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# FEDERAL SPECIFICATION

# PAINT, TREE MARKING

The General Services Administration has authorized the use of this Federal Specification for all Federal agencies.

## 1. SCOPE AND CLASSIFICATION.

**1.1 Scope.** This specification covers three types of tree marking paint intended to be readily visible and capable of testing positive for tracer presence 6 years after application.

**1.2 Classification.** The paint shall be available in the following types.

Type I - Bulk, *not VOC limited*.
Type II - Aerosol
Type III - Bulk, Low Volatile Organic Compound (VOC) Content 420 g/L (3.5 lb/gal) max.

## 2. APPLICABLE DOCUMENTS.

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

**Federal Standards**

FED-STD-141 - Paint, Varnish, Lacquer, and Related Paints; Methods of Inspection, Sampling, and Testing
FED-STD-123 - Marking for Shipment (Federal Agencies)
FED-STD-313 - Material Safety Data Sheets, Preparation and Submission of
FED-STD-595 - Colors Used in Government Procurement

**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.

**American National Standards**

ANSI/ASQC Z1.4-1993 - Sampling Procedures and Tables for Inspection by Attributes

(Application for copies should be addressed to: American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

Beneficial comments, recommendations, additions, deletions, clarification's, etc and any data which may improve this document should be sent to: General Services Administration, Engineering and Commodity Management Division (10FTE), 400 15th St. SW, Auburn, WA 98001

**Federal Highway Administration**

Highway Color Tolerance Charts PR Color #1, #2, and #6

(Application for copies may be addressed to Hale Color Charts, Inc., 11765 Old Frederick Road, Marriotsville, MD 21104; (410) 489-9569.)

**American Society for Testing and Materials (ASTM) Standards:**

D 1640 - Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
D 1729 - Visual Evaluation of Color Differences of Opaque Materials
D 2244 - Calculation of Color Differences from Instrumentally Measured Color Coordinates
D 2697 - Volume Nonvolatile Matter in Clear or Pigmented Coatings
D 3335 - Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
D 3924 - Environment for Conditioning and Testing Paint, Varnish, Lacquer and Related Materials
D 3925 - Sampling Liquid Paints and Related Pigmented Coatings
D 3960 - Volatile Organic Compound (VOC) Content of Paints and Related Coatings
E 170 - Terminology Relating to Radiation Measurements and Dosimetry
E 260 - Practice for Packed Column Gas Chromatography
G 26 - Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water Exposure of Nonmetallic Materials

(Obtain ASTM standards from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. The issue of the ASTM test methods in effect on the date of the solicitation shall be used to determine compliance with these requirements.)

**Commercial Standards**

US Product Standard PS 1-83 - Construction and Industrial Plywood

(Obtain copies from American Plywood Association, PO Box 11700, Tacoma, WA 98411)

## 3. REQUIREMENTS.

**3.1. Qualification.** The tree marking paint furnished under this description shall be products which are qualified for listing on the applicable qualified products list (see 6.4). Any change in the formulation of a qualified product or in manufacturing site or packaging location will necessitate its requalification. The product supplied under contract shall be identical, within manufacturing tolerances, to the product receiving qualification. Qualification will require that production facilities and security measures for tracer containing paint be approved by the qualifying activity.

**3.2. Tracer requirements.** Tree marking paint shall contain different laboratory and field tracers which allow a particular user Agency's tree marking paint to be identified by laboratory analysis prompted by field examination. Types I, II and III shall contain the same tracer system. Tracers shall be approved by the qualifying activity (see 6.4). To maintain uniqueness of tracer used in tree marking paint, supplier shall not divulge the identity of, nor supply the tracer to, other buyers for a period of 7 years after expiration or termination of contract. Manufacturer shall also certify that tracer supplied under this specification has never been supplied in tree marking paint to any consumer other than the Government Agency for which it was originally registered. The paint film shall test positive for the presence of field and laboratory tracers for a minimum period of six years after application.

**3.2.1. Tracer registration.** The unique tracer shall be registered for the exclusive use of a single Federal Government Agency. For example, USDA Forest Service paint shall contain tracers unique to, and registered for, that Agency only (see 6.3).

**3.2.2. Field identification of tracers.** A field test kit and instructions shall be available from each supplier that will enable trained personnel to tentatively identify their tracer containing paints in the field. The field test kit shall be labeled specifically by Agency, and shall not be interchangeable between Agencies. Ingredients shall not be listed on kits (see 29 CFR 1910.1200(i), Trade Secrets). Kits shall contain a minimum of 25 tests per kit. The field test method must be approved by the qualifying activity (See 6.4).

**3.2.3. Laboratory analysis.** The Government shall conduct necessary laboratory analysis. For a period of 7 years following expiration or termination of contract, the supplier shall furnish interpretation and advice on laboratory analysis reports to confirm presence, or absence, of the supplier's tracer. Additionally, occasional expert testimony may be needed from supplier, and compensated at rates negotiated with requiring Agency.

**3.2.4 Prohibited materials.** The manufacturer shall certify that the paint does not contain radioactive materials, C-4 or higher alcohols, benzene, toluene, ethylene glycol ethers, >200 ppm lead, hexavalent chromium compounds or halogenated hydrocarbons. In case of dispute, the method in Table II shall be used.

**3.3 Quantitative requirements**

**TABLE I Quantitative Requirements**

| Characteristics | Type I | | Type II | | Type III | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Min. | Max. | Min. | Max. |
| Total solids, % by volume (note 1) | 25 | – | – | – | 40 | – |
| Total solids, mls per container (note 1) | – | – | 75 | – | – | – |
| Contrast ratio @ 400 ft²/gal: | | | | | | |
| Yellow, red, orange | 0.85 | – | 0.85 | – | 0.85 | – |
| Blue, green | 0.92 | – | 0.92 | – | 0.92 | – |
| White | 0.95 | – | 0.95 | – | 0.95 | – |
| Black | 0.99 | – | 0.99 | – | 0.99 | – |
| Sag resistance | 4 | – | – | – | 4 | – |
| Dry hard time, hours (note 2) | – | 18 | – | 18 | – | 18 |
| Volatile organic content, g/l | – | – | – | – | – | 420 |

Note 1 - Manufacturers may calculate this requirement from batch card data but in case of dispute the method specified in Table II must be used.
Note 2 - Types I and II use 0.1 mm (4 mils) wet film thickness on MDO plywood. Type III use 0.076 mm (3 mils) wet film thickness on MDO plywood.

**3.4 Performance requirements.**

**3.4.1. Condition in container.** Tree marking paint as received, and after one year storage, shall be ready for use and shall require no more than one minute hand-stirring for types I and III containers larger than one gallon; nor more than one minute handshaking for Type II and Types I and III quarts and gallons, to disperse the paint to a useable condition. Mixed paint shall remain in suspension a minimum of 8 hours.

3.4.2. **Color.** The tree marking paint shall match the color specified within the limits of the Highway Color Tolerance Chart for yellow, red, and orange. Blue, green, white and black shall meet the descriptions below:

| | |
|---|---|
| Yellow: | PR Color #1 |
| Red: | PR Color #2 |
| Orange: | PR Color #6 |
| Blue: | FED-STD-595 color 35260, max. ΔE of 8.0 |
| Green: | FED-STD-595 color 34350, max. ΔE of 8.0 |
| White: | Minimum reflectance of 80 |
| Black: | Maximum reflectance of 4 |

**3.4.3. Spraying properties.**

**3.4.3.1. Types I and III.** Types I and III tree marking paint shall be capable of producing a 12 to 20 cm (3 to 5 inch) diameter spot at a minimum distance of 1.8 meters (6 feet) at temperatures of -29°C to 40°C (-20°F to 104°F) and relative humidities to 100 percent.

**3.4.3.2. Type II.** Type II paint with the stream nozzle shall project a thin solid stream of paint for a minimum horizontal distance of 1.5 meters (5 feet) without sputtering or interruption at -29°C to 40°C (-20°F to 104°F) and shall produce a 12 to 20 cm (3 to 5 inch) diameter spot. The banding nozzle shall produce a 12 to 20 cm diameter spot from a distance of 0.6 meters (2 feet) at temperatures from 10°C to 40°C (50°F to 104°F). The can shall deliver a minimum of 95 percent of net contents.

**3.4.4. Adhesion to cold and wet wood surfaces.** Tree marking paint shall have good adhesion to cold and to wet wood surfaces and shall show no evidence of blistering or film failure when tested as specified in 4.3.4.

**3.4.5. Accelerated weathering.** When tested as in 4.3.5, the tree marking paint shall show no checking or peeling and the color change shall not be greater than a ΔE value of 4.0. The field and laboratory tracers shall be detectable after weathering as specified in 4.3.5.

**3.4.6. Weather resistance.** When tested as in 4.3.6, the paint shall show good adhesion and the color shall be within the limits specified in 3.4.2 except that blue and green shall show no color change greater than a ΔE of 18. The field and laboratory tracers shall be detectable after weathering as specified in 4.3.6.

**3.4.7. Odor.** The odor of all three types of paint shall be approved by at least 3 members from the USDA Forest Service National Tree-Marking Steering Committee.

**3.5. Containers.**

**3.5.1 Types I and III.** Types I and III tree marking paint shall be supplied in 0.946 liter (1 quart), 3.78 liter (1 gallon) Style F (oblong), and 18.9 liter (5 gallon) quantities as specified (see 6.2). The containers shall be metal cans of commercial construction. The 18.9 liter container shall be an open head pail closed with a lug cover having a resealable pour spout. 0.946 liter containers shall be round, conical top, with threads compatible with the Nelson Nelspot D-103 spray gun. The 0.946 liter containers of tree marking paint shall be filled to a minimum of 935 mls (30 ounces), and allow insertion of the paint gun without causing overflow. Press-in metal inner seals shall not be used on 0.946 liter containers.

**3.5.2 Type II.** Type II tree marking paint shall be supplied in commercial metal aerosol dispensers of nominal 473 mls (16 fluid ounces) capacity with metal or reinforced plastic caps. Each container shall be equipped with a stream and a spotting nozzle. Each nozzle shall be identified by a different color and placed under the cap of the container. The label shall be prominently marked to indicate the use of each nozzle.

**3.6. Material Safety Data Sheet.** A Material Safety Data Sheet (MSDS) shall be submitted in accordance with FED-STD-313 (see 6.2).

**3.7. Special Marking.** Container labels shall:

(1) Identify the Government Agency for which manufactured.
(2) Identify date of manufacture and batch number
(3) Identify color of contents
(4) Bar code marking of NSN, batch number and QPL code.
(5) NOT indicate that the paint contains a tracer.

## 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, except the weather resistance requirement of 3.4.6, using facilities approved by the Government. The Government reserves the right to perform any of the inspections set forth herein when deemed necessary to assure that the tree marking paint conforms to prescribed requirements. Supplier's test results for each batch shall be made available upon request to: USDA Forest Service, SDTDC, (see 6.4 for address).

**4.2. Classification of inspections**. Inspections shall be classified as follows:

(a) Preparation for delivery (see 4.2.1).
(b) Acceptance testing (see 4.2.2)
(c) Qualification testing (see 4.2.3 and 6.4)

**4.2.1. Preparation for delivery.** A random sample of filled containers shall be selected in accordance with ANSI/ASQC Z1.4, inspection level S-2, acceptable quality level (AQL) 2.5 percent, and examined for compliance with 3.5, 3.7 and section 5.

**4.2.2. Acceptance testing.** Acceptance testing of individual lots shall consist of tests for all requirements specified in section 3 except accelerated weathering, weather resistance and odor.

**4.2.3 Qualification testing.** Qualification testing shall consist of tests for all requirements in section 3. Field qualification testing shall be conducted by the San Dimas Technology and Development Center (SDTDC) (see 6.4). Laboratory testing shall be conducted by a laboratory approved by the USDA Forest Service National Tree-Marking Steering Committee. Failure to conform to any requirement shall disqualify the paint for inclusion on the Qualified Products List (QPL) under this Federal Specification.

**4.3. Test methods.** The manufacturer may sample for test prior to filling containers, but the Government shall sample the paint in accordance with ASTM D 3925. All testing shall be as specified in Table II and as otherwise specified herein to determine compliance with the requirements of section 3. Unless otherwise specified, all tests shall be conducted at conditions specified in ASTM D 3924. Failure of any test shall be cause for rejection of the lot from which the sample was taken and removal from the Qualified Products List (QPL).

**TABLE II Index.**

| Characteristic | Requirement paragraph | FED-STD-141 | ASTM Method | Test paragraph |
|---|---|---|---|---|
| Prohibited materials | 3.2.4 | — | E170, E260 D3718, D3335 | — |
| Total solids | Table I | — | D2697 | 4.3.1 |
| Contrast ratio | Table I | 4121, Proc B Method B | — | — |
| Sag resistance | Table I | 4494 | — | — |
| Drying time | Table I | — | D1640 | — |
| Volatile organic content (VOC) | Table I | — | D3960 | — |
| Condition in container | 3.4.1 | 3011 | — | — |
| Color | 3.4.2 | — | D1729, D2244 | 4.3.2 |
| Spraying properties | 3.4.3 | — | — | 4.3.3 |
| Adhesion to cold and wet wood | 3.4.4 | — | — | 4.3.4 |
| Accelerated weathering | 3.4.5 | — | G26 | 4.3.5 |
| Weather resistance | 3.4.6 | — | — | 4.3.6 |
| Odor | 3.4.7 | — | D1296 | — |
| Tracer uniqueness | 3.2, 3.2.2 | — | — | 4.3.7 |

**4.3.1. Total solids (Type II only).** Carefully pierce the top of the aerosol can (the can may be cooled to reduce pressure) with a pointed instrument to produce a small hole and allow the propellant to escape. The hole may be enlarged after the gas flow slows. Cut the top of the can off when there is no further evidence of gas escaping and transfer the tree marking paint quantitatively into a tared beaker using several washes of acetone. Heat the beaker and contents on a water bath until all propellant is evolved. After cooling, weigh the beaker and determine the mass of the concentrate. Adjust the concentrate to a total solids content of 40 percent by weight with an appropriate solvent for the contrast ratio determination. Determine nonvolatile volume in accordance with ASTM D2697. Calculate the volume of concentrate by dividing the mass by the specific gravity. Calculate the nonvolatile volume by multiplying the percentage obtained in paragraph 8.4 of ASTM D2697 by the volume of concentrate.

**4.3.2. Color.** The tree marking paint shall be sprayed on a 15x15x1.2 cm MDO Plywood (Medium Density Overlay Plywood, PS 1-83) panel to obtain complete hiding and allowed to dry 48 hours. Yellow, red, and orange shall be matched to the appropriate color chart specified in 3.4.2 in accordance with ASTM D1729. Blue and green shall be matched to the specified color chip in accordance with ASTM D2244. The reflectance at complete hiding (tristimulus value Y) shall be determined in accordance with ASTM D2244 for white and black.

**4.3.3. Spraying properties.**

**4.3.3.1. Types I and III.** Condition the types I and III tree marking paint in a quart container with a Nelson Nelspot D-103 spray gun (use a .533 mm [.021 inch] nozzle for Type I and a .736 mm [.029 inch] nozzle for type III) at -29°C (-20°F) for 4 hours. Spray from a distance of 1.8 meters (6 feet) using two trigger pulls with a pause of approximately one-half second between pulls. Heat the container to 40°C (104°F) and repeat the test. A spot 7 to 13 cm (3 to 5 inches) in diameter shall be produced at each temperature. Examine for compliance with 3.4.3.

**4.3.3.2 Type II.** Weigh the full container before performing the tests specified in 4.3.3.2.1 and 4.3.3.2.2 and then the container shall be sprayed until paint does not spray. The container shall be weighed to determine the weight of paint discharged and the can opened and rinsed with solvent to remove any residual paint. Dry the can at 105°C (221°F) for 1 hour, cool and weigh to determine the weight of paint in the full container. The percentage of paint discharged shall be calculated for compliance with 3.4.3.

**4.3.3.2.1. Low temperature.** Condition the pressurized container with stream nozzle at -29°C (-20°F) for 4 hours and handshake 1 minute. Hold the container perpendicular to and 1.5 meters (5 feet) away from the vertical target. Depress the nozzle and hold open for 3 seconds. A spot 7 to 13 cm (3 to 5 inches) in diameter shall be produced on the target. Condition the container at 10°C (50°F) for 4 hours. Install the banding nozzle and hold the container perpendicular to and 0.6 meters (2 feet) away from the vertical target. Depress the nozzle and hold open for 2 seconds. A spot 7 to 13 cm (3 to 5 inches) in diameter shall be produced on the target.

**4.3.3.2.2. High temperature.** Condition the container from 4.3.3.2.1 at 40°C (104°F) 4 hours and test with the stream and banding nozzles as in 4.3.3.2.1. Cool the container to room temperature before spraying to depletion as specified in 4.3.3.2.

**4.3.4. Adhesion to cold and wet wood surfaces.**

**4.3.4.1. Adhesion to cold wood surfaces.** Condition one piece of 15x15x1.2 cm MDO plywood (Medium Density Overlay Plywood, PS 1-83) and the tree marking paint at -29°C (-20°F) for 4 hours. Apply the tree marking paint by spraying to a wet film thickness of 0.1 mm (4 mils). Observe for film formation and immediately return the panel to the cold box. Remove the panel after 7 days cold exposure and allow to equilibrate to room temperature for 48 hours. Check for adhesion by performing the dry-through test as specified in ASTM D1640. Removal of any portion of the film shall constitute failure of the requirement in 3.4.4.

**4.3.4.2. Adhesion to wet wood.** Immerse one piece of 15x15x1.2 cm MDO Plywood in water for 4 hours at room temperature. Remove from water and drain for 15 minutes. Apply the tree marking paint by spraying to a wet film thickness of 0.1 mm (4 mils). Allow to dry for 48 hours and check for adhesion by performing the dry-through test as specified in ASTM D1640. Removal of any portions of the film shall constitute failure of the requirement in 3.4.4.

**4.3.5. Accelerated weathering.**

**4.3.5.1. Panel preparation.** Apply tree marking paint by spraying to a wet film thickness of 0.1 mm (4 mils) on three 15x15x1.2 cm MDO plywood panels and air dry 7 days.

**4.3.5.2 Exposure.** Expose the panels to 700 hours accelerated weathering in accordance with ASTM G26, Method A, with a cycle of 102 minutes of light followed by 18 minutes of light and water spray.

**4.3.5.3. Evaluation.** Examine the exposed panels for checking, peeling, and color change for compliance with 3.4.5. The color change shall be determined in accordance with ASTM D2244. Test tree marking paints with the field test method and submit the exposed panels for laboratory analysis to determine the presence of the tracer for compliance with 3.4.5.

**4.3.6. Weather resistance.** The tree marking paint will be applied to standing trees in several forest locations selected by the qualifying activity, and evaluated yearly for six years for adhesion, color retention and tracer performance, and shall also be exposed as specified below.

**4.3.6.1. Panel preparation.** As specified in 4.3.5.1.

**4.3.6.2. Exposure.** Expose 3 panels to 3 years weathering at a 45° southern exposure and 3 panels to 3 years weathering at a 45° northern exposure at Forest Products Laboratory, Madison, WI.

**4.3.6.3. Evaluation.** Examine the exposed panels for checking, peeling and color change for compliance with 3.4.6. The color shall be examined as in 4.3.1. Test the paints with the field test method and submit the exposed panels for laboratory analysis to determine the presence of the tracer for compliance with 3.4.6.

**4.3.7 Tracer Uniqueness.** Apply tree marking paint with tracers registered to each government Agency to separate MDO plywood panels and allow to dry. Use the field test kit supplied by the manufacturer to verify the presence of tracer and its uniqueness as required by 3.2 and 3.2.2.

## 5. PREPARATION FOR DELIVERY

**5.1. Packaging, packing and marking.** The tree marking paint shall be furnished in quantities specified (see 6.2). The packaging shall be in accordance with 3.5. The packing shall be as otherwise specified (see 6.2). Marking shall be in accordance with FED-STD-123.

## 6. NOTES

**6.1. Intended use.** This description covers weather-resistant marking paints for marking and identifying trees. Marking paints are intended to provide a service life of 6 years after application. The paint is suitable for application through a temperature range of -29°C through 40°C (-20°F to 104°F).

**6.2 Ordering data.** Purchasers should include the following information in procurement documents:

(a) Title, and date of this specification.
(b) Type required (see 1).
(c) Color required (see 3.4.2).
(d) Quantity and size of container required (see 3.5).
(e) Packaging and packing level.
(f) Instructions and address for submission of MSDS (see 3.6)

**6.3 Registration of tracer.** Tracers are required to be registered for the exclusive use of individual Government Agency.

**6.3.1. Registration for USDA Forest Service.** To register the tracer for exclusive use by the USDA Forest Service, the contractor shall submit by registered letter, eyes only, return receipt required, a request for registration with sufficient description of the tracer to the following address where it will be recorded and filed in a security vault:

Mr. F. L. Garrett, Jr.
USDA Forest Service, SDTDC
444 E. Bonita Ave.
San Dimas, CA 91773

6.3.2. **Registration for Bureau of Land Management.** To register the tracer for exclusive use by the Bureau of Land Management, the contractor shall submit by registered letter, eyes only, return receipt required, a request for registration with sufficient description of the tracer to the following address where it will be recorded and filed in a security vault:

Bureau of Land Management
Oregon State Office
ATTN: Special Agent-in-Charge, Lynell Schalk
PO Box 2965
Portland, OR 97208

**NOTE: TRACER INFORMATION MUST BE SENT BY REGISTERED MAIL EYES ONLY**

**6.4. Qualification.** With respect to products requiring qualification, awards will be made only for products which are, at the time set for award by the contracting officer, qualified for inclusion in the applicable qualified products list, whether or not such products have actually been so listed by that date. The attention of the supplier is called to this requirement, and manufacturers are urged to arrange to have the products they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is: USDA Forest Service, SDTDC, 444 E Bonita Ave., San Dimas, CA 91773 and information pertaining to qualification of products to be obtained from this activity.

**6.5. Field user testing.** Field users will conduct monitoring tests under the direction of SDTDC. The results will be forwarded to SDTDC who will initiate steps to take corrective action if required.

**PREPARING ACTIVITY:**
**USDA-SDTDC**

**CIVIL AGENCY COORDINATING ACTIVITY:**
**GSA - FSS**
**INT-BLM**