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Standard Specification for Gouache Paints[1]

This standard is issued under the fixed designation D 5724; 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 gouache paints.

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

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 the standard. The values given in parentheses are for information only.

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 476 Specification for Titanium Dioxide Pigments[2]

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[3]

D 1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Herman-Type Gage[3]

D 1535 Test Method for Specifying Color by the Munsell System[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]

E 284 Terminology Relating to Appearance[3]

2.2 *Other Documents:*

Colour Index[5]

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.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *gouache paint*—a pigment dispersion in a water soluble gum/resin vehicle that dries water soluble and is formulated primarily for relatively opaque and matte applications.

3.3 Appearance terms used in this standard are defined in Terminology E 284.

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. 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,

[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 D01.57on 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] The Society of Dyers and Colourists, *Colour Index*, 3rd ed., 5 volumes and revisions, Available from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

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, and 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 in accordance with Test Methods D 4303 and the results indicating a different category are submitted to ASTM Subcommittee D01.57 for evaluation.

5.2 *Provide on the Label*:

5.2.1 Identification of gum/resin used.

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 8 and exposed, tested, and rated in accordance with Test Methods 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 8 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 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 just described.

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

5.3.4.1 Lightfastness III pigments have a color difference of more than 8.0 but not more than 16.0 CIELAB units.

5.3.4.2 Lightfastness IV pigments have a color difference of more than 16.0 but not more than 24.0 CIELAB units.

5.3.4.3 Lightfastness V pigments have a color difference of more than 24.0 CIELAB units.

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 5724." or "Conforms to ASTM D5724" or "Conforms to the quality requirements of ASTM D5724." This statement may be combined with other conformance statements, such as, "Conforms to the quality and health requirements of ASTM Specification D 5724 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 Gouache Paints

6.1 *Conditions Not Covered in This Specification that Affect Gouache Paints*:

6.1.1 *Substrate*—The effective pH of the paper used will affect the long-term color of the applied gouache paints.

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

6.1.3 *Storage*—With aging and elevated temperatures there may be a change in consistency and a discernible separation of vehicle.

6.2 *Vehicles*—Only water soluble gums/resins shall be used.

6.3 *Pigments*—Pigments used in gouache paints shall be limited to those in Table 1. Their lightfastness rating shall be

the numeral given in the same row.

6.4 *Additives*—Thickeners, preservatives, surfactants, and humectants may be used to achieve consistency, prevent microbe deterioration, and control application results.

6.5 *Inerts*—Inerts shall only be used to produce desirable working qualities.

6.6 *Preparation of Sample*—For paste and fluid paints, empty the contents of the previously unopened container onto a glass slab and mix thoroughly with a spatula to a homogeneous sample. For cake paints, take a piece of the cake on a glass slab and add water and mix until a homogeneous paint is formed.

6.7 *Coarse Particles*—Paints shall be free of oversized particles and shall form a uniform film. The maximum content of coarse particles shall be 1 % by 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 easily solubilized with water to a homogeneous color.

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 *Opacity (Hiding Power)*—Opacity rating requirements will be included in this specification as appropriate standards for opacity of paints are established. Test method described in Appendix X2 may be used to rate the opacity of a paint.

6.12 *Bleeding*—Bleeding rating requirements will be included in this specification as appropriate standards for bleeding of paints are established. Test Method B of D279 may be used to determine the rate of bleeding of paints.

6.13 *Color Specification*—Color specification of each color by Munsell notation by Test Method D 1535 may be given in an appropriate producer publication. Manufacturers are encouraged to put this specification on the container label when label size permits.

7. Lightfastness Determination

7.1 If a pigment is not listed in Table 1, test specimens of a gouache 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 1—A report of the results of these tests may be submitted to 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 *Substrates*—White unlacquered paper.[6]

7.2.2 *Chalk Resistant Titanium Dioxide Gouache Paint*.

7.2.3 *Drawdown Bar*, with 4-mil (100-µm) aperture.

7.3 *Mixing Whites for Dilution of Colors*:

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

	Weight,%
Gum arabic nonvolatile	6.4
Glycerine	4.6
Chalk resistant rutile titanium dioxide (conforming to Type IV in Specification D 476)	66.7

7.4 *Preparation of Test Paints*:

7.4.1 The pigment to be tested may be milled in a soft paste consistency. If a prepared paint of known composition is available, it may be used for this test instead of preparing a standard.

7.4.2 Dilute the pigment paste or paint with the mixing white and draw-down on unlacquered paper until the spectrophotometric measurement of the dry paint shows from 35 to 45 % reflectance at the wavelength of maximum absorption for that pigment. The wavelength of maximium 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 %.

7.4.2.1 To obtain this reflectance, use the Kubelka-Munk Single Constant Method described in Appendix X4 or use a trial and error method.

7.4.2.2 For gouache paints, 80 g of white paint is needed since paint used in the drawdown is lost.

7.4.2.3 For the initial weight of white stated in 7.4.2.1 and 7.4.2.2, the weighing must be accurate to 0.05 g.

7.5 *Preparation of Test Panels*:

7.5.1 Use an applicator with a 4-mil (100-µm)[7] aperture to make a drawdown at least 1.5 by 1.5 in. (40 by 40 mm), or other minimum size appropriate for the viewing area of the instrument used. Follow Method C in Practices D 823, if a motor-driven applicator is available. Pressure of about 500 g on the applicator is recommended. For manual drawdowns follow Method E in Practices D 823 when an auxiliary flatting bar is available. Return all recoverable paint to the batch to allow for repeat mixes and measurements.

7.5.2 When a motor-driven applicator or an auxiliary flatting bar is not available, tape the unlacquered paper on a

[6] The sole source of supply of the white unlacquered paper, Form NWK known to the committee at this time is The Leneta Co., 15 Whitney Rd., Mahwah, NJ 07430. 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] A 4-mil (100-µm) applicator was found satisfactory to obtain complete hiding for the mixing white in 7.3.1. Deeper aperture shall be used if complete hiding is not obtained, however, too thick drawdowns may cause cracking of films during exposure.

smooth surface such as a piece of glass. Position the applicator just above the upper edge of the paper and place a pool of the diluted paint in front of it. Grasp the sides of the applicator with the fingers and pull it down the paper with a smooth uniform motion.

7.5.3 Prepare four specimen panels for each pigment under test. Two are used in the first lightfastness tests and two are retained in a dark place, 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 Method D 4303.

7.5.4 Apply the test paints to the unlacquered paper as described in 7.5.1 or 7.5.2. The panels should be air dried for overnight.

7.5.5 Cut the test panel from a section of the drawdown that is uniformly colored. If a backing is needed to support the test panels, adhere the panels to an appropriate substrate, such as light weight posterboard.

8. Exposure

8.1 Conduct exposure tests, calculate mean color difference, and assign pigments to lightfastness categories as described in Test Method D 4303.[8]

9. Keywords

9.1 gouache paints; lightfastness; quality requirements; test specimens

[8] Lightfastness categories in Table 1 and Table X1.1 were determined by Test Methods B and C in Test Methods D 4303. In Test Method B using fluorescent lamps, irradiance was monitored continuously during tests by a pyranometer to a total irradiation of 1260 MJ/m^2. In Test Method C using an xenon arc exposure system, irradiance was monitored by a narrow bandpass radiometer at 340 nm. Calibration to a total radiation of 1260 MJ/m^2 was based on the solar radiation measurement in southern Florida by South Florida Test Service. The Florida data show that total spectral irradiation at 340 nm was 550.87 kJ/m^2 when the total irradiation reached 1260 MJ/m^2 in the outdoor underglass exposure rack. Accordingly, a xenon arc exposure test was carried out until the spectral irradiation at 340 nm reached 550.9 kJ/m^2.

TABLE 1 Suitable Pigments List

NOTE 1—Underlined information in the table and lightfastness category 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
AR	Acid Red
BR	Basic Red

Pigment Notations in Parenthesis:

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

Color Index Name	Ligthfastness Categeory	Common Name and Chemical Class	Color Index Number
		YELLOWS	
PY 3	I	Arylide Yellow I0G, with option of adding the name Hansa Yellow Light, arylide yellow	11710
PY 6	I	Arylide Yellow, arylide yellow	11670
PY 35	I	Cadmium (hue designation), concentrated cadmium zinc sulfide (CC), (SM)	77205
PY 37	I	Cadmium (hue designation), concentrated cadmium sulfide (CC), (SM)	77199
PY 42	I	Mars Yellow or Iron Oxide Yellow, synthetic synthetic hydrated iron oxide	77492
PY 43	I	Yellow Ochre, natural hydrated iron oxide	77492
PY 53	I	Nickel Titanate Yellow, oxides of nickel, antimony and titanium	77788
PY 65	II	Arylide Yellow RN, with option of adding Hanas Yellow RN, aryhde yellow	11740
PY 74 2GX70	II	Arylide Yellow 2GX70, Hansa Yellow 2GX70, arylide yellow (OP)	11741
PY 109	I	Isoindolinone Yellow G, tetrachroloisoindolinone	NA
PY 110	I	Isoindolinone Yellow R, tetrachroloisoindolinone	56280
PY 139	I	Isoindoline Yellow, isoindoline	NA
PY 170	II	Diarylide Yellow, diarylide yellow	21104

TABLE 1 *Continued*

		ORANGES	
PO 5	I	Dinitraniline Orange, dinitraniline (SM)	12075
PY 20	I	Cadmium (hue designation), concentrated cadmium sulfo-selenide	77202
PO 36	I	Benzimidazolone (hue designation) HL, benzimidazolane	11780
PO 43	I	Perinone Orange, perinone (DL)	71105
PO 73	II	Pyrrcle Orange, Pyrrolopyrrol	NA
		REDS	
PR 5	II	Naphthol ITR, naphthol ITR	12490
PR 9	II	Naphthol AS-OL, naphthol AS-OL	12460
PR 14'	II	Naphthol AS-D, naphthol AS-D	12380
PR 88MRS[A]	I	Thioindigoid Violet, thioindigoid	73312
PR 101	I	Mars Red or Iron Oxide Red, synthetic iron oxide	77491
PR 108	I	Cadmium (hue designation), concentrated cadmium-seleno sulfide (CC)	77202
PR 113	I	Cadmium Vermilion Red Light, Medium or Deep, cadmium mercury sulfide (CC)	77201
PR 122	II	Quinacridone (hue designation), γ quinacridone	73915
PR 170 F3RK-70	II	Naphthol Red, naphtol carbamide (DL)	12475
PR 188	I	Napthol AS, naphthol AS	12467
PV 19	I	Quinacridone (hue designation),γ quinacridone red	73900
		VIOLETS	
PV 14	I	Cobalt Violet, cobalt phosphate	77360
PV 19	I	Quinacridone (hue designation), quinacridone violet b	73900
PV 23	II	Dioxadine (hue designation), carbazole dioxazine	51319
		BLUES	
PB 15	I	Phthalocyanine Blue, or Pthalo Blue, copper phthalocyanine	74160
PB 17:1	II	Phthalocyanine Blue Lake, or Pthalo Blue Lake, trisulfonated copper phthalocyanine	74200:1
PB 27	I	Prussian Blue, Milori Blue, alkali ferric 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
		GREENS	
PG 7	I	Phthalocyanine Green, or Phthalo Green, chlorinated copper phthalocyanine	74260
PG 17	I	Chromium Oxide Green, anhydrous chromium sesquioxide	77288
PG 18	I	Viridian, hydrous chromium sesquioxide	77289
PG 19	I	Cobalt Green, oxides of cobalt and zinc, or cobalt zincate	77335
PG 23	I	Green Earth, or Terre Verte, natural ferrous silicate containing magnesium and aluminum potassium silicates	77009
PG 36	I	Phthalocyanine Green or Phthalo Green, chlorinated and brominated copper phthalocyanine	74265
		BROWNS[B]	
PBr 7	I	Burnt Sienna, calcined natural iron oxide	77492
PBr 7	I	Burnt Umber, calcined natural iron oxide containing manganese	77492
PBr 7	I	Raw Sienna, natural iron oxide	77492
PBr 7	I	Raw Umber, natural iron oxide containing manganese	77492
PBr 11	I	Magnesium Ferrite, synthetic iron oxide containing magnesium oxide	77495
PBr 24	I	Chrome Titanate Yellow, oxides of chrome, antimony and titanium	77310
PBr 25	I	Benzimidazolone Brown, monoazo benzimidazolone	12510
		BLACKS	
PBk 1	I	Jet Black, aniline black	50440
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
		WHITES[C]	
PW 4	I	Zinc White, zinc oxide with option of adding the name Chinese White	77947
PW 5	I	Lithopone, zinc sulfide coprecipitated with barium sulfate	77115
PW 6	I	Titanium White, titanium dioxide (rutile or anatase) with option of including some barium sulfate or zinc oxide	77891
PW 7	I	Zinc Sulfide, zinc sulfide	77975

[A] Applies only to Novoperm Red Violet MRS, product of Hoechst AG, D-6230 Frankfurt am Main, Germany. Pigments described as thioindigoids have varying degrees of lightfastness.

[B] Color Index Number 77491 can be used as an alternate to 77492 for PBr 7.

[C] Information on white pigments is given in Appendix X3.

APPENDIXES

(Nonmandatory Information)

X1. LIGHTFASTNESS III, IV AND 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 solely to establish common terminology. Pigments in Lightfastness Category III may be satisfactory when used full strength (that is, without the enclusion of white in the formula, without dilution with white) or with

TABLE X1.1 Lightfastness III, IV and V

Colour Index Name	Lightfastness Category	Common Name and Chemical Class	Colour Index Number
		YELLOWS	
PY 1	III	Arylide Yellow G, with option of adding the name Hansa Yellow Medium, Monoazo: acetocetyl	11680
PY 1:1	III	Arylide Yellow G, with option of adding the name Hansa Yellow Medium, Monoazo: acetocetyl	11680
PY 55	V	Diarylide Yellow AAPT, Disazo	21096
PY 55(OP)	V	Diarylide Yellow AAPT, Disazo.	21096
PO 13	V	Pyrazolone Orange, Disazo (DM)	21110
PO 16	V	Dianisidine Orange, Disazo	21160
PO 34RL01	V	Diarylide Orange RL01, Disazo: diarylide/pyrazolone	21115
PO 34RL70	III	Diarylide Orange RL70, Disazo: diarylide/pyrazolone	21115
PR 3	III	Toluidine Red, Monoazo: 2-naphthol	12120
PR 4	IV	Chlorinated Para Red, Monoazo: 2-naphthol	12085
PR 7	III	Naphthol Red AS-TR, Monoaxo: 3-hydroxy-2-naphthanilide	12420
PR 12	III	Naphthol Red AS-D, Monoazo: 3-hydroxy-2-naphthanilide	12385
PR 23	V	Naphthol Red Dark AS-BS, Monoazo: 3-hydroxy-2-naphthanilide	12355
PR 31	V	Naphthol Red AS-BS, Monoazo: 3-hydroxy-2-naphthanilide	12360
PR 48:2	V	Calcium BON Red, Monoazo: salt of 2-naphthol acid	15865:2
PR 48:3	V	Strontium BON Red, Monoazo: salt of 2-naphthol acid	15865:3
PR 49:1	V	Barium Lithol Red, Monoazo: salt of 2-naphthol acid dye	15630:1
PR 52:2	V	Manganese Red Lake C, Monoazo: salt of 2-naphthol acid	15860:2
PR 57:1	V	Calcium Lithol Red, Monoazo: salt of 2-naphthol acid	15850:1
PR 60:1	IV	Pigment Scarlet 3B, Monoazo: salt of 2-naphthol acid	16105:1
PR 81	IV	Rhodamine 6G Lake, Xanthrene: salt of basic dye	45160:1
PR 83	IV	Alizarine Red, Anthraquinone: 1,2-dihydroxy anthraquinone lake	58000
PR 112	III	Naphthol Crimson, naphthol carbamide	12475
PR 170F5RK	III	Naphthol Crimson, Monoazo: 3-hydroxy-2-naphthanilide	12475
BR 12	V	Phloxine Lake, Methine: basic red dye	48070
AR 87	V	Eosine Lake, Xanthrene: Acid Red 87 dye	45380
PV 1	V	Rhodamine B Lake, Xanthrene: PTMA salt of Basic Violet 10 dye	45170:2
PV 2	V	Rhodamine 3B Lake, Xanthrene: PTMA salt of Basic Violet 11 dye	45175:1
PV 3	V	Methyl Violet Lake, Triphenylmethane: PTMA salt of Basic Violet 1 dye	42535:2
PV 39	IV	Crystal Violet Lake, Triphenylmethane: PTMA salt of Basic Violet 3 dye	42555:2
PB 1	V	Victoria Blue, Triphenylmethane: PTMA salt of Basic Blue 7 dye	42595:2
PG 8	III	Pigment Green B, Nitroso ferric-nitroso-beta-naphthol	10006

Lightfastness III, ($\Delta E^* > 8, < 16$) fair lightfastness
Lightfastness IV, ($\Delta E^* > 16, < 24$) poor lightfastness
Lightfastness V, ($\Delta E^* > 24$) very poor lightfastness

extra protection from exposure to light.

X2. TEST METHOD FOR OPACITY OF PAINTS

X2.1 Scope

X2.1.1 This test method is used to test opacity of paints. Several drawdown bars having different aperture sizes are used.

X2.2 Preparation

X2.2.1 Prepare sample as described in 6.6. If the paint is very thick, it may be necessary to add a minimum amount of water to make the paint fluid enough to drawdown smoothly.

X2.3 Procedure

X2.3.1 Make several drawdowns of different layer thicknesses on black/white opacity charts[9] with drawdown bars of different aperture sizes. Follow drawdown instructions in 7.5.1.

X2.3.2 Measure the drawdowns over the black part and over the white part of each chart to find the aperture size where the contrast ratio (a ratio between luminance Y of a paint film on a black and white substrate, that is, Yb/Yw) is 0.98 or larger.

X2.4 Report

X2.4.1 Rate the opacity of the sample by the minimum aperture size where the contrast ratio is 0.98 or larger. An example is as follows:

Aperture Size	Rating
100 µm or less	opaque
from 100–130 µm	semiopaque
from 130–160 µm	semitransparent
over 160 µm	transparent

[9] The sole source of supply of the laquered opicity charts, Form 2A known to the committee at this time is The Leneta Co. 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.

X3. CHALKING OF PAINTS REDUCED WITH WHITE

X3.1 When gouache paints are reduced with white, they sometimes chalk under exposure to light. This is mainly due to the type of pigment contained in the white paint. In Table X3.1 the effects of several white pigments on chalking are shown. A phthalocyanine blue pigment (PB 15) and a group of white pigments were prepared in a gum arabic vehicle. The blue paint was then reduced with each white as described in 7.4.2. The reduced paints were exposed in a xenon arc exposure apparatus in accordance with this specification and Test Method D 4303. The color difference between the exposed and unexposed paint specimens are given in CIELAB units (ΔE*ab) in Table X3.1.

TABLE X3.1 Effects of Type of White Pigment on Chalking

White Pigment	Type in Specification D 476	ΔE*ab
Rutile TiO_2	Type II	7.54
Rutile TiO_2	Type III	1.12
Rutile TiO_2	Type IV	1.10
Anatase TiO_2(ordinary type)	Type I	21.89
Anatase TiO_2(surface modified type)	Type I	13.50
ZnO	...	8.32
$ZnS/BaSO_4$(mixture similar ratio to lithopone)	...	6.77
ZrO_2	...	1.99

X4. KUBELKA-MUNK SINGLE CONSTANT METHOD FOR PREPARING PAINT FILMS 40 ± 5 % REFLECTANCE

X4.1 Prepare a mixture of white and colorant in proportions estimated to give a paint having a reflectance of 30 to 60 % at the wavelength of maximum absorption. Calculate the concentration of colorant in white in this batch, as follows:

$$C_c = W_c/(W_w + W_c) \quad \text{(X4.1)}$$

where:

C_c = concentration of colorant, and
W_w and W_c = weight of white and colorant, respectively, used in the batch.

Draw or brush a film of this paint over contrast paper at a thickness sufficient to give complete visual hiding.

X4.1.1 After allowing the film to dry, measure the reflectance of this film at the wavelength of maximum absorption with a spectrophotometer or, if using a colorimeter, the reflectance with the filter that gives the lowest reading (see Note X4.1). Calculate the Kubelka-Munk Single Constant Value of this reflectance, as follows:

$$(K/S)_m = [1 - (R_m - 0.04)]^2/2(R_m - 0.04) \quad \text{(X4.2)}$$

where:

$(K/S)_m$ = Kubelka-Munk value,
R_m = reflectance measurement of the mixture, made with the specular component included expressed as a decimal value, and
0.04 = decimal value correction for surface reflectance.

X4.1.2 Calculate the Kubelka-Munk absorption coefficient for unit concentration, as follows:

$$K_c = (K/S)_m/C_c \quad \text{(X4.3)}$$

where K_c = unit absorption coefficient.

X4.2 Based on the results of the trial mixture, calculate the concentration of colorant in white required to give the desired 35 to 45 % reflectance at the wavelength of maximum absorption.

$$C_d = (K/S)_{40\,\%}/K_c = 0.4500/K_c \quad \text{(X4.4)}$$

where C_d = concentration of colorant in white predicted to give a paint with the desired 35 to 45 % reflectance value.

X4.3 Adjust the concentration of the trial batch so that the concentration of colorant equals C_d. The changes in colorant concentration, ΔC are as follows:

$$\Delta C = C_d - C_c \quad \text{(X4.5)}$$

These changes are positive if the trial batch has a reflectance greater than 40 % and negative if the reflectance is less than 40 %. If ΔC is positive, add more colorant to the trial batch to bring the concentration of colorant to C_d. If ΔC is negative, add more white to bring the concentration of colorant to C_d. Because it may be necessary to add large amounts of white to correct for concentrations of colorant giving reflectance values far below 40 %, it is usually best to prepare a trial batch expected to give a ΔC value that is moderately positive or only slightly negative.

X4.3.1 For the case where ΔC is positive, the weight of colorant needed to prepare a second batch is as follows:

$$\Delta W_c = W_c - C_d(W_w + W_c)/C_d - 1 \times (LF) \quad \text{(X4.6)}$$

where:

ΔW_c = weight of colorant to be added to the trial batch to obtain a corrected batch with a colorant concentration of C_d, and
LF = "loss factor" = weight of paint from trial batch used to prepare the corrected batch/weight of paint prepared as trial batch.

The loss factor, LF , allows for paint removed to prepare drawdowns, loss by transfer to different containers, etc. This term may be neglected if losses are small compared to the batch size. The other terms are as defined in the previous sections of this appendix.

X4.3.2 For the case where ΔC is negative, the weight of white needed to prepare a corrected batch corresponds to,

$$\Delta W_w = W_c - C_d(W_w + W_c)/C_d \times (LF) \quad \text{(X4.7)}$$

where ΔW_w = weight of white needed to adjust the colorant concentration in the batch to C_d. Other terms are as defined above or in previous sections of this appendix.

X4.4 Prepare a paint film from the adjusted batch. After drying, measure the reflectance at the wavelength of maximum absorption. If this value does not fall within 35 to 45 %, repeat X4.1.1 through X4.3, where $C_d$now becomes the $C_c$for the

next batch correction. Normally only a single iteration is necessary and a second batch correction will not be needed.