue designation), cadmium sulfide coprecipitated with barium sulfate (SM)	77199:1
PY 42	I	Mars Yellow or Iron Oxide Yellow, with option of adding the name Yellow Iron Oxide, synthetic hydrated iron oxide	77492
PY 42	I	Mars Orangeor Iron Oxide Orange, synthetic hydrated iron oxide	77492
PY 43	I	Yellow Ochre, natural hydrated iron oxide	77492
<[rule]>PY 53	I	Nickel Titanate Yellow, oxides of nickel, antimony and titanium	77788
PY 65	I	Arylide Yellow RN, with option of adding Hansa Yellow RN, arylide yellow	11740
PY 73	I	Arylide Yellow GX, with option of adding the name Hansa Yellow GX, arylide yellow	11738
PY 74 (LF)	I	Arylide Yellow 5Gx, with option of adding Hansa Yellow 5GX, arylide yellow	11741
PY 83 (HR70)	I	Diarylide Yellow HR70, diarylide yellow	21108
PY 97	I	Arylide Yellow FGL, arylide yellow	11767
PY 98	I	Arylide Yellow 10GX, with option of adding the name Hansa Yellow 10GX, arylide yellow	11727
PY 108	I	Anthrapyrimidine Yellow, anthrapyrimidine	68420
PY 109	I	Isoindolinone Yellow G, tetrachloroisoindolinone	NA
PY 110	I	Isoindolinone Yellow R, tetrachloroisoindolinone	56280
PY 112	I	Flavanthrone Yellow, flavanthrone	70600
PY 138	I	Quinophthalone Yellow, quinophthalone	56300
PY 139	I	Isoindoline Yellow, isoindoline	NA
PY 150	I	Nickel Azo Yellow, nickel complex azo	NA
PY 151	I	Benzimidazolone (hue designation) H4G, benzimidazolone	13980
PY 153	I	Nickel Dioxine Yellow, dioxine yellow nickel complex	NA
PY 154	I	Benzimidazolone (hue designation) H3G, benzimidazolone	11781
PY 175	I	Benzimidazolone (hue designation) H6G, benzimidazolone	11784
PY 184	I	Bismuth Vanadate Yellow, bismuth vanadate	NA
		ORANGES	
PO 5	II	Dinitraniline Orange, dinitraniline (SM)	12075
PO 20	I	Cadmium (hue designation), concentrated cadmium sulfo-selenide (CC)	77202
PO 20:1	I	Cadmium-Barium (hue designation), cadmium sulfoselenide coprecipitated with barium sulfate	77202:1
PO 23	I	Cadmium Vermilion Orange, concentrated cadmium mercury sulfide (CC)	77201
PO 23:1	I	Cadmium-Barium Vermilion Orange, cadmium mercury sulfide coprecipitated with barium sulfate	77201:1
PO 36	I	Benzimidazolone (hue designation) HL, benzimidazolone	11780
PO 43(DL)	I	Perinone Orange, perinone	71105
PO 48	I	Quinacridone (hue designation), quinacridone	NA
PO 49	I	Quinacridone (hue designation), quinacridone	NA
PO 60	I	Benzimidazolone (hue designation) HGL, benzimidazolone	11782
PO 62	I	Benzimidazolone (hue designation) H5G, monoacetolone	11775
		REDS	
PR 5	II	Naphthol ITR, naphthol ITR	12490
PR 7	I	Naphthol AS-TR, naphthol AS-TR	12420
PR 9	I	Naphthol AS-OL, naphthol AS-OL	12460

TABLE 1 *Continued*

Colour Index Name	Lightfastness Category Acrylic	Common Name and Chemical Class	Colour Index Number
		REDS (cont'd)	
PR 14	II	Naphthol AS-D, naphthol AS-D	12380
PR 88 MRS[A]	I	Thioindigoid Violet, thioindigoid	73312
PR 101	I	Indian Red, synthetic red iron oxide (bluish hue) 77491	
PR 101	I	Light or English Red Oxide, synthetic red iron oxide (yellowish hue)	77491
PR 101	I	Mars Red or Iron Oxide Red, with option of adding the name Red Iron Oxide, synthetic red iron oxide	77491
PR 101	I	Mars Violet or Iron Oxide Violet, with option of adding the name Violet Iron Oxide, synthetic iron oxide (violet hue)	77015
PR 101	I	Venetian Red, synthetic iron oxide (yellowish hue)	77491
PR 102	I	Light Red, calcined yellow ochre	77492
PR 106	I	Vermilion, mercuric sulfide (DL)	77766
PR 108	I	Cadmium (hue designation), concentrated cadmium-seleno sulfide (CC)	77202.1
PR 108:1	I	Cadmium-Barium (hue designation), cadmium seleno-sulfide coprecipitated with barium sulfate	77202:1
PR 112	II	Naphthol AS-D, naphthol AS-D	12370
PR 113	I	Cadmium Vermilion Red Light, Mediumor Deep, concentrated cadmium mercury sulfide (CC)	77201
PR 113:1	I	Cadmium-Barium Vermilion Red Light, Medium or Deep, cadmium mercury sulfide coprecipitated with barium sulfate	77201:1
PR 119	I	Naphthol Red, naphthol	NA
PR 122	I	Quinacridone (hue designation), γ quinacridone	73915
PR 123	II	Perylene (hue designation), perylene	71145
PR 149	I	Perylene (hue designation), perylene	77137
PR 168	I	Brominated Anthanthrone, brominated anthanthrone	58300
PR 170F3RK-70	I	Naphthol Red, naphthol carbamide	12475
PR 170F5RK	II	Naphthol Crimson, naphthol carbamide	12475
PR 171	I	Benzimidazolone (hue designation),monoazo benzimidazolone	12512
PR 175	I	Benzimidazolone (hue designation), benzimidazolone	71513
PR 179	I	Perylene (hue designation), perylene	71130
PR 181	I	Thioindigoid Magenta, thioindigoid	73360
PR 188	I	Naphthol AS, naphthol AS	12467
PR 190	I	Perylene (hue designation), perylene	71140
PR 192	I	Quinacridone (hue designation), γ quinacridone red	NA
PR 194	I	Perinone Red Deep, perinone	71100
PR 202	I	Quinacridone (hue designation), quinacridone	73907
PR 206	I	Quinacridone Burnt Orange,quinacridone	NA
PR 207	I	Quinacridone (hue designation), quinacridone red	73900
PR 209	I	Quinacridone Yellow Red, quinacridone red γ	73905
PR 242	I	Disazo condensation	20067
PR 254	I	Pyrrole Red, pyrrolopyrrol	73902
PR 255	I	Pyrrole Scarlet, pyrrolopyrrol	NA
PV 19	I	Quinacridone (hue designation), γ quinacridone red	73900
		PURPLES	
PV 15	I	Ultramarine Red, complex silicate of sodium and aluminum with sulfur, or sodium alumino-sulphosilicate	77007
PV 15	I	Ultramarine Violet, complex silicate of sodium and aluminum with sulfur, or sodium alumino-sulphosilicate	77007
PV 19(DL)	I	Quinacridone (hue designation), quinacridone violet b	73900
PV 23 (RS)	II	Dioxazine Purple, carbazole dioxazine	51319
PV 31	I	Isoviolanthrone Violet, isoviolanthrone	60010
		BLUES	
PB 15	I	Phthalocyanine Blue orPhthalo Blue, copper phthalocyanine	74160
PB 16	I	Phthalocyanine Blue, metal free phthalocyanine	74100
PB 22	I	Indanthrone Blue, indanthrone	69810
PB 27	II	Prussian Blue with option of adding the name Milori Blue, ferri-ammonium ferrocyanide	77510
PB 28	I	Cobalt Blue, oxides of cobalt and aluminum or cobalt aluminate	77346
PB 29	I	Ultramarine Blue, complex silicate of sodium and aluminum with sulfur, or sodium alumino-sulphosilicate	77007
PB 33	I	Manganese Blue, barium manganate with barium sulfate	77112
PB 35	I	Cerulean Blue, oxides of cobalt and tin or cobalt stannate	77368
PB 36	I	Cerulean Blue, Chromium orCobalt Chromite Blue, oxides of cobalt and aluminum, or cobalt chromite	77343
PB 60	I	Indanthrone Blue, indanthrone	69800
		GREENS	
PG 7	I	Phthalocyanine Green orPhthalo Green, chlorinated copper phthalocyanine	74260
PG 10	I	Green Gold with option of adding the name Nickel Azo Yellow, nickel chelated azo	12775
PG 17	I	Chromium Oxide Green, anhydrous chromium sesquioxide	77288
PG 19	I	Cobalt Green, oxides of cobalt and zinc, or cobalt zincate	77335
PG 23	I	Green Earth or Terra Verte, natural ferrous silicate containing magnesium and aluminum potassium silicates	77009
PG 26	I	Cobalt Green, cobalt chromite	77344
PB 36	I	Cobalt Chromite Green orCobalt Turquoise, oxides of cobalt and chromium, or cobalt chromite	77343
PG 36	I	Phthalocyanine Green, chlorinated and brominated phthalocyanine	74265
PG 50	I	Light Green Oxide, oxides of nickel, cobalt, and titanium	77377

TABLE 1 *Continued*

Colour Index Name	Lightfastness Category Acrylic	Common Name and Chemical Class	Colour Index Number
		BROWNS	
PBr 6	I	Mars Brown or Iron Oxide Brownwith option of adding the name Brown Iron Oxide, synthetic brown iron oxide or mixture of synthetic iron oxides	77499
PBr 7	I	Burnt Sienna, calcined natural iron oxide	77491 or 77492
PBr 7	I	Burnt Umber, calcined natural iron oxide containing manganese	77491 or 77492
PBr 7	I	Raw Sienna, natural iron oxide	77491 or 77492
PBr 7	I	Raw Umber, natural iron oxide containing manganese	77491 or 77492
		BLACKS	
PBk 6	I	Lamp Black, nearly pure amorphous carbon	77266
PBk 7	I	Carbon Black, nearly pure amorphous carbon	77266
PBk 9	I	Ivory Black or Bone Black, amorphous carbon produced by charring animal bones	77267
PBk 10	I	Graphite Gray, crystallized carbon	77265
PBk 11	I	Mars Black or Iron Oxide Black, with option of adding the name Black Iron Oxide, synthetic black iron oxide	77499
		WHITES	
PW 4	I	Zinc White, zinc oxide	77947
PW 6	I	Titanium White, titanium dioxide (rutile or anatase)	77891

[A]Applies only to Permanent Red Violet MRS, product of Clariant Corp., Coventry, RI 02816. Pigments described as thioindigoids have varying degrees of lightfastness.

APPENDIXES

(Nonmandatory Information)

X1. LIGHTFASTNESS III, IV, V

X1.1 The pigments in Table X1.1 are not sufficiently lightfast to be used in paints that conform to this specification. These pigments are listed here solely to establish common terminology. It is recommended that the Lightfast Category and the underlined information in Table X1.1 be given on product labels. Pigments in Lightfastness Category III may be satisfactory when used full strength (without dilution with white) or with extra protection from exposure to light.
Lightfastness III, ($\Delta E^* > 8$, <16); fair lightfastness
Lightfastness IV, ($\Delta E^* > 16$, < 24) poor lightfastness
Lightfastness V, ($\Delta E^* > 24$) very poor lightfastness

TABLE X1.1 Lightfastness III, IV, V

Colour Index Name	Lightfastness Category	Common Name and Chemical Class	Colour Index Number
PY6	III	Arylide Yellow 3G, Monoazo: acetocetyl	11670
PO 1	III	Arylide Anisidine, Monoazo: acetocetyl	11725
PR 17	III	Naphthol Red AS-D, Monoazo: 3-hydroxy-2-naphthanilide	12390
PR 52.1	V	Calcium Red Lake C, Monoazo: salt of 2-naphthol acid	15860:1
PR 83	IV	Alizarin Crimson, Anthraquinone: 1,2-dihydroxy anthraquinone lake	58000
PR 146	III	Naphthol Carmine FBB, Monoazo: 3-hydroxy-2-naphthanilide	12495
PV 23 BS	III	Dioxazine Purple, Oxazine: carbazole	51319
PG 8	III	Pigment Green B, Nitroso: ferric-nitroso-beta-naphthol	10006

X2. KUBELKA-MUNK SINGLE CONSTANT METHOD FOR PREPARING PAINT FILMS 40 ± 5 % REFLECTANCE

X2.1 Prepare a 6-mil (150-µm) drawndown of a mixture of white and colorant in proportions estimated to give a paint having a reflectance of 35 to 45 % at the wavelength of maximum absorption. Calculate C_c, the concentration of colorant in this mix, as follows:

$$C_c = W_c / W_w + W_w \quad \text{(X2.1)}$$

where:
$W_w$and W_c = weight of white and colorant, respectively, with weights accurate to 10^{-1} g.

X2.1.1 After drying, measure the film's reflectance at the wavelength of maximum absorption with a spectrophotometer, specular component excluded. Calculate $(K/S)_m$, the Kubelka-Munk Single Constant Value of this reflectance as follows:

$$(K/S)_m = (1 - R_m)^2 / 2(R_m \quad \text{(X2.2)}$$

where:
R_m = reflectance measurement of the mixture, expressed as a decimal value.

X2.1.2 Calculate K_c, the Kubelka-Munk absorption coefficient for unit concentration as follows:

$$K_c = (K/S)_m / C_c \quad \text{(X2.3)}$$

X2.2 Calculate C_d the concentration of colorant in white required to give the desired 35 to 45 % reflectance at the wavelength of maximum absorption as follows:

$$C_d = 0.045\, K_c \quad \text{(X2.4)}$$

X2.3 Calculate W_c, weight of colorant in batch of paint to be used for coating test panels as follows:

$$W_c = C_d (W_w + W_c) \quad \text{(X2.5)}$$

where:

W_w = weight of white the user determines will provide the approximate batch size desired.

X2.4 Prepare an initial drawndown of the resulting batch, let dry and measure the reflectance at the wavelength of maximum absorption to ensure it falls within the desired 35 to 45 % range.