

CCC-S-00320 (Army-MO)

18 November 1963

SUPERSEDING

(See section 6)

INTERIM FEDERAL SPECIFICATION

SHEETING AND TAPE, REFLECTIVE;

ADHESIVE BACKING

This interim Federal specification was developed by the Department of the Army, U. S. Army Engineer Research and Development Laboratories, Mobility Command, Fort Belvoir, Va., based upon currently available technical information. It is recommended that Federal Agencies use it in procurement and forward recommendations for changes to the preparing activity at the address shown above.

1. SCOPE AND CLASSIFICATION

1.1 Scope. - This specification covers flexible, colored, reflective sheeting and tape coated on one side with an adhesive backing and protected by a removable liner.

1.2 Classification. - The reflective material shall be of the following types, classes, and colors as specified (see 6.2):

Type I - Sheeting, reflective (sheets or rolls).

Type II - Tape, reflective (rolls).

Class 1 - Manual application (pressure sensitive adhesive).

Class 2 - Mechanical application.

a. - Solvent activated.

b. - Heat activated.

Colors: White, silver white No. 1 and No. 2, yellow, red, dark red, orange, green, blue, and gold.

FSC 8305
FSC 9390

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2. APPLICABLE SPECIFICATIONS, STANDARDS, AND OTHER PUBLICATIONS

2.1 Specifications and standards. - The following specifications and standards 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 Specifications:

| | |
|-----------|-----------------------------------------------------------------------------------|
| QQ-A-362 | - Aluminum Alloy Plate and Sheet, Alclad 2024. |
| PPP-B-601 | - Boxes, Wood, Cleated-Plywood. |
| PPP-B-621 | - Boxes, Wood, Nailed and Lock-Corner. |
| PPP-B-636 | - Box, Fiberboard. |
| PPP-T-76 | - Tape, Pressure-Sensitive Adhesive Paper, Water Resistant, (For Carton Sealing). |
| PPP-T-97 | - Tape; Pressure-Sensitive Adhesive, Filament Reinforced. |

Federal Standards:

| | |
|------------------|---------------------------------------------------|
| FED. TEST METHOD | - Paint, Varnish, Lacquer, and Related Materials; |
| STD. No. 141 | Methods of Inspection, Sampling, and Testing. |

(Activities outside the Federal Government may obtain copies of Federal specifications and standards as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

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(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D. C., Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, and Auburn, Washington.

(Federal Government activities may obtain copies of Federal specifications and standards and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Specifications:

MIL-L-10547 - Liners, Case, Waterproof.

Military Standards:

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

MIL-STD-129 - Marking for Shipment and Storage.

(Copies of Military specifications and standards required by suppliers 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 otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

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OFFICIAL CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York 16, N. Y.)

AMERICAN TRUCKING ASSOCIATION

National Motor Freight Classification Rules.

(Application for copies should be addressed to the American Trucking Association, 1616 P Street NW, Washington 6, D. C.)

INTERSTATE COMMERCE COMMISSION

49 CFR 71-78 - Code of Federal Regulations, Interstate Commerce Commission Rules and Regulations for the Transportation of Explosives and Other Dangerous Articles.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.)

3. REQUIREMENTS

3.1 Description. - The reflective sheeting and tape shall consist of a smooth, flat, exterior film with spherical glass lens elements embedded beneath the outer surface. A light-reflecting material shall be applied behind the spherical elements, resulting in a nonexposed optical reflecting system. This reflecting system shall have a precoated adhesive backing protected by a removable liner.

3.2 Preproduction sample. - The preproduction sample is defined as a production sample which will be identical to the reflective sheeting and tape which the manufacturer will subsequently produce in fulfillment

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of the contract. As soon as practicable after award of the contract and prior to submission of any reflective sheeting and tape for final acceptance, the contractor shall furnish a preproduction sample for examination and test to determine conformance to this specification. Examination and tests shall be those specified herein. Approval of the preproduction sample by the activity concerned shall not relieve the contractor of his obligation to supply reflective sheeting and tape conforming to this specification. Any changes or deviations of the reflective sheeting and tape from the preproduction sample shall be subject to the approval of the contracting officer.

3.3 Material. - Material shall be as specified herein. Material not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.4 Temperature requirements.

3.4.1 Storage temperatures. - The reflective sheeting and tape shall not crack, peel, chip, or be otherwise damaged when stored under the following conditions:

Air temperature

High - Plus 160° F. Time period, 4 hours daily for 3 days.

Low - Minus 70° F. Time period, 4 hours daily for 3 days,
no solar radiation.

3.4.2 Thermal and humidity extremes. - The reflective sheeting and tape applied to aluminum panels shall not crack, peel, or chip when

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exposed to hot thermal extremes for 24 hours, cold thermal extremes for 72 hours, and high- and low-humidity extremes for 24 hours.

3.5 Components.

3.5.1 Exterior film. - The exterior film shall be a colored or clear, transparent, flexible, smooth-surfaced, moisture-resisting material. The film may be applied as a sheet or as a sprayed-on coating or by other methods of commercial application that will obtain the specified characteristics.

3.5.2 Spherical elements. - A uniform monolayer of spherical glass lens elements shall be embedded in a binder. The glass spheres shall not be affected by acid.

3.5.3 Binder. - The binder shall be formulated and processed to serve as a binder for the glass spheres and to produce a firm bond between the spheres and the exterior film. The binder shall provide a base for the light-reflecting material.

3.5.4 Adhesive backing. - The adhesive backing applied to the reflective material shall adhere to smooth, clean, nonporous, painted or unpainted, corrosion- and weather-resistant surfaces and shall produce a bond to support a 1-3/4-pound weight for 5 minutes without the bond peeling for a distance of not more than 2 inches. The adhesive shall retain all its adhesive characteristics for a minimum period of 1 year (see 6.3).

3.5.5 Removable liner. - The adhesive backing of the reflective sheeting and tape shall be covered by a protective, removable liner.

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The liner shall be removable from the adhesive backing without sticking or tearing, after storage in a temperature of 160° F., plus or minus 5° F., for 4 hours while being subjected to a static load of 2.5 psi.

3.5.6 Color. - The color of the reflective sheeting and tape shall be white, silver whites No. 1 and No. 2 (see 6.1.2), yellow, red, dark red, orange, green, blue, and gold. The chromaticity limits of the colors shall be as shown in table I.

3.5.7 Composite assembly. - The composite assembly of the sheeting or tape, with the liners removed, shall have a tensile strength of not less than 5 pounds per inch of width (ppiw) nor more than 20 ppiw.

agation shall be not less than 10 percent nor more than 45 percent.

3.6 Surface characteristics.

3.6.1 Reflective intensity. - The reflective intensity values of the reflective sheeting and tape shall be not less than the values specified in table II, for each color as applicable (see 6.7).

3.6.2 Rainfall. - After accelerated weathering as specified herein, the reflective intensity value of the reflective sheeting and tape shall not be reduced by more than 10 percent of the minimum values shown in table II.

3.6.3 Specular gloss. - The reflective sheeting and tape, when measured with a gloss-meter, shall have a specular-gloss reading of not less than 40.

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Table I. CIE Chromaticity Coordinate Limits

| Color | 1 | | 2 | | 3 | | 4 | | Reflectance limits (%) |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|------------------------|
| | x | y | x | y | x | y | x | y | |
| Silver white #1 | 0.309 | 0.308 | 0.350 | 0.359 | 0.338 | 0.371 | 0.295 | 0.322 | Min. 37.0 |
| Silver white #2 | 0.309 | 0.308 | 0.350 | 0.359 | 0.338 | 0.371 | 0.295 | 0.322 | Min. 37.0 |
| Yellow | 0.504 | 0.458 | 0.525 | 0.473 | 0.493 | 0.507 | 0.474 | 0.488 | 30.0 to 39.0 |
| Red | 0.633 | 0.319 | 0.680 | 0.320 | 0.649 | 0.351 | 0.601 | 0.347 | 8.0 to 11.0 |
| Gold | 0.457 | 0.409 | 0.484 | 0.426 | 0.459 | 0.451 | 0.436 | 0.430 | 20.0 to 27.0 |
| Orange | 0.600 | 0.370 | 0.624 | 0.375 | 0.605 | 0.394 | 0.582 | 0.388 | 12.0 to 15.0 |
| Blue | 0.134 | 0.043 | 0.169 | 0.097 | 0.154 | 0.125 | 0.114 | 0.077 | 0.9 to 2.0 |
| Green | 0.133 | 0.376 | 0.147 | 0.436 | 0.123 | 0.454 | 0.104 | 0.386 | 4.0 to 7.0 |
| White | 0.309 | 0.308 | 0.337 | 0.343 | 0.323 | 0.354 | 0.295 | 0.322 | Min. 37.0 |
| Dark red | 0.649 | 0.306 | 0.695 | 0.305 | 0.680 | 0.320 | 0.633 | 0.319 | 5.0 to 7.0 |

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Table II. Reflective Intensity Values
(Minimum)

| Divergence angle degrees | Incidence angle degrees | White | Silver white #1 | Silver white #2 | Yellow | Red | Dark red | Orange | Green | Blue | Gold |
|-----------------------------|----------------------------|-------|--------------------|--------------------|--------|------|-------------|--------|-------|------|------|
| 0.2 | -4 | 38.0 | 38.0 | 63.0 | 23.0 | 11.0 | 9.0 | 17.0 | 12.0 | 7.0 | 39.0 |
| 0.2 | +10 | 35.0 | 35.0 | 60.0 | 21.0 | 10.0 | 8.0 | 16.0 | 11.0 | 6.0 | 37.0 |
| 0.2 | +20 | 27.0 | 27.0 | 55.0 | 14.0 | 8.0 | 6.0 | 13.0 | 10.0 | 5.0 | 30.0 |
| 0.2 | +30 | 18.0 | 18.0 | 43.0 | 8.0 | 5.0 | 4.0 | 8.0 | 7.0 | 3.0 | 21.0 |
| 0.2 | +40 | 9.0 | 9.0 | 30.0 | 3.0 | 2.0 | 2.0 | 4.0 | 4.0 | 1.0 | 12.0 |
| 0.2 | +50 | 7.0 | 7.0 | 16.0 | 1.0 | 1.0 | 0.8 | 2.0 | 2.0 | 0.6 | 5.0 |
| 0.5 | -4 | 21.0 | 21.0 | 31.0 | 14.0 | 6.0 | 5.0 | 9.0 | 6.0 | 4.0 | 18.0 |
| 0.5 | +10 | 20.0 | 20.0 | 30.0 | 13.0 | 6.0 | 4.0 | 9.0 | 6.0 | 4.0 | 18.0 |
| 0.5 | +20 | 17.0 | 17.0 | 28.0 | 9.0 | 5.0 | 3.0 | 7.0 | 5.0 | 3.0 | 16.0 |
| 0.5 | +30 | 13.0 | 13.0 | 24.0 | 6.0 | 3.0 | 2.0 | 5.0 | 4.0 | 2.0 | 13.0 |
| 0.5 | +40 | 7.0 | 7.0 | 18.0 | 2.0 | 2.0 | 1.0 | 3.0 | 3.0 | 1.0 | 8.0 |
| 0.5 | +50 | 2.0 | 2.0 | 11.0 | 0.9 | 1.0 | 0.6 | 1.0 | 1.6 | 0.4 | 3.0 |
| 2.0 | -4 | 5.0 | 5.0 | 6.0 | 2.0 | 1.0 | 0.8 | 1.6 | 1.0 | 0.4 | 3.0 |
| 2.0 | +10 | 5.0 | 5.0 | 6.0 | 2.0 | 1.0 | 0.7 | 1.6 | 1.0 | 0.4 | 3.0 |
| 2.0 | +20 | 4.6 | 4.6 | 6.0 | 2.0 | 1.0 | 0.6 | 1.6 | 1.0 | 0.4 | 3.0 |
| 2.0 | +30 | 4.0 | 4.0 | 5.0 | 1.0 | 0.8 | 0.5 | 1.0 | 0.9 | 0.3 | 3.0 |
| 2.0 | +40 | 2.6 | 2.6 | 4.0 | 1.0 | 0.6 | 0.3 | 0.9 | 0.9 | 0.2 | 2.0 |
| 2.0 | +50 | 1.0 | 1.0 | 3.0 | 0.3 | 0.3 | 0.2 | 0.6 | 0.5 | 0.1 | 1.0 |

Note: These values are tentative and will be adjusted after additional procurement experience and sample evaluation.

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3.7 Fungus resistance. - After inoculation with the test organism Aspergillus niger and incubation for 14 days, the reflective sheeting and tape shall show no appreciable formation of fungus growth. Any formation of fungus growth shall be noninjurious to the reflective sheeting and tape surface and shall be removable by wiping with a soft cloth. At completion of the incubation, the reflective sheeting and tape shall retain the full reflective intensity values as specified in table II. The sheeting and tape shall not be removable from the aluminum panels without damage.

3.8 Accelerated weathering. - When subjected to accelerated weathering for 1,200 hours, the reflective sheeting and tape shall show no discoloration detectable to the naked eye from a viewing distance of 25 feet when compared to an unweathered specimen. The reflective materials shall show no evidence of cracking, scaling, pitting, or blistering nor excessive shrinkage or expansion. The reflective materials shall retain not less than 80 percent of the reflective intensity values specified in table II. The sheeting and tape shall not be removable from the aluminum panels without damage.

3.9 Solvent resistance. - When exposed to specified standard commercial solvents, the reflective sheeting and tape shall show no evidence of dissolving, puckering, or blistering.

3.10 Flexibility. - When bent around a 3/4-inch-diameter mandrel, the reflective sheeting and tape shall show no evidence of cracking around the outside of the bend.

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3.11 Shrinkage. - With the protective liner removed from the back of the reflective sheeting and tape, shrinkage shall be not more than 1/32 inch in 10 minutes nor more than 1/8 inch in 24 hours, per 9 by 9 inch section of material.

3.12 Thickness. - The thickness of the reflective sheeting and tape shall be as follows:

- (a) The thickness of the reflective materials without the protective liner shall be not more than 0.010 inch.
- (b) The thickness of the reflective materials including the protective liner shall be not more than 0.016 inch.

3.13 Size and shape. - The luminous sheeting and tape shall be furnished either in flat sheets or in rolls of the size, shape, and quantity specified (see 6.2). Rolls shall be wound on commercial-type cores.

3.13.1 Splicing. - When the luminous material is furnished in rolls, there shall be not more than three splices per 50 yards of material. Splices shall be suitable for application as supplied.

3.14 Instructions. - Instructions defining a step-by-step procedure for application of the reflective sheeting and tape shall be furnished by the supplier and shall be included with each package of reflective material. Any restrictions on the application procedure or any precautions to be exercised regarding surface preparation and applicable temperature shall be specified.

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3.15 Types and classes.

3.15.1 Type I, reflective sheeting. - The type I, reflective sheeting shall be furnished either in flat sheets or in rolls as specified. Sheeting shall be of any width over 6 inches.

3.15.2 Type II, reflective tape. - The type II, reflective tape shall be furnished in rolls only. Tape shall be in widths up to and including 6 inches.

3.15.3 Class 1, manual application. - The class 1 reflective sheeting and tape shall have a pressure-sensitive adhesive backing for manual application after removal of the protective liner.

3.15.4 Class 2, mechanical application. - The class 2 reflective sheeting and tape shall have a tack-free adhesive backing to be activated by one of the following methods:

- (a) Solvent activated. - The adhesive backing shall be activated by applying activator solvents conforming to Interstate Commerce Commission Code (I.C.C.) 49 CFR 71-78 requirements for nonflammable mixtures with a flashpoint above 140° F. The solvents shall be furnished with reflective material in the quantities specified by the supplier.
- (b) Heat activated. - The adhesive backing shall be activated by applying heat in excess of 175° F. to the material.

3.16 Workmanship. - The reflective sheeting and tape shall be free from ragged edges, cracks, scales, pits and blisters, or other harmful, extraneous materials.

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4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspection. - Inspection shall be classified as follows:

- (a) Preproduction inspection of the reflective sheeting and tape.
- (b) Quality conformance inspection of the reflective sheeting and tape.
- (c) Inspection of preparation for delivery.

4.3 Preproduction inspection.

4.3.1 Examination. - The reflective sheeting and tape shall be examined for the defects specified in 4.5.1. Presence of one or more defects shall be cause for rejection.

4.3.2 Tests. - The reflective sheeting and tape shall be tested as specified in 4.5.2. Failure of any test shall be cause for rejection.

4.4 Quality conformance inspection.

4.4.1 Sampling. - Sampling for examination and tests shall be in accordance with Military Standard MIL-STD-105, inspection level L4.

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4.4.1.1 Examination. - Samples selected in accordance with 4.4.1 shall be examined for the defects specified in 4.5.1. AQL shall be 6.5 percent defective.

4.4.1.2 Tests. - Samples selected in accordance with 4.4.1 shall be tested as specified in 4.5.2.4, 4.5.2.6, 4.5.2.7, 4.5.2.8, 4.5.2.9, 4.5.2.10, 4.5.2.11, 4.5.2.14, 4.5.2.15, and 4.5.2.16. AQL shall be 4.0 percent defective.

4.5 Inspection procedure.

4.5.1 Examination. - The reflective sheeting and tape shall be examined for the following defects:

101. Materials not as specified.
102. Color not as specified.
103. Exterior film not smooth surfaced.
104. Glass spheres not uniformly applied.
105. Sizes and shapes not as specified.
106. Rolls not wound on cores.
107. More than three splices per 50 yard rolls.
108. Splicing not as specified.
109. Instruction procedures not furnished or inadequate.
110. Solvent not furnished with class 2a, reflective sheeting and tape.
111. Workmanship not as specified.
112. Improper preparation for delivery.

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4.5.2 Tests.

4.5.2.1 Test conditions.

4.5.2.1.1 Test panels. - When tests are to be performed using test panels, the reflective material shall be applied to smooth aluminum panels, cut from aluminum sheets conforming to Federal Specification QQ-A-362, temper T3, or any equal type of aluminum sheeting. Apply the material in accordance with the furnished instructions.

4.5.2.1.2 Test specimens. - Unless otherwise specified in the test method or test paragraph, the test specimens shall be 1 inch by 12 inches in size.

4.5.2.1.3 Sample conditioning. - Unless otherwise specified herein, all applied and unapplied test samples shall be conditioned in accordance with Federal Standard FED. TEST METHOD STD. No. 141, section 7, for 24 hours prior to testing.

4.5.2.2 Test methods. - All test methods specified herein shall be in accordance with Federal Standard FED. TEST METHOD STD. No. 141.

4.5.2.3 Temperature tests.

4.5.2.3.1 Storage. - Place samples of reflective material in storage and expose to the following temperatures (see 6.4.1): plus 160° F. and minus 70° F., plus or minus 5° F., for 4 hours per day for 3 days, without solar radiation. Check samples after each day. Nonconformance to 3.4.1 shall constitute failure of this test.

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4.5.2.3.2 Hot thermal extremes. - Subject panel-applied specimens of the reflective material to a 24-hour cycle of temperature and solar radiation starting with 10 hours at plus 90° F., without solar radiation: 5 hours of steadily increasing temperature to plus 155° F., and with radiation intensity (see 6.4.3, 6.4.4, and 6.4.5) increasing from 0 to 105 watts per square foot (50 percent infrared, 44 percent visible, 6 percent ultraviolet): 4 hours of constant conditions at maximum radiation intensity: 5 hours of decreasing temperature and radiation intensity to 90° F. and 0 intensity. Wind velocity shall be 7 mph at 5 to 10 feet. Nonconformance to 3.4.2 shall constitute failure of this test.

4.5.2.3.3 Cold thermal extremes. - Condition panel-applied specimens of the reflective material in a temperature of minus 40° F. Subject specimens to an air temperature of minus 65° F. and a sky temperature (see 6.4.6) of minus 80° F. for 72 hours and then recondition them at minus 40° F. Wind velocity shall be 5 mph at 5 to 10 feet. Nonconformance to 3.4.2 shall constitute failure of this test.

4.5.2.3.4 High-humidity extremes. - Subject panel-applied specimens of the reflective material to 20 hours of relative humidity (see 6.4.2) between 93 and 97 percent at air temperature, from 80° F. to 85° F., followed by 4 hours of 100 percent relative humidity with condensation at 75° F. to 80° F. Air movement and radiation shall be negligible. Nonconformance to 3.4.2 shall constitute failure of this test.

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4.5.2.3.5 Low-humidity extremes. - Subject panel-applied specimens of the reflective material to a 24-hour cycle at relative humidity and temperature conditions as follows: 10 hours of 15 percent relative humidity at 90° F.; 5 hours of steadily decreasing relative humidity and increasing temperature to 5 percent relative humidity at 125° F.; 4 hours of constant conditions; and 5 hours of steadily increasing relative humidity and decreasing temperature to 15 percent relative humidity at 90° F. Nonconformance to 3.4.2 shall constitute failure of this test.

4.5.2.4 Tensile strength and elongation. - Determine the tensile strength and elongation of the sheeting or tape in accordance with methods 6224 and 6225. The machine speed shall be 12 inches per minute, and the report shall be expressed in ppiw. Nonconformance to 3.5.7 shall constitute failure of this test.

4.5.2.5 Glass sphere tests.

4.5.2.5.1 Extraction. - Extract the spherical glass lens elements from the reflective material. Extraction may be accomplished by cutting a specimen of the material into approximately 1/4-inch segments and immersing the segments in lacquer thinner that has been heated to approximately 130° F. Stir the thinner until the film is dissolved and the lens elements have settled. Decant the thinner and repeat the process until the extracted lens elements are clean.

4.5.2.5.2 Acid resistance. - Examine the extracted lens elements microscopically to determine the presence of any opaque lenses. Immerse approximately 0.1 cc of the lens elements in 1.00 cc of a 5N solution

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of concentrated sulphuric acid (H_2SO_4) and distilled water for 30 minutes, and examine the lens elements microscopically. Nonconformance to 3.5.2 shall constitute failure of this test.

4.5.2.6 Removable liner. - Store samples of the reflective material in a temperature of 160° F. for 4 hours and subject to a pressure of 2.5 psi. Allow the samples to cool to room temperature (70 to 80° F.). Nonconformance to 3.5.5 shall constitute failure of this test.

4.5.2.7 Adhesive bond. - Cut a 1-inch by 6- to 12-inch specimen from the sample used for the test in 4.5.2.6, and apply 4 inches at one end of the specimen to a test panel. Suspend the panel in a horizontal position with the specimen facing downward. Attach a 1-3/4-pound weight to the free end of the specimen and allow it to hang free at an angle of 90 degrees to the panel surface for 5 minutes. Nonconformance to 3.5.4 shall constitute failure of this test.

4.5.2.8 Color. - Determine the color of the reflective material in accordance with method 4252, except that the test specimen may be illuminated at 45 degrees and viewed normal to the surface. Observations shall be made at four randomly located areas across the full width of the test specimen. A space of not less than 1 inch shall separate each area. Nonconformance to 3.5.6 and table I shall constitute failure of this test.

4.5.2.9 Reflective intensity.

4.5.2.9.1 Apparatus. - A projector, having a maximum lens diameter of 1 inch and capable of projecting a uniform beam of light, shall be

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used to illuminate the specimen. The light reflected from the specimen shall be measured with a photo-electric receiver whose response has been corrected for the color sensitivity of the eye. A selenium barrier layer photocell corrected to the sensitivity of the eye with a Kodak Wratten Filter No. 102 shall be considered as proper color correction for the purpose of this test. The maximum dimension of the active area of the receiver shall be 1 inch. The maximum effective area of the specimen shall be 1 square foot. The maximum dimension of the specimen shall be no greater than 1.5 times the minimum dimension. The distance from the center of the specimen to both the front lens of the projector and the receiver shall be 50 feet, plus or minus 2 inches. The arrangement shall be as shown in figure 1.

4.5.2.9.1.1 Test procedure. - Measure the distance from the projector to the specimen, the area of the specimen, and the illumination incident on the specimen. Measure the illumination incident on the receiver due to reflection from the specimen at six angles of incidence (see 6.4.7) for each of three angles of divergence (see 6.4.8). The angles of incidence shall be minus 4 degrees, plus 10 degrees, plus 20 degrees, plus 30 degrees, plus 40 degrees, and plus 50 degrees; the angles of divergence shall be 0.2, 0.5, and 2.0 degrees. The illumination incident on the specimen and the receiver shall be measured in the same units. Compute the reflective intensity, R , from the following equation:

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$$R = \frac{L_r}{L_s} \left(\frac{d^2}{A} \right)$$

L_r = Illumination incident upon the receiver.

L_s = Illumination incident upon the sample measured in the same units as L_r .

d = Distance in feet from the sample to the projector.

A = Area in square feet of the sample.

Nonconformance to 3.6.1 and table II shall constitute failure of this test.

4.5.2.10 Rainfall. - Clean and prepare panel-applied 8- by 12-inch specimens in accordance with method 2021. Place specimens in an upright position 6 inches below the holes of the water nozzle and 4 inches in front of the nozzle. Sufficient water pressure shall be applied so that the upper surface of the spray envelope strikes the top of the test specimen. A water nozzle and test setup is shown in figure 2. With water falling on the specimen, the reflective intensity value shall be measured as specified in 4.5.2.9 except that the measurement shall be made at angles of 0.2-degree divergence and minus 4-degree incidence only. Nonconformance to 3.6.2 shall constitute failure of this test.

4.5.2.11 Gloss. - Measure the specular gloss of the reflective material in accordance with method 6103. Nonconformance to 3.6.3 shall constitute failure of this test.

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4.5.2.12 Fungus resistance. - Determine the fungus resistance of the reflective material by the following method.

4.5.2.12.1 Test organism. - The test organism used in this test shall be Aspergillus niger, ATCC No. 6275 (see 6.5). Cultures of this organism shall be carefully maintained on a potato-dextrose agar medium and promptly renewed if there is evidence of contamination. The stock cultures may be kept for not more than 4 months in a refrigerator at a temperature from 3° to 10° C. (37.4° to 50° F.). Subcultures incubated at 28° to 30° C. (82.4° to 86° F.) for 10 to 14 days shall be used in preparing the inoculum.

4.5.2.12.2 Culture medium. - The culture medium shall have the following composition:

| | |
|--------------------------------------|--------------|
| NaNO ₃ | - 3.0 grams |
| K ₂ HPO ₄ | - 1.0 gram |
| MgSO ₄ ·7H ₂ O | - 0.5 gram |
| KCl | - 0.25 gram |
| Agar | - 15.0 grams |

Distilled water to make 1,000 ml

The pH shall be 5.5 to 6.5; if otherwise, adjust to that range with HCl or NaOH. After mixing, the ingredients shall be sterilized by autoclaving for 15 minutes at 15 psi (121° C.). Under sterile conditions, the medium shall be poured into six 150 by 20 mm petri dishes, about 65 ml per dish, and allowed to harden.

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4.5.2.12.3 Inoculum. - Add about 10 ml of sterile, distilled water containing about 0.005 percent of a nontoxic wetting agent to a sub-culture (10 to 14 days old) of the test organism in a ripe, fruiting condition. The spores shall be forced into suspension with a sterile camel's-hair brush (or other suitable means) and diluted to 100 ml with sterile, distilled water.

4.5.2.12.4 Preparation of specimens. - Cut three 3- by 3-inch specimens from the sample and apply to test panels with the reflective surface up. Completely immerse the test specimens in a leaching tank of continuously flowing water for 24 hours and then remove and dry. The leaching tank shall be large enough to hold an amount of water weighing not less than 50 times the weight of the specimens. The water entering the tank shall not fall directly on the specimens and shall flow at a rate of 5 to 10 liters per hour. The pH of the water shall be in the range of 6.0 to 8.0.

4.5.2.12.5 Inoculation. - Under aseptic conditions, dip each specimen in 70 percent ethanol for a few seconds, rinse in distilled water, and place firmly on the surface of the solidified agar medium contained in the petri dishes. Place specimens with the reflective surface facing up, one specimen to each dish. With a sterile pipette, distribute 1.0 to 1.5 ml of inoculum over the surface of each specimen and the surrounding medium.

4.5.2.12.6 Incubation period. - The period of incubation shall be 14 days at a temperature of 29° C. to 32° C. (84.2° F. to 89.6° F.) and 85 to 90 percent relative humidity.

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4.5.2.12.7 Control. - Test three control specimens of untreated, porous-grade filter paper with the specimens of the reflective material to check the viability of the inoculum. At the end of the incubation period, the controls should be covered with fungus growth.

4.5.2.12.8 Test results. - Upon completion of the incubation period, examine the specimens visually for fungus growth. Wipe the specimens with a soft cloth wet with a 70 percent ethanol solution. Condition the specimens in accordance with 4.5.2.1.3 except that the conditioning period shall be 48 hours. Test the specimens in accordance with 4.5.2.9. Nonconformance to 3.7 shall constitute failure of this test.

4.5.2.13 Accelerated weathering. - Expose specimens of panel-applied reflective material to 1,200 hours of accelerated weathering in accordance with method 6152. Once every 24 hours each specimen shall be removed from the weathering machine and shall be placed in cold storage at 0° F. for 1 hour. After completion of the 1,200-hour exposure period, test the specimens in accordance with 4.5.2.9. Nonconformance to 3.8 shall constitute failure of this test.

4.5.2.14 Solvent-resistance. - Determine the resistance of the reflective material to the solvents specified herein by immersing the material in glass exposure containers at room temperature in accordance with method 6011. Specimens, each 1 inch by 6 inches, shall be applied to test panels. Solvents and immersion time shall be as follows:

| <u>Solvents</u> | <u>Immersion time</u> |
|------------------------------------------|-----------------------|
| Methyl alcohol, kerosene, and turpentine | 10 minutes |
| Toluol and xylol | 1 minute |

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At the end of the immersion period, the test panels shall be removed from the exposure containers and allowed to dry. Nonconformance to 3.9 shall constitute failure of this test.

4.5.2.15 Flexibility. - Test flexibility of the reflective material in accordance with method 6221 using a 3/4-inch-diameter mandrel. Before testing, the specimens shall be applied to test panels 2-3/4 inches wide by 11 inches long by 0.020 inch. Nonconformance to 3.10 shall constitute failure of this test.

4.5.2.16 Shrinkage. - The test specimen shall be a 9-inch by 9-inch square section of the reflective material. Remove the protective liner from the back of the specimen. Place the specimen on a flat surface with the adhesive side up and leave for 24 hours. After 10 minutes, check dimensions of the specimen; and again after 24 hours, recheck the dimensions to establish the extent of shrinkage. Nonconformance to 3.11 shall constitute failure of this test.

4.5.2.17 Thickness. - Thicknesses of the reflective material shall be established in accordance with method 6183. Nonconformance to 3.12 shall constitute failure of this test.

4.6 Inspection of preparation for delivery. - The packaging, packing, and marking shall be examined and tested to determine compliance with section 5 of this specification.

5. PREPARATION FOR DELIVERY

5.1 Packaging.

5.1.1 Levels A and C. - Each roll of tape, each roll of sheeting, and flat sheets, with the instructions and the activator solvents

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required for class 2a, shall be packaged in substantial commercial containers that will afford protection against deterioration and damage.

5.2 Packing. - Packing shall be level A, B, or C, as specified (see 6.2).

5.2.1 Level A. - Packaged reflective material of like description and the activator solvents in the quantity required shall be packed together in a close-fitting box conforming to Federal Specification PPP-B-621, class 2, style optional; Federal Specification PPP-B-601, overseas type, style optional; or Federal Specification PPP-B-636, V3c, style optional. Each wood box shall be lined with a sealed case liner conforming to Military Specification MIL-L-10547, type I or II, grade A or B, class 2, L-2 or M material. The wood boxes shall be closed and strapped in accordance with the appendix to the box specification. The gross weight of each wood box shall not exceed 200 pounds. Fiberboard boxes shall be sealed with water-resistant tape conforming to Federal Specification PPP-T-76; reinforced with tape conforming to Federal Specification PPP-T-97, type 2, class B; and applied in accordance with the appendix to the box specification, table 1A and 2A.

5.2.2 Level B. - Packaged reflective material of like description and the activator in the quantity required shall be packed together as specified in 5.2.1, except wood boxes shall not require a case liner and the boxes shall be domestic type or class as applicable.

5.2.3 Level C. - The reflective material, activator solvents, and instructions shall be packed to assure carrier acceptance and safe

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delivery to destination at lowest rates if containers complying with Uniform Freight Classification Rules, National Motor Freight Classification Rules, or other carrier rules applicable to the mode of transportation.

5.3 Marking. - Packages and shipping containers shall be marked in accordance with Military Standard MIL-STD-129.

6. NOTES

6.1 Intended use. - The reflective sheeting and tape are intended for use in reflectorizing surfaces, signs, markers, and the like, to assure their visibility at night under normal as well as under black-out conditions, when exposed to a source of light and whether dry or totally wet by rain.

6.1.1 Application. - The reflective sheeting and tape are intended for application directly to smooth, clean, nonporous, painted, or unpainted, corrosion and weather-resistant surfaces.

6.1.2 Silver whites. - Silver white No. 1 is intended for use in background applications. Silver white No. 2 is intended for use as applied or demountable copy for use with darker colored backgrounds.

6.2 Ordering data. - Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Types, classes, and colors required (see 1.2).
- (c) Size, shape, and quantity of flat sheets required (see 3.13).

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(d) Width, length, and quantity of rolls required (see 3.13).

(e) Level of packing required (see 5.2).

6.3 Adhesive characteristics. - In lieu of testing, the supplier may furnish a certificate stating that the adhesive backing will retain all of its adhesive characteristics for a minimum period of 1 year. Should the adhesive backing fail before 1 year when applied in accordance to the supplier's recommendations, then the supplier shall replace the remaining reflective materials without any extra cost to the Government.

6.4 Definitions. - The following definitions shall apply throughout this specification where applicable.

6.4.1 Temperatures. - Temperatures specified herein refer to values measured under standard conditions of light, ventilation, and radiation shielding. Temperatures are measured at heights of 5 feet or more above the ground level.

6.4.2 Relative humidity. - The ratio expressed as the percent of the amount of water vapor in a given space to the amount the space would contain if saturated.

6.4.3 Infrared radiation. - Solar radiation of wave lengths greater than 7,000 A (0.00007 cm).

6.4.4 Ultraviolet radiation. - Solar radiation of wave lengths less than 4,000 A (0.00004 cm).

6.4.5 Visible radiation. - Solar radiation of wave lengths greater than 4,000 A, but less than 7,000 A.

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6.4.6 Sky temperature. - The effective temperature of the sky used in determining the heat loss from the earth's surface by radiation to the sky.

6.4.7 Incidence angle. - The angle having as its sides the line normal to the center of the sample and the line joining the center of the sample to the center of the projection lens. If the line normal to the sample is on the same side of the projector as the receiver, the incidence angle is positive. If the line normal to the sample is on the opposite side of the projector from the receiver, the incidence angle is negative.

6.4.8 Divergence angle. - The angle having as its sides the line joining the center of the sample with the center of the projection lens, and the line joining the center of the sample with the center of the receiver.

6.5 Fungus test organism. - The organism used in the fungus resistance test specified in 4.5.2.12 may be obtained from the American Type Culture Collection, 2112 M Street NW, Washington 7, D. C., or for service use, from the Pioneering Research Division, Quartermaster Research and Engineering Center, Natick, Mass.

6.6 Supersession data. - This specification includes the requirements of Military Specification MIL-R-13689A dated 10 January 1956.

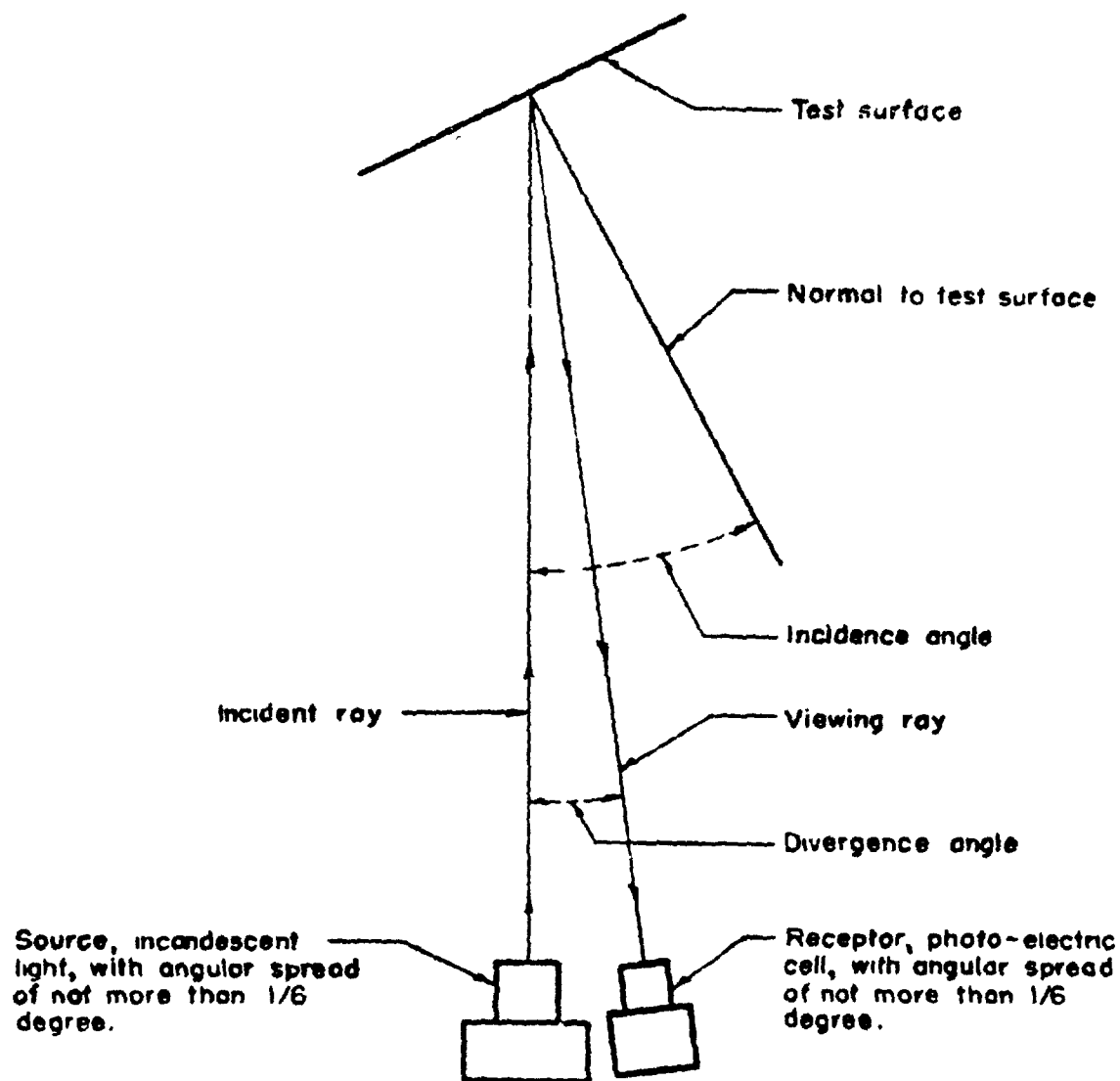
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6.7 The values in table II are based on test results from a limited number of samples not considered to be sufficient to provide an acceptable manufacturing tolerance. Allowances may be made at the discretion of the purchaser. Modifications to the values may be made after additional test data is obtained.

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Note: Angles are measured in the same horizontal spread.

Figure 1—Incidence and divergence angles as measured in reflection factor test.

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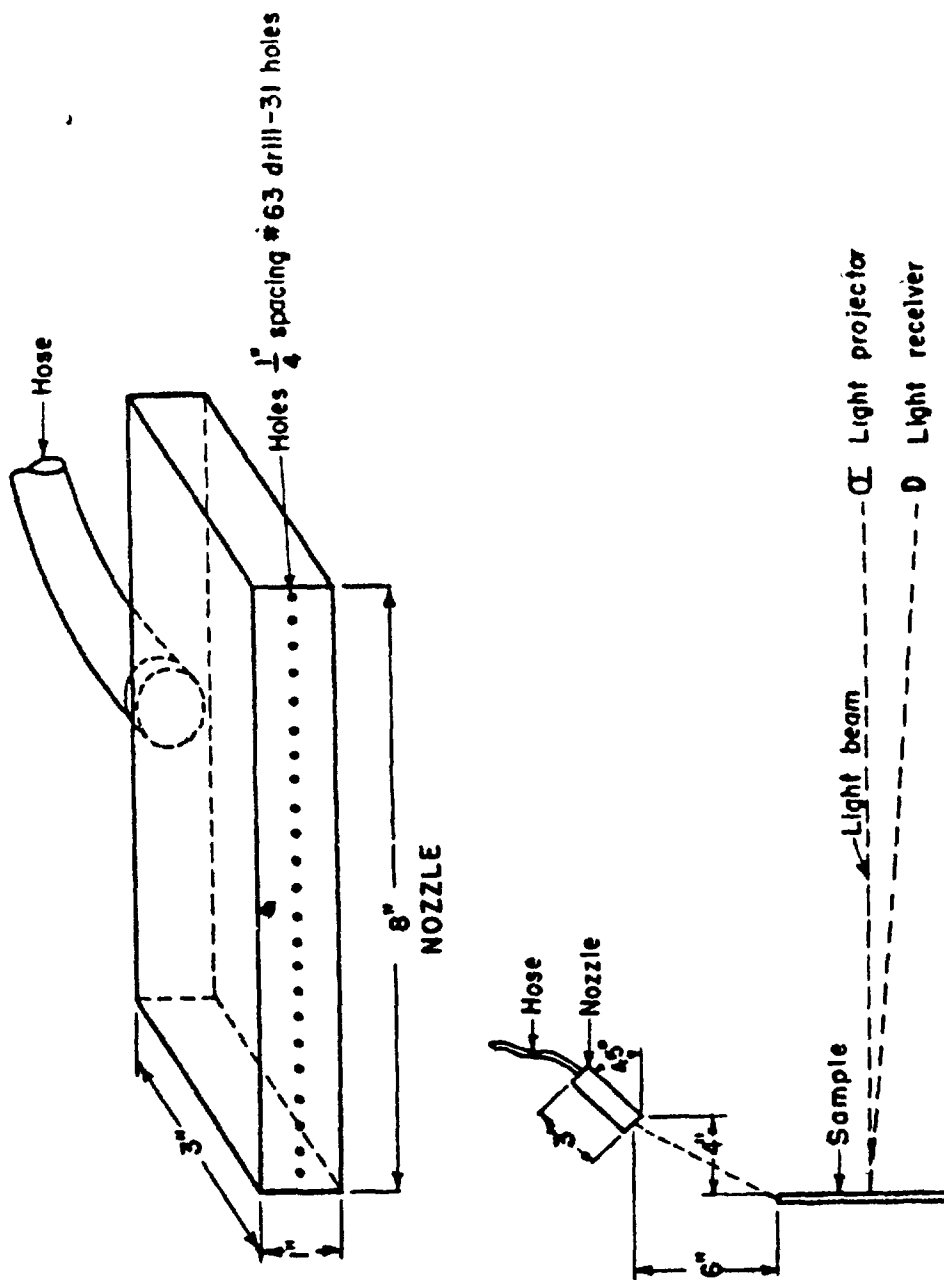


Figure 2 - Test set up for rainfall test.

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