

3501 BASIC REQUIREMENTS FOR PAINTS

3501.1 SCOPE

Provide paints for construction and maintenance.

3501.2 REQUIREMENTS

A Package Stability

Ensure the paint does not cake, liver, thicken, curdle, gel, or show other objectionable properties that cannot be corrected by stirring six months after delivery.

B Colors

Provide paint matching the Federal Standard 595 colors or the Department's standard colors as required by the contract. The Department's standard colors are located at the Materials Laboratory. A paint color is considered to match the specified Standard if $\Delta E \leq 3.0$ when measured according to ASTM D 2244.

C Toxic Metals and Volatile Organic Compounds (VOC)

Provide paints free of toxic metals and meeting the requirements of Federal and MPCA VOC regulations.

D Manufacturing and Packaging

Screen paint while filling containers to remove coarse particles and skins.

Package the paint in new containers marked with the following information:

- (1) Name of the manufacturer,
- (2) Name of contents,
- (3) Specification number,
- (4) Date, and
- (5) Manufacturer's batch number.

Provide paint in quantities based on the volume or unit weight at 77 °F [25 °C].

E Drying Time

Ensure drying time for paint meets the requirements of the contract.

F Approval Process

Obtain approval for the paint from the Engineer before use, unless the contract requires the paint selection or it appears on the on the Approved/Qualified Products List.

3501.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the Schedule of Materials Control or as required by the contract.

Provide a color Draw Down sample on a Leneta chart per ASTM D 2805 to the Engineer for verification of the finish coat color by the Materials Laboratory.

3520 ZINC-RICH PAINT SYSTEMS

3520.1 SCOPE

Provide zinc-rich paint systems.

3520.2 REQUIREMENTS 3501

A Zinc-Rich Primer

Provide multi-component zinc-rich primer capable of being spray-applied in accordance with the manufacturer's instructions and applications guide. After mixing according to the manufacturer's recommendation, strain the primer through a 30-60 mesh screen or a double layer of cheesecloth to remove un-dispersed zinc agglomerates. Formulate the primer to produce a distinct contrast with blast cleaned steel and with the subsequent intermediate coat.

A.2 Pigment

Provide a metallic zinc pigment meeting the requirements of ASTM D 520. Only add inert materials to the pigment for tinting. Ensure the inert materials do not reduce the effectiveness of the galvanic protection.

A.3 Finished Primer

Provide finished primer meeting the requirements in Table 3520-1:

Table 3520-1 Finished Primer Requirements	
Characteristic	Requirement
Zinc portion, total solids by weight	≥ 75.0 %
Pot life at 77° F [25° C]	≥ 4 h
Density of VOC	≤ 3.5 lb/gal [420 g/L]
Slip coefficient of cured primer	≥ 0.33
Cure time for recoating*	per Manufacturer's Product Data Sheet
* When applied at 3 mil [74 μm] dry-film thickness at 77 °F [25 °C] and 50 percent R.H.	

B Approved Epoxy Zinc-Rich Systems

Provide a zinc-rich paint system listed on the Approved/Qualified Products List for Bridge Structural Steel Coatings.

B.1 Epoxy Zinc-Rich System

Provide an epoxy zinc-rich system consisting of an epoxy zinc-rich primer, an epoxy intermediate coat, and an aliphatic urethane finish coat.

B.2 Inorganic Zinc-Rich System

Provide an inorganic zinc-rich system consisting of solvent-based inorganic zinc-rich primer, an epoxy intermediate coat, and an aliphatic urethane finish coat.

B.3 Moisture-Cure Zinc-Rich System

Provide a moisture-cure zinc-rich system consisting of moisture-cure zinc-rich primer, a urethane intermediate coat, and an aliphatic urethane finish coat.

B.4 Two Coat Zinc-Rich System

Provide a moisture cure zinc-rich system consisting of moisture-cure zinc-rich primer and a fast-dry polyaspartic urethane finish coat.

C Color

Provide a semi-gloss finish coat as required by the contract.

D Packaging and Labeling

Provide multi-component paints packaged in separate containers or kits that ensure paint manufacturer's mixing proportions are achieved when using the entire container.

3520.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance with each batch, lot, or both for each component of the zinc-rich paint system.

Provide a color Draw Down sample on a Leneta chart per ASTM D 2805 to the Engineer for verification of the finish coat color by the Materials Laboratory.

3532 EXTERIOR POLYURETHANE PAINT

3532.1 SCOPE

Provide exterior polyurethane finish paint for use on steel lighting cabinets, signs, handrails, traffic signal poles and transformer bases.

3532.2 REQUIREMENTS 3501

Provide paint free of toxic metals and meeting the requirements of Federal and MPCA VOC regulations.

Provide an aliphatic polyurethane finish coat listed on the Approved/Qualified Products List for Traffic Signal Paint Systems.

Use the finish coat with an intermediate coat or primer and intermediate coat from the same manufacturer.

A Color

Provide the following semi-gloss finish coat in colors chosen from the Federal Standard 595C colors unless otherwise required by the contract:

- (1) Dark green: Federal Standard Number 595C Color Number 14062, and
- (2) Yellow: Federal Standard Number 595C Color Number 13538.

3532.3 SAMPLING AND TESTING 3501

Sample at rates and sizes meeting the requirements of the Schedule of Materials Control or as required by the contract.

Provide a color Draw Down sample on a Leneta chart per ASTM D 2805 to the Engineer for verification of the finish coat color by the Materials Laboratory.

3533 ALUMINUM POLYURETHANE PAINT

3533.1 SCOPE

Provide aluminum-filled polyurethane paint for use as a finish coat on bridges, sign posts, traffic signal poles, and luminaire extensions.

3533.2 REQUIREMENTS

Provide paints free of toxic metals and meeting the requirements of Federal and MPCA VOC regulations.

Provide an aluminum polyurethane paint listed on the Approved/Qualified Products List for Traffic Signal Paint Systems.

Use the finish coat with an intermediate coat or primer and intermediate coat from the same manufacturer.

3533.3 SAMPLING AND TESTING

Sample at the rates and sizes meeting the requirements of the Schedule of Materials Control or as required by the contract.

Provide a color Draw Down sample on a Leneta chart per ASTM D 2805 to the Engineer for verification of the finish coat color by the Materials Laboratory.

3584 EXTERIOR MASONRY ACRYLIC EMULSION PAINT

3584.1 SCOPE

Provide acrylic latex paint for coating exterior masonry.

3584.2 REQUIREMENTS 3501

Provide paints free of toxic metals and meeting the requirements of Federal and MPCA VOC regulations.

Provide acrylic latex paint listed on the Approved/Qualified Products List, meeting the requirements of Federal Specification TT-P-19, and having a vehicle consisting of 100 percent straight acrylic polymer.

Provide paint in the color required by the contract. Only use light fast colorants.

3584.3 SAMPLING AND TESTING 3501

Sample at the rates and sizes meeting the requirements of the Schedule of Materials Control or as required by the contract.

Provide a color Draw Down sample on a Leneta chart per ASTM D 2805 to the Engineer for verification of the finish coat color by the Materials Laboratory.

3590 EPOXY RESIN PAVEMENT MARKINGS

3590.1 SCOPE

Provide reflectorized white and yellow two-component, 100 percent solids epoxy resin pavement markings that are free of toxic heavy metals for installation on bituminous and concrete pavement surfaces.

3590.2 REQUIREMENTS

A General

Apply epoxy resin pavement markings including lines, legends, symbols, crosswalks, and stop lines, in accordance with 2582, "Permanent Pavement Markings." Use materials capable of producing pavement markings of specified thickness in accordance with 3590.2.B.6, "Thickness," and retroreflectivity in accordance with 2582.3.C.3, "Retroreflectivity," unless otherwise required by the contract. Provide yellow markings distinguishable from white markings in the dark.

Provide epoxy resin pavement marking systems listed on the Approved/Qualified Products List and as classified by the following types:

- (1) Type I: A fast cure material suitable for line applications and, under ideal conditions, may not require coning.
- (2) Type II: A slow cure material suitable for all applications of pavement markings under controlled traffic conditions requiring coning. Provide flagging as directed by the Engineer.

Use Slow Dry Type II epoxy material for epoxy pavement markings, unless otherwise required by the contract.

The Department will not require the mixing of individual components before use if stored for no greater than 12 months.

B Epoxy Resin Material

Provide epoxy resin material meeting the following requirements and characteristics:

- (1) Composed only of epoxy resins and pigments,
- (2) Does not emit or leach solvents into the environment upon application to a pavement surface,
- (3) The infrared spectrum for all components shall match the reference sample provided by the manufacturer for the product tested and approved by the Department,
- (4) Type II material completely free of Tri-Methyol Propane Tri-Acrylate and other multi-functional monomers,
- (5) Free of lead, cadmium, mercury, hexavalent chromium and other toxic heavy metals as defined by the Environmental Protection Agency,
- (6) White material no darker than or no yellower than 17778 of Federal Standard Number 595C Colors,
- (7) Daytime color of the yellow epoxy meeting the following CIE Chromaticity limits using illuminant "D65/2":

Table 3590-1				
Daytime Chromaticity Coordinates (Corner Points) — Yellow				
	1	2	3	4
x	0.470	0.485	0.520	0.480
y	0.440	0.460	0.450	0.420

- (8) White daylight directional reflectance (Y) of least 83 percent,
- (9) Yellow daylight directional reflectance (Y) of at least 50 percent, and
- (10) Nighttime color of yellow meeting the following chromaticity limits in ASTM D 6628 Table 2:

Table 3590-2				
Nighttime Chromaticity Coordinates (Corner Points) — Yellow				
	1	2	3	4
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

B.1 Adhesion Capabilities

Provide material meeting the adhesion requirements of the American Concrete Institute Committee 403 when tested on portland cement concrete. Apply epoxy resin pavement markings during the test to concrete pavements with a tensile strength of at least 300 psi [2,070 kPa] and ensure the failure of the system occurs in the concrete during testing.

B.2 Abrasion Resistance

Provide material with an abrasion resistance wear index no greater than 82 when tested in accordance with ASTM C 501 with a CS 17 wheel under a load of 1,000 g for 1,000 cycles. The Department defines the wear index as the weight in milligrams of material abraded from the sample under the test conditions.

B.3 Hardness

Provide material with a Type D durometer hardness from 75 to 90 when tested in accordance with ASTM D 2240 after curing for 72 h at 73 °F \pm 4 °F [23 °C \pm 2 °C].

B.4 Tensile Strength

Provide material with a tensile strength of at least 6,000 psi [41,370 kPa] when tested in accordance with ASTM D 638 after curing for 72 h at 73 °F \pm 4 °F [23 °C \pm 2 °C].

B.5 Compressive Strength

Provide material with a compressive strength of at least 12,000 psi [82,700 kPa] when tested in accordance with ASTM D 695 after curing for 72 h at 73 °F \pm 4 °F [23 °C \pm 2 °C].

B.6 Thickness

Apply the epoxy resin pavement marking with a wet film thickness at least 15 mil [380 μ m] on pavement surfaces, except apply a wet film thickness at least 20 mil [508 μ m] for SUPERPAVE wearing courses in accordance with 2360, "Plant Mixed Asphalt Pavement."

C Glass Beads

Provide glass beads meeting the requirements of AASHTO M 247, Type I and the following:

C.1 Coatings

Treat the beads as recommend by the manufacturer and meeting the requirements of Section 4.4.2 of AASHTO M 247.

C.2 Roundness

Provide beads with a roundness of at least 80 percent.

For 15 mil [380 μ m] epoxy resin pavement marking applications, apply the glass beads at a rate of at least 25 lb per gal [3.0 kg per L]. Apply beads at a greater rate as recommended by the material manufacturer to meet the required minimum levels of retroreflectivity in accordance with 2582, "Permanent Pavement Markings."

3590.3 SAMPLING AND TESTING

Test the daylight directional reflectance and the color meeting the requirements of ASTM E 1349.

Provide 1 pt [0.5 L] samples of each manufacturer's lot or batch of material when manufactured to the Department. Provide 1 pt [0.5 L] samples of Part A (yellow/white epoxy resin) and Part B (catalyst) to the Materials Laboratory. Mark the samples with the following information:

- (1) Name of manufacturer,
- (2) Manufacturer product number,
- (3) Lot or batch number,
- (4) Date of manufacture,
- (5) Color, and
- (6) State project numbers for intended material use.

Submit to the Engineer a manufacturer's Certificate of Compliance for all components of the epoxy resin pavement marking system.

Mark containers for epoxy components with the following information:

- (1) Name of manufacturer,
- (2) Product identification number,
- (3) Lot or batch number,
- (4) Date of manufacture,
- (5) Color, and
- (6) Net weight of contents.

3591 HIGH SOLIDS WATER-BASED TRAFFIC PAINT

3591.1 SCOPE

Provide fast-dry white and yellow acrylic latex traffic marking paints for use with drop-on glass beads for application on concrete and bituminous pavements.

3591.2 REQUIREMENTS

A General Requirements

Use paint listed on the Approved/Qualified Products List for High Solids Water-Based Traffic Paint.

A.1 Quality

Provide paint meeting the following requirements and characteristics:

- (1) Formulated from first-grade materials,
- (2) Capable of being applied by conventional traffic striping equipment at elevated spray temperatures with drop-on glass beads,
- (3) Smooth,
- (4) Homogeneous, and
- (5) Free of coarse particles, skins, or other foreign materials detrimental to the application or appearance of the paint.

A.2 Package Stability

Within 12 months from the time of delivery, if the paint cakes, settles, livers, thickens, skins, curdles, gels, or shows other objectionable properties not correctable with stirring, return the paint to the manufacturer for credit. Ensure the manufacturer adds anti-settling agents, stabilizers, and other additives to ensure proper storage stability.

A.3 Manufacturing and Packaging

Provide paint from a manufacturer capable of producing paint in batches of at least 1,000 gal [3,786 L]. Provide paint screened with a 40 mesh or finer screen to remove coarse particles, skins, or foreign material.

Provide paint packaged in lined, new totes of 55 gal [208 L] or 5 gal [19 L] containers meeting the following requirements and characteristics:

- (1) Full removable-head universal drums meeting the requirements of DOT-17H,
- (2) Drum covers containing one 2 in [51 mm] fitting and one ¾ in [19 mm] fitting,
- (3) Marked with the following information:
 - (3.1) Manufacturer's name,
 - (3.2) Type of paint,
 - (3.3) Batch number,
 - (3.4) Date of manufacture,
 - (3.5) Gross weight and
 - (3.6) Container weight.

To prevent formation of "skins," ensure the manufacturer uses one of the following:

- (1) A "float" of ammonia water on the paint surface, or
- (2) A "floating type" plastic liner on the top of the filled container.

B Properties of Finished Paint

Provide paint with properties in accordance with Table 3591-1:

Table 3591-1 Paint Properties	
Parameter	Range
Weight per gallon at 77 °F [25 °C]	≥12.0 lb per gal
Viscosity, Krebs Stormer, at 77 °F [25 °C]	80 KU – 100 KU
Grind, Hegman	≥3
Total solids	≥ 73% by weight
Non-volatile vehicle	≥43% by weight
Pigment	45% – 62% by weight
Titanium dioxide, white paint	≥ 1.0 lb/gal
Dry time, 12 mil [305 μm] WFT at 65% RH	≤ 12 min
Dry through, at 90% RH	≤ 130 min
Daylight directional reflectance, white	≥ 83%
Daylight directional reflectance, yellow	≥ 50%
Contrast ratio	≥ 0.98
Flexibility and adhesion	No cracking or flaking
Water resistance	No blistering or loss of adhesion
Settling	≥ 6 rating
Skinning at 48 h	—
Track free time	≤ 3 min
pH	≥ 9.6

C Specific Requirements

Use a vehicle composed of a 100 percent acrylic polymer.

Use white material no darker than or no yellower than 17778 of Federal Standard Number 595C Colors.

Use yellow paint with a daytime color meeting the following CIE Chromaticity limits using illuminant “D65/2”:

Table 3591-2 Daytime Chromaticity Coordinates (Corner Points)				
	1	2	3	4
x	0.470	0.485	0.520	0.480
y	0.440	0.460	0.450	0.420

Use yellow paint with a nighttime color meeting the following chromaticity limits as specified by ASTM D 6628, Table 2:

	1	2	3	4
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

Use white and organic yellow paints free of the following heavy metals:

- (1) Lead,
- (2) Mercury,
- (3) Cadmium,
- (4) Hexavalent chromium, and
- (5) Other toxic heavy metals as defined by the United States Environmental Protection Agency.

Apply glass beads immediately after applying a paint line at a rate of at least 8 lb per gal [960 g per L] or as recommended by the manufacturer to achieve the minimum levels of retroreflectivity in accordance with 2582, "Permanent Pavement Markings."

Evenly distribute glass beads on paint.

3591.3 SAMPLING AND TESTING

Provide 1 pt [0.5 L] manufacturer-provided paint samples of each batch and a certification stating that the sample represents the full manufactured batch.

The Department may base acceptance on 1 pt [0.5 L] samples taken at the point of delivery or from the Contractor's supply.

Submit to the Materials Laboratory the manufacturer's certified test results with each batch of paint, including tests for weight per gallon, viscosity, and drying time.

Provide the manufacturer's certified test results, for tests performed annually at the start of paint production, meeting the following requirements:

Table 3591-2 Paint Property Standard	
Parameter	Standard
Weight per gallon	ASTM D 1475
Viscosity	ASTM D 562
Grind fineness	ASTM D 1210
Total solids	ASTM D 2369
Total pigment	ASTM D 2371
Titanium dioxide	ASTM D 4563, ASTM D 1394
Dry time, 12 mil [305 µm] wet	ASTM D 711, modified
Daylight directional reflectance	ASTM E 1349
Contrast ratio, 15 mil [381 µm] wet	ASTM D 2805
Bleeding ratio	Federal Specification TT-P-85
Color	ASTM E 1349
pH	ASTM E 70

3592 DROP-ON GLASS BEADS

3592.1 SCOPE

Provide treated glass beads for retro-reflectorizing traffic marking paint.

3592.2 REQUIREMENTS

Provide treated glass beads meeting the following characteristics and requirements:

- (1) Listed on the Approved/Qualified Products List,
- (2) Made from clean colorless transparent glass,
- (3) Smooth,
- (4) Spherically shaped,
- (5) Free from milkiness, pits, excessive air bubbles, chips, and foreign material,
- (6) Capable of being applied by conventional striping equipment,
- (7) Produce a retro-reflectorized line when viewed at night with automobile headlights, and
- (8) Meet the requirements of AASHTO M 247, Type 1 "Standard Gradation" except with at least 80 percent true spheres.

Provide beads with dual surface treatment meeting the following requirements and characteristics for use with water-based paints:

- (1) Moisture resistant silicone treatment meeting the requirements of AASHTO M 247 and as recommended by the paint manufacturer,
- (2) Silane adherence surface treatment as recommended by the paint manufacturer, and
- (3) Meet the adherence treatment Dansyl Chloride Test of AASHTO M 247.

Provide beads for use with epoxy resins with a moisture resistant silicone surface treatment as recommended by the epoxy resin manufacturer.

Unless otherwise specified, provide beads packaged in moisture-proof, multi-wall shipping bags, and in containers marked with the following information:

- (1) Manufacturer name,
- (2) Manufacturer address,
- (3) Type of moisture treatment,
- (4) Batch number, and
- (5) Date of manufacture.

Deliver the containers and contents in a dry condition. The Engineer will reject beads not meeting the requirements of this specification.

3592.3 SAMPLING AND TESTING

Provide samples in the rates and sizes meeting the requirements of the Schedule for Materials Control and as required by the contract.

The Engineer will test in accordance with AASHTO M 247, except the Engineer will determine roundness meeting the requirements detailed in the Laboratory Manual.