

**California Department of Transportation
Specification PTWB-01R2¹ for
Paint, Rapid Dry Waterborne Traffic Line, White, Yellow, and Black**

1.0 SCOPE

This Specification covers a ready-mixed, one-component, waterborne acrylic traffic line paint which can be applied to either asphalt concrete or portland cement concrete pavements.

2.0 SPECIFICATIONS AND STANDARDS

The following Specifications, Test Methods, and Standards in effect on the opening date of the Invitation for Bid form a part of this Specification where referenced.

- American Society for Testing and Materials (ASTM) Designations: D93, D476, D522, D562, D711, D869, D1210, D1475, D1640, D2369, D3168, D3335, D3718, D3723, D3960, D4563, D5380, D6628, D7585, E70, E313, E1710 and G154.
- Federal Specification 595b, Color #33538 and #37038.
- U.S. Environmental Protection Agency (EPA) Method 24
- Code of Federal Regulations, Title 49.
- California Code of Regulations, Title 22, Division 4.
- California Department of Transportation, Test Method No. 660.
- California Department of Transportation, Standard Specifications, latest revision.

3.0 REQUIREMENTS

3.1 General:

This Specification is intended to specify traffic paint that will meet pavement delineation requirements for highway construction and maintenance. This traffic paint is to be used in conjunction with glass spheres to produce pavement delineation that is visible during both day and night conditions.

3.2 Composition:

¹ Note: This Specification cancels and supersedes; PTWB-01R2(November 2016), #PTWB-01R2 (March 2010), #PTWB-01R1 (October , 2009), #PTWB-01 (February, 2006), #PTWB-01(Dec, 2003), #PTWB-01 (September, 2002), #PTWB-01 (September, 2001), #8010-20B (January, 2000), #8010-20A (February, 1997) and #8010-20 (March, 1996)

3.2.1 Acrylic Polymer Emulsion:

The paint binder shall consist of one of the commercial acrylic or styrene/acrylic polymer emulsions described below;

- Dow Chemical, Fastrack HD-21A
- Dow Chemical, Fastrack 3427
- Dow Chemical Fastrack 5408
- Arkema Coating Resins, Encor DT-400
- Arkema Coating Resins, Encor DT-250
- BASF, Acronal Xpress 4347

3.2.2 Prime Pigments:

White paint:

The white paint shall contain a minimum of 1 lb per gallon of titanium dioxide pigment meeting ASTM Designation: D476 Type II (Rutile). The titanium dioxide content will be determined using ASTM Designations: D 4563 and D 5380.

Yellow paint:

The yellow paint shall be pigmented with Pigment Yellow C.I. #65 and/or Pigment Yellow C.I. #75. Other pigments may be added to meet the yellow color and opacity requirements in sections; 3.3.19 and 3.3.16, respectively. However, the paint shall not contain lead or chromium at levels above the limits set in sections; 3.3.23 and 3.3.24.

3.2.3 The remainder of the paint composition shall be determined by the manufacturer - within the constraints of the requirements below. It shall be the manufacturer's responsibility to produce a pigmented waterborne traffic paint containing the necessary; co-solvents, dispersants, preservatives, wetting agents and all other additives - so that the paint will retain its viscosity, stability and all other properties as specified herein. No glass beads or sand shall be permitted in the paint formulations. In addition to being essentially lead and chromium free, the paint shall not contain any hazardous materials at levels that would cause the paint (when dry) to be classified as a hazardous waste under Title 22, Division 4, section 66261.20 of the California Code of Regulations.

3.3 Characteristics of the Finished Paint:

3.3.1 Condition in the Container

The paint, as received, shall show no evidence of; biological growth, corrosion of the container, livering or hard settling. The paint shall be returned to a smooth and homogeneous consistency, which is free from; gel structures, persistent foam or air bubbles - using only hand mixing.

Section Number	Material	White	Yellow	Black
3.3.2	Degree of Settling, minimum, ASTM Designation: D869	7	7	7
	A 1 pint paint can is filled with a well mixed sample. The can is capped and allowed to set undisturbed at standard ² conditions for 14 days. The settling is then determined as specified in ASTM Designation: D869. The 1-quart laboratory samples of each batch, as received, shall also pass this test.			
3.3.3	Nonvolatile Content, weight %, ASTM Designation: D2369	77 ±2.0	76 ±2.0	76 ±2.0
3.3.4	Pigment Content, weight %, ASTM Designation: D3723	60 ±2.0	58 ±2.0	58 ±2.0
3.3.5	% Nonvolatile in Vehicle (%NVV), weight %, minimum	42	42	42
	Calculated as; $\% \text{ NVV} = \frac{\% \text{ Nonvolatile Content} - \% \text{ Pigment}}{100 - \% \text{ Pigment}} \times 100$			
3.3.6	Density, g/ml at 25°C ASTM Designation: D1475	1.68 ±0.04	1.63 ±0.04	1.62 ±0.04
3.3.7	Consistency, K.U. at 25 ±1°C ASTM Designation: D562	78-92	78-92	78-90

² Standard conditions are defined here as: 23±2°C and 50±5% relative humidity.

Section Number	Material	White	Yellow	Black
3.3.8	Fineness of Dispersion, Hegman, minimum, ASTM Designation: D1210	3.0	3.0	3.0
3.3.9	Dry to No Pick-Up Time, without beads, minutes, maximum, ASTM Designation: D711	10	10	10
3.3.10	Dry Through, minutes, maximum	20	20	20
	This test may be performed on the same draw down sample as in section 3.3.9. The test is the same as outlined in ASTM Designation: D1640 except that the lightest thumb pressure possible should be used. The thumb is rotated through an angle of 90 degrees while lightly in contact with the film. The drying time at which this rotation does not break the film is recorded.			
3.3.11	Dry Through, at 90% relative humidity, minutes, maximum	180	180	-
	Draw down the paint on a glass panel to a wet film thickness of 13 mil. Immediately place the panel in a humidity chamber maintained at 23+2°C and 90+5% relative humidity. Test in accordance with ASTM Designation: D1640 except that the pressure exerted shall be the minimum needed to maintain contact between the thumb and the paint film. Check the film for a dry through condition at 15 minute intervals. The thumb is rotated through an angle of 90 degrees while lightly in contact with the film. The drying time at which this rotation does not break the film is recorded. Quickly return the glass panel to the humidity chamber after each check.			
3.3.12	Volatile Organic Compounds (VOC), grams per liter of paint, excluding water, maximum	100	100	100

Section Number	Material	White	Yellow	Black
	Use U.S. EPA Method 24 or other approved method in effect at the time of paint manufacture to determine the VOC level and water content of the paint.			
3.3.13	Flashpoint, °C, minimum, ASTM Designation: D93 Method A	38	38	38
3.3.14	Flexibility, ASTM Designation: D522 Method B	Pass	Pass	Pass
	Use 4x6 inch tin-plated steel panels 10 mils thick. Prepare the panel by lightly buffing one side with Grade 0 (medium-fine) steel wool, followed by cleaning with toluene and drying. Draw down the paint on the buffed side of the panel to a wet film thickness of 5 mils. Air dry the panel for 24 hours at standard conditions, then bake for 5 hours at 105+2°C and finally condition the panel for 30 minutes at standard conditions. Bend the panel 180° over a ½ inch mandrel in 1 second, then examine under a magnification of 10 times. The paint film shall not; crack, chip or flake when the panel is bent around the mandrel.			
3.3.15	Appearance	Pass	Pass	Pass
	Draw down a 13 mil thick wet film of the paint on a glass plate and allow to dry for 24 hours at standard conditions. The paint shall produce a film which is smooth, uniform, and free from; grit, undispersed particles, craters, pinholes and cracking.			
3.3.16	Dry Opacity, minimum	0.93	0.89	1.0
	On a black-white Leneta chart, Form 2C-Opacity, draw down a uniform 5 mil thick wet film of paint covering both the black and white portions of the chart. Measure the wet film thickness with an appropriate gauge. Dry for 24 hours at standard conditions. Use a BYK-Gardner "Color-Guide" Spectrophotometer to measure the opacity according to the manufacturer's instructions. Calibrate the spectrophotometer according to the manufacturer's			

Section Number	Material	White	Yellow	Black
	instructions using; 2° Observer/Illuminant "C" measurement conditions, and the (Y, x, y) color system.			
3.3.17	Yellowness Index, maximum	8	-	-
	Draw down a 13 mil thick wet film of the white paint on two 3x6 inch chromate treated aluminum panels (i.e.: Q Panel Co., type AL). Dry for 24 hours at standard conditions. Save one panel for the Accelerated Weathering test (section 3.3.21). Using a BYK-Gardner "Color-Guide" Spectrophotometer, follow the manufacturer's instructions (see section 3.3.16), and measure the Yellowness Index of the white paint film using the ASTM Designation: E313 mode.			
3.3.18	Daytime Luminance Factor	≥87	47-60	≤4
	Using the draw down panels prepared in sections 3.3.17 or 3.3.19, measure the reflectance of the white and yellow paint films using the BYK-Gardner "Color-Guide" Spectrophotometer. Follow the manufacturer's instructions to obtain the Reflectance or "Y" value (see section 3.3.19).			
3.3.19	<p>Yellow Color</p> <p>Draw down the yellow paint on two chromate treated aluminum panels as described in section 3.3.17. One panel should be used for the Accelerated Weathering test (section 3.3.21). Retain the other yellow panel as a control and for the Reflectance test (section 3.3.18). The yellow color shall match Federal Standard 595b, color #33538 and shall lie within the "box" formed by the chromaticity coordinate limits as defined below, when tested according to California Test 660 and plotted on a C.I.E. (1931) Chromaticity Diagram. A BYK-Gardner "Color-Guide" spectrophotometer, that has been set up as described below, can also be used to measure the chromaticity coordinates. The measured yellow color shall lie within the "box" formed by the chromaticity coordinate limits - both before and after the Accelerated Weathering test (see section 3.3.21). A graph for plotting the</p>			

Section Number	Material	White	Yellow	Black
	<p>chromaticity coordinates is available from the Transportation Laboratory.</p> <p>Color System: C.I.E. (1931) Chromaticity Diagram, (Y, x, y) Measurement conditions: 2° Observer / Illuminant "C" Hue: 580 to 583.5 nm Minimum color saturation: $x=0.7000-0.5000y$ Brightness: $Y=47$ to 60</p> <p>The yellow color coordinates shall lie within a "box" defined by plotting the following four (x,y) pairs on the C.I.E. Chromaticity Diagram (1931).</p> <p>(x1,y1) = (0.5125, 0.4866) (x2,y2) = (0.4733, 0.4533) (x3,y3) = (0.4848, 0.4305) (x4,y4) = (0.5348, 0.4646)</p>			
3.3.20	<p>Black Color</p> <p>Draw down the black paint on a chromate treated aluminum panel as described in section 3.3.17. After drying for 24 hours at standard conditions the color shall closely match Federal Standard 595b, color #37038. The black paint must also meet the Daytime Luminance Factor requirement in section 3.3.18.</p>			
3.3.21	<p>Accelerated Weathering Test</p> <p>Ultraviolet Light and Condensate Exposure, 300 hours total, ASTM Designations: G154 and G151.</p> <p>Prepare samples of the white and yellow paints as described in sections 3.3.17 and 3.3.19. Alternately expose the samples to; eight hours of UV exposure at 60°C, followed by four hours condensate exposure at 50°C - in a QUV Accelerated Weathering Tester. Type UVA-340 bulbs are used at an irradiance level of 0.77 watts per square meter per nm. at 340 nm., as measured at the sample surface during the UV cycle. After 300 hours total exposure the paint samples shall meet the requirements below.</p>			

Section Number	Material	White	Yellow	Black
	<p>White - Yellowness Index after weathering, maximum, 12 (see section 3.3.17)</p> <p>Yellow - Must pass Yellow Color test after weathering (see section 3.3.19)</p>			
3.3.22	Lead, mg/kg in dried paint, maximum, ASTM Designation: D3335	20	20	20
3.3.23	Chromium, mg/kg in dried paint, maximum, ASTM Designation: D3718	5	5	5
3.3.24	Thick Application Cracking Resistance	Pass	Pass	Pass
	<p>On a black-white Leneta chart, Form 2C-Opacity, draw down a stripe of the paint 3 inches wide and at least 6 inches long and having a 60±5 mil wet film thickness. Allow the paint to dry for 48 hrs. at standard conditions on a horizontal surface. After 48 hrs. the paint film shall not exhibit any cracks.</p>			
3.3.25	Accelerated Package Stability	Pass	Pass	Pass
	<p>Fill a clean 1 pint resin-lined, friction-top paint can with a well-stirred sample. Measure the initial Consistency as in section 3.3.7. Close the can tightly. Store this can in an oven at a temperature of 52°C for 14 days. After 14 days remove the can from the oven and allow the can to cool overnight. Determine the Consistency of the paint as in section 3.3.7, except allow hand stirring of the sample for 5 minutes to ensure uniform redistribution of any settlement before testing. The Consistency of the paint shall not change more than 7 K.U. after this heated storage period – when compared to the initial Consistency. Draw down a 13 mil thick wet film of this sample on a glass plate and examine for Appearance as in 3.3.15.</p>			
3.3.26	Infrared Spectra of Nonvolatile Vehicle, allowable variation from	None	None	None

Section Number	Material	White	Yellow	Black
	laboratory reference spectra, ASTM Designation: D3168			
3.3.27	pH, ASTM Designation: E70	10 ±1.0	10 ±1.0	10 ±1.0
3.3.28	Initial Retroreflectivity of Applied Paint (with beads), $\text{mcd} \cdot \text{m}^{-2} \cdot \text{lx}^{-1}$, minimum	250	175	-
	The paint shall produce delineation that has the minimum required level of retroreflectivity when applied to pavement (with drop-on beads) according to the manufacturer's recommendations. Drop-on glass beads shall be uniformly applied at a minimum rate of 5-lb per gallon of paint. The retroreflectivity shall be measured as specified in ASTM Designation: D7585 using a retroreflectometer meeting ASTM Designation: E1710.			
3.3.29	Color after Application The color of the applied white and yellow stripes and markings (with beads) shall conform to the daytime and nighttime color requirements in ASTM Designation: D 6628.			

3.4 Workmanship, Settling and Shelf-Life:

- 3.4.1 The paint shall be free from dried paint skins and foreign materials such as; dirt, sand, fibers, or other materials capable of clogging; screens, valves, pumps, or other equipment used in paint striping apparatus.
- 3.4.2 The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container and shall not become granular or curdled. Any settlement of the pigment in the paint shall result in a thoroughly wetted soft mass that permits the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with a minimum of resistance to the sidewise manual motion of the paddle across the bottom of the

container. This stirring shall return the paint to a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement or any other cause, then the paint shall be considered unfit for use.

- 3.4.3 The paint shall retain all specified properties under normal storage conditions for 8 months after acceptance and delivery. Ordered paint shall be no more than 90 days old (based on date of manufacture) upon delivery to a Department of Transportation Maintenance facility. The date of manufacture shall be clearly marked on each container. The vendor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The characteristics of any replacement paint, as specified in section 3.3, shall remain satisfactory for 8 months from the date of acceptance and delivery.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Sampling and Testing:

A one-quart representative sample of each batch of traffic paint intended for use by the Department of Transportation must be sent to the Transportation Laboratory for testing and approval **before** the batch is shipped. The address of the Transportation Laboratory is listed in section 6.4. A batch shall be that amount of paint which was manufactured and packaged in a single operation. The Department of Transportation reserves the right to take random samples of batches of paint destined for use by the Department, at the manufacturer's facility. If requested by the Inspector, batch tickets must also be provided for batches of paint produced for the Department.

A manufacturer's test report shall be included with the one-quart sample of each batch sent to the Transportation Laboratory. The following information shall be included in the manufacturer's test report:

- State Specification number (#PTWB-01R2 (November, 2016)).
- Batch number, batch volume, color, date of manufacture.
- Dry to No Pick-Up time (section 3.3.9).
- Dry Opacity (section 3.3.16).
- Yellowness Index (of white only, see section 3.3.17).
- Reflectance (section 3.3.18).

- Yellow Color (of yellow only, see section 3.3.19).
- Consistency (section 3.3.7).
- Nonvolatile Content, Weight Percent (section 3.3.3).
- Pigment, Weight Percent (section 3.3.4).
- Density (section 3.3.6).

Once the Transportation Laboratory approves a batch of paint, the manufacturer will be notified that the batch is approved for shipment.

The Department of Transportation reserves the right to retest any batch of traffic paint after delivery. Data from such retesting shall prevail over all other tests and will be the basis of rejection. Material not meeting the specification shall be removed and replaced by the supplier at their expense, including all costs for handling, retesting and shipping.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging:

All manufactured paint shall be prepared at the factory ready for application. The finished paint shall be furnished in the container size specified in the purchase order or contract.

- When 19 liter (5-gal.) containers are specified, they shall be round and have standard full open head and bail.
- If 208 liter (55-gal.) steel drums are specified, they must have removable lids and airtight band fasteners.
- When 946 liter (250-gal.) bulk containers are specified, they shall be an industry standard type bulk paint container.
- When 1325 liter (350-gal.) bulk containers are required by the purchase order or contract, the paint shall be delivered in a container (tote) meeting the following requirements.
 1. Tank volumes are estimated and so specified in each of three (3) Bulk Container drawings dated 09-04-91. Vendor shall allow a 19 liter headspace for expansion of the paint.
 2. Maximum size in regards to width, depth and height shall be in accordance with one of the three drawings dated 09-04-91.
 3. Top openings; 46 cm diameter manhole and 15 cm diameter fill cap/viewport.
 4. Bottom outlet; 5 cm I.D. full flow non-restrictive valve with outlet guard.

5. Outlet to have 'Ever-Tite' or compatible quick coupler.
6. Fabricated from 304 stainless steel.
7. Capable of being stacked two (2) high when full.
8. Capable of being lifted by crane (lifting eye) and forklift when full.
9. Top of tank shall be equipped with one (1) vacuum relief valve and one (1) pressure relief valve.
10. Top opening and outlet shall provide for easy installation of liner.
11. Proper certification by the California Highway Patrol that the container complies with all applicable laws, rules, and regulations.

All shipping containers must comply with Code of Federal Regulations, Title 49 and all other applicable Federal and State Regulations governing their use. The containers and lids must be lined with a suitable coating so as to prevent attack by the paint or by agents in the airspace above the paint. The lining must not come off the container or lid as skins. Lids with bungholes shall not be used.

Containers shall be colored white, including lids, and have an identifying band of the appropriate color around and within the top one-third of the container. Stainless steel containers (totes) do not need to be painted white.

All containers shall be properly sealed with suitable gaskets and shall show no evidence of leakage and shall remain in satisfactory condition for a period of 12 months after delivery. The vendor shall be held responsible for replacing containers unfit for use and will be responsible for all costs and transportation charges incurred in replacing paint and containers.

All containers shall be palletized and banded for shipment.

5.2 Marking:

All containers of paint shall be labeled showing the State Specification number (PTWB-01R2), manufacturer's name, date of manufacture, color and manufacturer's batch number. Containers shall be clearly labeled "Waterborne Traffic Paint".

All containers of the paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of California.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are; toxic, corrosive, flammable, etc., as outlined in the Code of Federal Regulations, Title 49.

The Contractor shall list on the Demountable Weight Tags the kilograms per liter and pounds per gallon each for the white, yellow and black paints.

6.0 NOTES

6.1 Certification of Compliance:

The manufacturer shall furnish a Certificate of Compliance with each batch of paint, in accordance with the provisions of Section 6-2.03C of the Department of Transportation's Standard Specifications, 2015. This Certificate must state that the particular batch of paint complies with State Specification #PTWB-01R2 (November, 2016).

6.2 Safety Data Sheets:

The manufacturer shall furnish SDS product information sheets whenever paint is delivered to a Department of Transportation facility.

6.3 Air Pollution Compliance:

The paint shall comply with all air pollution control rules and regulations within the State of California in effect at the time the paint is manufactured.

6.4 Contact Information:

Please send batch samples to the Transportation Laboratory for testing at the address below.

California Department of Transportation
Transportation Laboratory – Chemistry Section
5900 Folsom Blvd.
Sacramento, CA 95819
Attention: Richard Wilmshurst, phone: (916) 227-7041

California Dept. of Transportation

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