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SUPERSEDING
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FEDERAL SPECIFICATION

# COATING COMPOUND, REFLECTIVE

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration for the use of all Federal agencies.

## 1. SCOPE

1.1 Scope. This specification covers a one-package reflective coating compound for safety markings which ensure visibility at night.

## 2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Federal Specifications:

PPP-B-636 - Boxes, Shipping, Fiberboard.
PPP-C-96 - Cans, Metal, 28-Gage and Lighter.

Federal Standards:

Fed. Test Method Std. No. 370 - Instrumental Photometric Measurements of Retroreflective Materials and Retroreflective Devices.

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions, as outlined under General information in the Index of Federal Specifications, Standards, and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification, other Federal specifications, and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston; New York; Philadelphia; Washington, DC; Atlanta; Chicago; Kansas City, MO; Fort Worth; Houston; Denver; Los Angeles; San Francisco; and Seattle, WA.

(Federal Government activities may obtain copies of Federal specifications, standards, commercial item descriptions, and the Index of Federal Specifications, Standards, and Commercial Item Descriptions from established distribution points in their agencies.)

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

(Copies of Military specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

National Motor Freight Traffic Association, Inc., Agent:

National Motor Freight Classification.

(Application for copies should be addressed to the American Trucking Associations, Inc., Traffic Department, 1616 P Street, N.W., Washington, DC 20036.)

Uniform Classification Committee, Agent:

Uniform Freight Classification.

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

American Society for Testing and Materials (ASTM) Standards:

D 659 - Evaluating Degree of Chalking of Exterior Paints.
D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
D 1640 - Drying, Curing, or Film Formation of Organic Coatings at Room Temperature.
D 1729 - Visual Evaluation of Color Differences of Opaque Materials.
D 272 - Vacuum Distillation of Solvents from Solvent Base Paints for Analysis.
D 260 - Recommended Practice for General Gas Chromatographic Procedures.
G 23 - Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials.

3. REQUIREMENTS

3.1 Volatile solvent. The solvent, when tested as specified in 4.4.1, shall conform to the following requirements by volume:

(a) The total of solvents with olefinic or cyclo olefinic unsaturation shall not exceed 5 percent.
(b) The total of aromatic compounds with eight or more carbon atoms in the molecule, except ethylbenzene, methyl benzoate, and phenyl acetate, shall not exceed 8 percent.
(c) The total of ethylbenzene, toluene, and branched-chain ketones shall not exceed 20 percent.
(d) A solvent which may be classified into more than one of the above groups shall be considered a member of the group having the lowest allowable concentration.
(e) The total of (a), (b), and (c) shall not exceed 20 percent.

3.2 Condition in container. When tested as specified in 4.4.2, a freshly opened, full container of the coating shall show no skinning and no more settling or caking than may be easily redispersed with a paddle to a uniform consistency. The coating, following vigorous hand mixing, shall remain in suspension for at least 20 minutes.

3.3 Storage stability (partially full container). The coating shall show no skinning when tested as specified in 4.4.3.

3.4 Flexibility. When tested as specified in 4.4.4, the coating shall show no cracking or flaking of the film over the primed part of the panel.

3.5 Accelerated weathering. When tested as specified in 4.4.5, the coating shall meet the color requirements in 3.2.6 and shall show no more chalking that the No. 8 photograph of ASTM D 659.

3.6 Water resistance. When tested as specified in 4.4.6, the coating shall show no blistering or wrinkling immediately upon removal of the panels. After 24 hours air dry, there shall be no softening, dulling, or whitening of the coating.

3.7 Color. The color shall be determined in accordance with 4.4.7. The color shall be uniform and shall conform to the appropriate Munsell color notation shown below:

| | Hue | Value | Chroma |
|---|---|---|---|
| Silver-gray | N | 5.0 thru 7.0 | |
| Yellow | 10 YR or 2.5 Y | 8.0 minimum | 10.0 minimum |
| White | N | 8.5 minimum | |

3.8 Adhesion. When tested as specified in 4.4.8, the dried film shall not flake or separate from the substrate.

3.9 Drying time. When tested as specified in 4.4.9, the coating shall have a maximum tack free dry time of 2 hours and a maximum dry hard times of 24 hours.

3.10 Specific intensity per unit area (SIA). When tested as specified in 4.4.10, the SIA of each specimen shall be not less than the values shown in table I. Specific intensity per unit area shall be expressed in candelas per footcandle per square foot.

TABLE I. Specific intensity per unit area (cd $fc^{-1}$) $ft^{-2}$

| Color | Observation angle | Entrance angle 4° before weathering | 4° after weathering | 15° before weathering | 15° after weathering | 30° before weathering | 30° after weathering |
|---|---|---|---|---|---|---|---|
| Silver-gray | 0.2° | 20.0 | 15.5 | 19.0 | 15.0 | 16.5 | 12.9 |
| | 0.5° | 10.0 | 7.8 | 9.0 | 7.1 | 8.2 | 6.5 |
| White | 0.2° | 17.0 | 13.1 | 15.5 | 12.3 | 11.5 | 8.7 |
| | 0.5° | 8.0 | 6.4 | 7.0 | 5.6 | 6.0 | 4.8 |
| Yellow | 0.2° | 7.0 | 5.6 | 6.0 | 4.8 | 5.0 | 4.0 |
| | 0.5° | 3.5 | 2.8 | 3.0 | 2.4 | 2.5 | 2.0 |

3.11 Quantities. The coating compound shall be furnished in 12-pounds units.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein.

4.2 Inspection of preparation for delivery. An inspection shall be made to determine whether the packaging, packing, and marking comply with the requirements of section 5. The sample unit shall be one shipping container fully prepared for delivery and selected at random. Sampling shall be in accordance with MIL-STD-105. The inspection level shall be S-2 with acceptable quality level (AQL) of 4.0 percent defective.

4.3 Testing of the end item.

4.3.1 Lot. The coating shall be assembled into lots as specified in MIL-STD-105. In MIL-STD-105, the words "essentially the same conditions" shall be interpreted to mean a manufacturer's batch and defined as the end product of all raw materials mixed, blended, or processed in a single operation.

4.3.2 Sampling of the end item. For the purposes of sampling, the lot shall be expressed in units of gallons. Samples from lots shall be taken in accordance with MIL-STD-105 using inspection level S-1 and an AQL of 4.0.

4.4 Test procedures. The coating shall be tested according to the procedures in table II. Unless otherwise specified, standard testing conditions are a temperature of 23° ± 1° C and relative humidity of 50 ± percent. All test reports shall contain the individual values utilized in expressing the final result. All tests shall be evaluated for conformance to the requirements specified in section 3. Failure to pass any test or noncompliance to any requirement shall be cause for rejection of the lot.

TABLE II. Test procedures

| Characteristics | Required reference | Applicable test methods: ASTM Method | Applicable test methods: Paragraph referenced |
|---|---|---|---|
| Volatile solvent | 3.1 | D 3272 | 4.4.1 |
| Condition in container | 3.2 | --- | 4.4.2 |
| Storage stability (partially full container) | 3.3 | --- | 4.4.3 |
| Flexibility | 3.4 | --- | 4.4.4 |
| Accelerated weathering | 3.5 | G 23 | 4.4.5 |
| Water resistance | 3.6 | D 1308 | 4.4.6 |
| Color | 3.7 | D 1729 | 4.4.7 |
| Adhesion | 3.8 | --- | 4.4.8 |
| Drying time | 3.9 | D 1640 | 4.4.9 |
| Specific intensity per area unit | 3.10 | --- | 4.4.10 |

4.4.1 Solvent analysis. Analyze the solvent by gas chromatograph. The solvent shall be separated from the coating as specified in ASTM D 3272, and then injected into the gas chromatograph. The procedure specified in ASTM E 260, and any apparatus, operating conditions, columns, and options permitted therein shall be used for the chromatographic analysis. The accuracy of the analysis shall be 0.25 percent absolute by weight over three or more runs. All peaks 0.5 percent of the sample or greater shall be identified and quantified. Convert percent by weight to percent by volume, and evaluate the results for compliance with 3.1.

4.4.2 Condition in container. Before agitating the contents of the container in which the material was originally packaged, open the container and note if skinning has occurred. If the material is skinned, remove any continuous skin with a spatula by carefully cutting the skin free from the container. Lower a spatula or paddle into the container and note if the material is curdled or livered. Thoroughly stir the coating, noting whether any settled material can be re-dispersed to a uniform consistency. Also, note if the material remains in suspension as required. Evaluate for compliance with 3.2.

4.4.3 Storage stability (partially full container). A 170 g (6 oz) sample of the coating shall be measured into a wide-mouth glass jar, 114 mm (4-1/2 in) in height and 51 mm (2 in) in diameter. The cover shall be secured tightly and the jar inverted momentarily. The jar shall be placed in an upright position in the dark at a temperature of 22° to 27° C. The sample shall not be agitated or disturbed until inspected. The coating shall be evaluated after 48 hours for compliance with 3.3.

4.4.4 Flexibility.

4.4.4.1 Test panels. Test panels shall measure 152 x 305 mm (6 x 12 in) and shall be of aluminum alloy, 0.5 mm (0.02 in) thick. Apply a film of white alkyd primer using a 2-in Bird applicator with a 0.003 in gap clearance. Allow the panel to dry for 24 hours at standard conditions. The reflective coating shall be applied over the white primer using a 3-1/2 in Bird applicator with a 0.006 in gap clearance. Air dry the panel at standard conditions for 10 minutes. Bake the panel for 30 minutes at 121° ± 2° C, and then condition the panel for 48 hours at standard conditions.

4.4.4.2 Procedure. Immerse a test panel, prepared as specified in 4.4.6.1, for 15 minutes in a bath of melting ice. Remove the panel from the ice bath and immediately bend it on a 6.4 mm (1/4-in) mandrel in the following manner. Place the test panel, with the coated side uppermost on the mandrel in the following manner. Place the test panel, with the coated side uppermost on the mandrel, at a point equidistant from the top and bottom edges of the panel, and bend the panel double in one second. Examine the film at the bend under magnification of 7 diameters, using diffused light with an intensity of 45 to 55 footcandles. Cracks occuring at either end and extending no more than 6.4 mm (1/4-in) shall be disregarded. The panels shall be evaluated for compliance with 3.4.

4.4.5 Accelerated weathering. Test panels, prepared as specified in 4.4.10.1, shall be exposed to 300 hours of accelerated weathering in an enclosed carbon-arc lamp apparatus in accordance with ASTM G 23 and evaluated for compliance with 3.5.

4.4.6 Water resistance. The test panel shall be prepared as specified, in 4.4.4.1, except the panel of reflective coating shall be maintained for one week at standard conditions and not baked. Then, the panel shall be immersed in distilled water at 23° ± 1° C for 24 hours in accordance with ASTM D 1308, section 5.4, and evaluated for compliance with 3.6.

4.4.7 Color. Test panels shall be prepared as specified in 4.4.10.1. Color shall be determined using the daylight source in accordance with ASTM D 1729, and evaluated for compliance with the requirements in 3.7.

4.4.8 Adhesion. The test panel shall be prepared as specified in 4.4.10.1. Using a stylus, cut two parallel scratches 25 mm (1-in) apart and penetrating to the substrate. A 25 mm (1-in) wide strip of tape with a minimum adhesion value of 25 oz/in shall be applied across the scratches, adhesive sidedown. Press tape with two passes of a 2 kg (4.5 lb) rubber-covered roller approximately 89 mm (3.5-in) diameter by 45 mm (1.75 in) wide. The surface of the roller shall have a Durometer hardness value of 70 to 80 range. Remove the tape in one abrupt motion and examine the film for compliance with 3.8.

4.4.9 Drying time. The test panel shall be prepared as specified in 4.4.10.1. Tack-free dry time dry hard time for the reflective coating shall be determined in accordance with ASTM D 1640 for compliance with 3.9.

4.4.10 Specific intensity per unit area.

4.4.10.1 Test panels. Use glass test panels measuring 165 x 432 x 6 mm (6-1/2 x 17 x 1/4-in) and cleaned to no water break. Using the Dow Latex Film Applicator, apply a film of white primer using the 0.007 in side of the applicator. Allow the panel to dry for 24 hours at standard conditions. The reflective coating shall be applied over the white primer using the 0.010 in side of the applicator and maintained at standard conditions for 48 hours.

4.4.10.2 Test conditions.

(a) Observation distance (D') - 100 ft.
(b) Entrance angle (B) -4°, 15°, 30°.
(c) Observation angles ($\alpha$) -0.2°, 0.5°.
(d) Presentation angle ($\gamma$) -0°.
(e) Receptor aperature angle ($\delta$) - 10 minutes of arc (1/6 degree).
(f) Source aperature angle ($\sigma$) -10 minutes of arc (1/6 degree).

4.4.10.3 Procedure. Test panels shall be prepared as specified in 4.4.3.1. Specific intensity per unit area shall be determined in accordance with Federal Test Method Standard 370 and evaluated for compliance with the requirements in 3.10. After the initial measurements have been taken, the panels shall be exposed to 300 hours of accelerated weathering in an enclosed carbon-arc lamp apparatus in accordance with ASTM G 23. After weathering, the panels shall be maintained at standard conditions for 24 hours. Specific intensity per unit area shall be determined on these panels in accordance with Federal Test Method Standard 370 and evaluated for compliance with the requirements of 3.10.

## 5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be Level A or commercial, as specified (see 6.2).

5.1.1 Level A. The 12-pound quantity of coating compound shall be packaged in metal cans conforming to PP-C-96, type V, class 2. Exterior plan B coating and side seam striping shall be required. The cans shall be provided with wire handles which shall be galvanized or otherwise protectively coated to resist corrosion.

5.1.2 Commercial. The 12-pound quantity of coating compound shall be packaged in accordance with normal commercial practice. The complete package shall be designed to protect the enamel against damage during shipment, handling, and storage.

5.2 Packing. Packing shall be Level A or commercial, as specified (see 6.2).

5.2.1 Level A. Four 12-pound cans of coating compound, packaged as specified in 5.1, shall be packed in fiberboard boxes conforming to grade V3c, V3s, or V2s, of PPP-B-636. The boxes shall be closed, waterproofed, and reinforced in accordance with the appendix of PPP-B-636. Alternatively, wirebound, cleated plywood, or nailed wood boxes shall be acceptable shipping containers when lined with a waterproof barrier material. The barrier material shall be sealed at the edges with waterproof tape or adhesive.

5.2.2 Commercial. The coating compound shall be packed in a manner that will assure acceptance by common carrier and provide product protection against loss and damage during multiple shipments, handling, and storage. The shipping container shall be in compliance with the National Motor Freight Classification and Uniform Freight Classification.

5.3 Marking. Marking shall be as specified in the contract or order.

## 6. NOTES

6.1 Intended use. This reflective coating compound is intended for reflectorizing surfaces, obstacles, and signs. It can be used on safety warning devices, docks piers, guard rails, license plates, lettering, monograms, and bridge abutments, for marking trees, posts, curbs, obstructions, and for other emergency marking purposes. This coating can be applied over wood, concrete, metal, and fiberboard.

6.2 Ordering data. Purchasers should select the preferred options permitted herein, and include the following information in procurement documents:

(a) Title, number, and date of this specification.
(b) Color required (see 3.7).
(c) Selection of applicable levels of packaging and packing required (see 5.1 and 5.2).

6.3 Surface preparation. As the reflective brightness may vary with the condition of the surface, it is recommended that for best results the surface be previously primed or painted. Primed or enameled surfaces must be thoroughly dry before application of the reflective coating. Maximum durability is obtained on surfaces previously prepared with a good quality exterior enamel undercoat.

6.4 Coverage. The reflective coating compound should be applied at a rate of 25 to 35 square feet per pound. Best results are obtained with a single uniform coat. Coatings lighter than recommended will result in reduced brilliance and durability. However, heavier coatings will not provide a corresponding increase in brilliance and may actually result in reduced brilliance. Best results will be obtained in applications made at temperatures above 50° F. If the coating is applied at temperatures below 50° F, the initial reflectivity of the coating will be lower.

6.5 Shelf-life surveillance. For the purpose of shelf-life surveillance, the reflective coating compound stored in the original unopened container shall show no skinning, livering, hard dry caking, or gummy sediment, and shall readily remix to a homogeneous state. In addition, it shall meet the drying time requirement in 3.9.

Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See Section 2 of this specification to obtain extra copies and other documents referenced herein.