RESOLUTION A.658(16)

Adopted on 19 October 1989
Agenda item 10

USE AND FITTING OF RETRO-REFLECTIVE MATERIALS ON LIFE-SAVING APPLIANCES

THE ASSEMBLY,

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines concerning maritime safety,

RECALLING resolution MSC.6(48) whereby the Maritime Safety Committee adopted a revised chapter III of the International Convention for the Safety of Life at Sea, 1974, as amended,

CONSIDERING that under the provisions of regulation 30.2.7 of that revised chapter III, life-saving appliances shall be fitted with retro-reflective material where it will assist in detection and in accordance with the recommendations of the Organization,

HAVING CONSIDERED the recommendation made by the Maritime Safety Committee at its fifty-seventh session,

1. ADOPTS the Recommendation on the Use and Fitting of Retro-Reflective Materials on Life-Saving Appliances and the Technical Specification for Retro-Reflective Material for Use on Life-Saving Appliances, set out in Annexes 1 and 2, respectively, to the present resolution;

2. RECOMMENDS Contracting Governments to the International Convention for the Safety of Life at Sea, 1974, as amended, to make arrangements to ensure that life-saving appliances are fitted with retro-reflective material in the manner set out in Annex 1 to the present resolution or in such other manner as is considered by the Administration, to be substantially equivalent;

3. RECOMMENDS FURTHER that the Technical Specification for Retro-Reflective Material for Use on Life-Saving Appliances set out in Annex 2 to the present resolution be considered by Administrations as a standard for retro-reflective material, the application of which will contribute to keeping life-saving appliances at the high level of quality required;

4. AGREES that the Administration may accept life-saving appliances already fitted with retro-reflective materials in accordance with resolution A.274(VIII);

5. REQUESTS the Maritime Safety Committee to keep this recommendation under review and to report as necessary to the Assembly;

6. REVOKES resolution A.274(VIII).

ANNEX 1

RECOMMENDATION ON THE USE AND FITTING OF RETRO-REFLECTIVE MATERIALS ON LIFE-SAVING APPLIANCES

1 LIFEBOATS AND RESCUE BOATS

Retro-reflective materials should be fitted on top of the gunwale as well as on the outside of the boat as near the gunwale as possible. The materials should be sufficiently wide and long to give a minimum area of 150 cm^2 and should be spaced at suitable intervals (approximately 80 cm from centre to centre). If a canopy is fitted, it should not be allowed to obscure the materials fitted on the outside of the boat, and the top of the canopy should be fitted with retro-reflective materials similar to those mentioned above and spaced at suitable intervals (approximately 80 cm centre to centre). In the case of partially enclosed or totally enclosed lifeboats, such materials should be placed as follows:

.1 for detection by horizontal light beams – at suitable intervals at half the height between the gunwale and the top of the fixed cover; and

.2 for detection by vertical light beams (e.g. from helicopters) – at suitable intervals around the outer portion of the horizontal (or comparable) part of the top of the fixed cover;

.3 retro-reflective materials should also be fitted on the bottom of lifeboats and rescue boats which are not self-righting.

2 LIFERAFTS

Retro-reflective materials should be fitted around the canopy of the liferaft. The material should be sufficiently wide and long to give a minimum area of 150 cm^2 and should be spaced at suitable intervals (approximately 80 cm from centre to centre) at a suitable height above the waterline, doorways included, if suitable. On inflatable liferafts, retro-reflective materials should also be fitted to the underside of the floor, cross-shaped in the centre. The dimension of the cross should be half the diameter of the liferaft, and a similar cross should be applied to the top of the canopy.

On liferafts which are not equipped with canopies, materials which should be sufficiently wide and long (to give a minimum area of 150 cm^2) should be attached to the buoyancy chamber at suitable intervals (approximately 80 cm from centre to centre) in such a manner that they are visible both from the air and from a ship.

3 LIFEBUOYS

Retro-reflective materials of a sufficient width (approximately 5 cm) should be applied around or on both sides of the body of the lifebuoy at four evenly-spaced points.

4 BUOYANT APPARATUS

Buoyant apparatus should be fitted with retro-reflective materials in the same manner as liferafts without canopies, always depending on the size and shape of the object. Such materials should be visible both from the air and from a ship.

5 LIFEJACKETS

Lifejackets should be fitted with patches of retro-reflective materials with a total area of at least 400 cm^2 distributed so as to be useful for search from air and surface craft from all directions. In the case of a reversible lifejacket, the arrangement should be complied with no matter which way the lifejacket is put on. Such material should be placed as high up on the lifejacket as possible.

6 IMMERSION SUITS

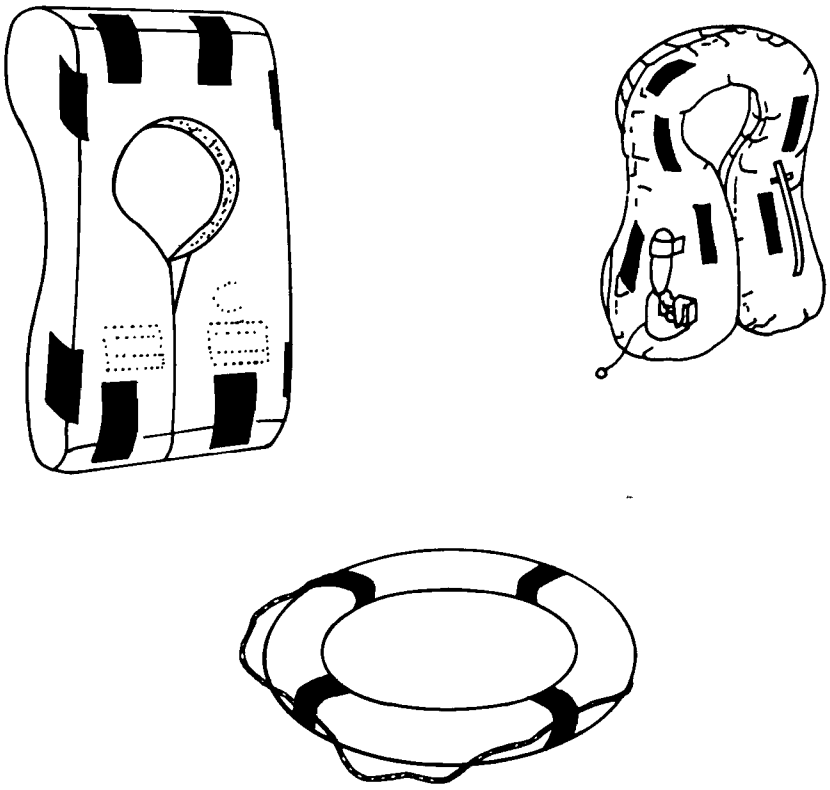
Immersion suits should be fitted with patches of retro-reflective material with a total area of at least 400 cm^2 distributed so as to be useful for search from air and surface craft from all directions.

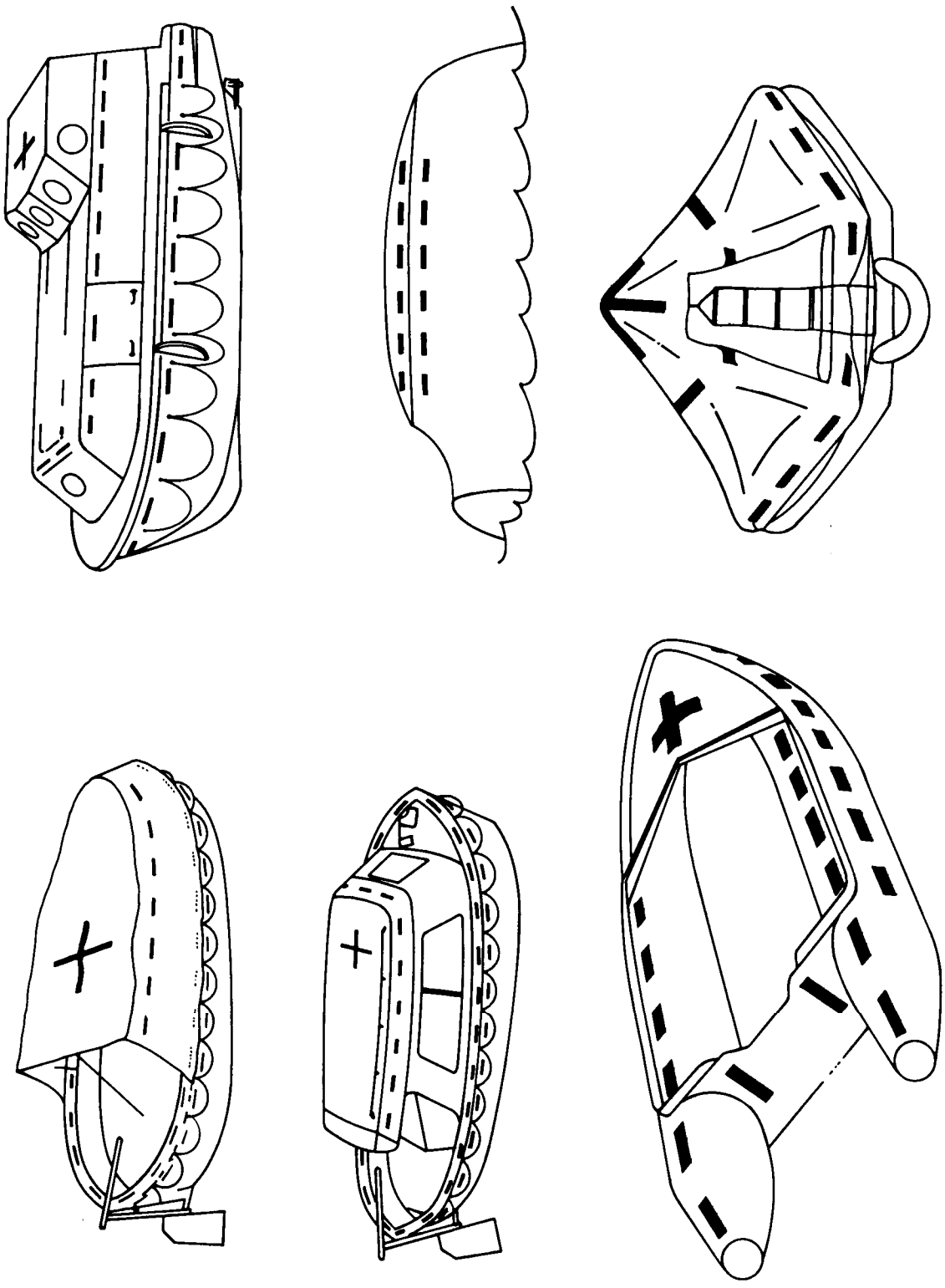
For an immersion suit that does not automatically turn the wearer face up, the back of the suit should be fitted with retro-reflective material with a total area of at least 100 cm^2.

7 GENERAL REMARKS

.1 Retro-reflective materials should be such as will meet the minimum technical specification given in Annex 2.

.2 The illustrations reproduced in this Annex are intended to provide Administrations with examples from which guidance may be taken when fitting retro-reflective materials in accordance with these guidelines.





ANNEX 2

TECHNICAL SPECIFICATION FOR RETRO-REFLECTIVE MATERIAL FOR USE ON LIFE-SAVING APPLIANCES

1 SCOPE

The present specification describes retro-reflective material for application to the flexible or rigid surfaces of life-saving appliances to assist in their detection.

2 CLASSIFICATION

Type I : Flexible materials not for continuous outdoor exposure.

Type II: Highly weather-resistant material for continuous outdoor exposure.

3 PERFORMANCE REQUIREMENTS

3.1 Photometric requirements

The minimum coefficient of retro-reflection (R') when illuminated by CIE Standard Illuminant A (colour temperature 2856 K) should be as specified in table 3.1 for the retro-reflective areas of new and dry material when tested as described in section 4.2. The brightness of the retro-reflective material, when tested as described in section 4.9, should be not less than 80% of the table 3.1 values.

TABLE 3.1

Minimum coefficient of retro-reflection R' in $cd.lx^{-1}.m^{-2}$

Entrance angle B_1 ($B_2 = 0$)	Observation angles 0.1°	0.2°	0.5°	1°
5	180	175	72	14
30	140	135	70	12
45	85	85	48	9.4

3.2 Accelerated weathering

Applied to an aluminium test panel, the material should show no significant discoloration, cracking, blistering or dimensional change, and should have not less than 80% of the specified minimum reflective intensity values in table 3.1, when tested as described in section 4.10.

3.3 Seawater immersion

Where tested as described in section 4.3, the material should show no evidence of blistering, delamination or subsurface corrosion. The material should show no evidence of "whitening" and its retro-reflective intensity should not be reduced below the retro-reflective values in table 3.1 except within 5 mm of each side of the required cuts.

3.4 Flexibility

There should be no cracking of the retro-reflective material, after conditioning for 4 hours at −30°C, when bent around a 3.2 mm mandrel and tested as described in section 4.4.

3.5 Tensile strength

Tensile strength N (newton) per 25 mm width:

material without support	≥16 N
material with support	≥330 N longitudinal
for mechanical fastening	≥200 N transverse

when tested as described in section 4.5.

3.6 Adhesive strength

For adhesive-backed material only. The adhesive strength should be not less than 16 N per 25 mm width when tested as described in section 4.6.

3.7 Blocking

The material should show no blocking when tested as described in section 4.7.

3.8 Salt spray resistance

The material should show no evidence of corrosion or degradation that would impair its effectiveness or reduce the coefficient of retro-reflection below the values in table 3.1 after exposure to a saline mist for 120 hours followed by cleaning with a dilute neutral detergent solution as described in section 4.8.

3.9 Temperature resistance

The material should show no evidence of cracking, distortion, or loss of coefficient of retro-reflection below the values in table 3.1 after exposure, in a dry atmosphere, for 24 hours to a temperature of 65 ± 2°C and subsequent exposure for 24 hours to a temperature of −30 ± 2°C.

3.10 Fungus resistance

Applied to an aluminium test panel, the material should not support fungus growth, should show no loss of coefficient of retro-reflection below the levels in table 3.1, and should not be removable from the test panel without damage, when tested as described in section 4.11.

3.11 Abrasion resistance

Applied to an aluminium test panel, the material should not have less than 50% of the specified minimum reflective intensity values in table 3.1, when tested as described in section 4.12.

3.12 Soil resistance and cleanability

Applied to an aluminium test panel, the material should not have any significant visible damage or permanent soiling when tested as described in section 4.13.

4 TEST METHODS AND INTERPRETATION OF TEST RESULTS

4.1 Test conditions and number of samples

Test specimens should be conditioned for 24 hours at a temperature of 23 ± 1°C and 50 ± 5% relative humidity before being tested. All test results should be interpreted as the average obtained from testing at least three specimens.

4.2 Photometric performance

The photometric performance should be measured using the general procedure recommended by CIE Report No.54, 1982. The sample dimensions should be 150 mm by 150 mm. Entrance and observation angles should be as specified in table 3.1. Readings shall be taken at not greater than 30° increments as the observation half-plane is rotated about the reference axis (i.e. at rotation angles (ε) of 0°, 30°, 60°, 90°, 120°, 150° and 180°). Each measured value should be the average of the readings for all of the required samples.

4.3 Seawater immersion

Prepare a 75 mm × 150 mm test panel.

(A)	Material without support:	After removing protective liner paper, apply specimens to a clean aluminium panel surface, using a hand-roller for application.
(B)	Material with support for mechanical fastening:	Tape edges of test specimens to a clean aluminium panel.

The retro-reflective material on each test panel is cut with a sharp knife from each corner diagonally opposite so that an "X" is formed. The cuts must be made completely through the material to the metal panel.

Immerse the test panels to half length in a 4% (by weight) salt water solution (4 g NaCl dissolved in 96 ml distilled water) at 25°C, using a glass beaker covered by a glass plate. After a 16-hour immersion period, remove the panels from the beaker, rinse salt deposits from the panels, and examine the sample following a 10-minute recovery period and again after 4 hours for compliance with the requirements described in section 3.3.

4.4 Flexibility

Condition test specimen for 4 hours in a cold chamber at −30°C. A 3.2 mm mandrel should be conditioned at the same temperature. The sample should be bent over the free-standing mandrel, gently applying gloved finger pressure.

For material without support, remove protective liner and talc the adhesive to prevent sticking.

4.5 Tensile strength

Prepare three test samples 25 mm in width and 150 mm in length. Insert samples into the grips or jaws of the testing machine so that the load is distributed evenly across the width of the samples and the initial test length is 100 mm. Determine tensile strength at a speed of 300 mm per minute. Record average tensile strength at break in newtons per 25 mm width for all three test samples. For material without support, remove protective liner paper before inserting samples in the tensile tester.

4.6 **Adhesive strength** (for material without support only)

Prepare three test samples 25 mm in width and 200 mm in length for each type of surface to which the material is to be applied. Remove protective liner paper for 80 mm in length and apply test specimens to the test surfaces. Test surfaces should be aluminium, GRP, each type of lifejacket and lifebuoy that the material is to be used on, and inflatable liferaft buoyancy tube material. Test surfaces should be 50 mm in width, 90 mm in length, and of the thickness normally used and should be properly cleaned by wiping the surface with a suitable solvent.

Apply test specimens with a solid brass roller, 80 mm in diameter and 40 mm in width covered with rubber approximately 6 mm thick and having a hardness of 80 ± 1 RHD and a total mass of approximately 2 kg. Use three passes for roller application and allow to have a 120 mm free overlap strip to be used for inserting into the jaw clamp of the testing instrument. One test panel should be immersed in distilled water in a covered container for 16 hours before adhesive strength testing and the other test panel should be immersed in salt water (4% NaCl by weight) in a covered container for 16 hours before adhesive strength testing. (This test method is required only for retro-reflective material that is designed for use with an adhesive. If a particular test panel used in testing results in a test failure, the retro-reflective material should not be approved for attachment to material of the type used as the test panel). Peel back at an angle of 180° at a speed of 300 mm per minute. Record adhesive strength in newtons per 25 mm width. Repeat the adhesive strength tests on samples subjected to the weathering test in section 4.10.

4.7 **Blocking**

Stack two 100 mm × 100 mm pieces of material, retro-reflective face to retro-reflective face, between two pieces of glass plate 3 mm thick of the same size as the samples and place in an air-circulating oven operating at 65°C. Place an 18 kg weight centrally on the top glass plate, and close the oven. After 8 hours, remove the test assembly from the oven, take the retro-reflective material from between the plates, and cool for 5 minutes. Separate the two pieces of retro-reflective material, and examine for evidence of adhering or peeling of the surface.

4.8 **Salt spray resistance**

Prepare test specimens as described in section 4.3 (A) and (B), respectively, and expose them to a salt spray chamber.

The test should consist of five periods of 22 hours' exposure each, separated by an interval of 2 hours during which samples are allowed to dry. The saline mist should be produced by atomizing, at a temperature of 35 ± 2°C, a saline solution obtained by dissolving five parts of NaC1 in 95 parts of water, containing not more than 0.2% of impurities.

4.9 **Photometric performance when wet**

An unweathered 150 mm × 75 mm specimen should be mounted in a vertical plane, with the 150 mm dimension oriented horizontally. Apply sufficient water so that the entire specimen surface is covered by a continuous moving film of water. Measure the coefficient of retro-reflection at 0.2° observation angle and 5° entrance angle. An example of an appropriate test apparatus is shown in figure 1.

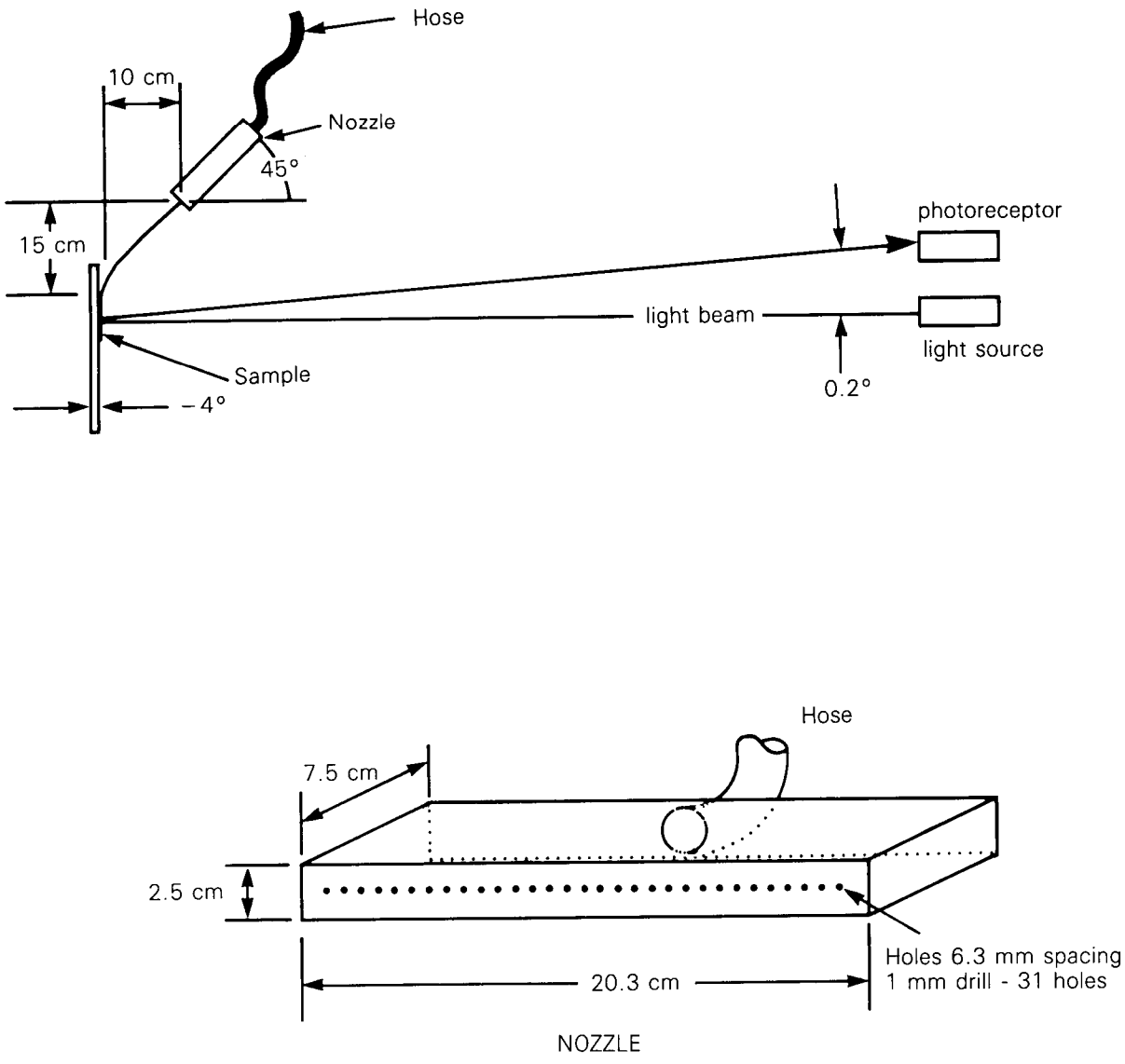


Figure 1 – *Suggested wet test apparatus*

4.10 Accelerated weathering

The photometric performance of the material should be determined according to section 4.2 after the material has been exposed in a sunshine carbon arc weatherometer for the following periods:

Type I material : 750 h
Type II material : 1,500 h

After exposure, the material should be examined for the requirements and characteristics in section 3.2.

4.11 Fungus resistance

Prepare three 75 mm × 75 mm test panels as described in section 4.3 (A). Prepare three additional test panels as described in section 4.3 (B), using non-rusting, non-staining clips or fasteners (in lieu of tape) to hold the material flat. Expose the panels to mildew, using the soil burial method, for a period of two weeks. The microbial activity of the soil should be verified by exposing untreated cotton fabric of 400 g/m^2 to 475 g/m^2 to the soil bed for the first five days. The soil should be considered to be satisfactory if this control sample loses not less than 50% of its original tensile strength during this exposure.

At the end of the exposure period, the test panels should be removed from the soil bed, gently washed to remove soil, and wiped with a soft cloth wetted with a 70% ethanol solution. Condition the panels under standard conditions for 48 hours. Test the photometric performance of the specimens as described in section 4.2 and, when finished, attempt to remove the material from the test panel.

4.12 Abrasion resistance

An apparatus is required which should consist of an electric motor mounted on a flat metal plate, and a mechanism through which the motor will impart a reciprocating motion to a brush lengthwise across the full length of a test panel clamped to the plate. Prepare one test panel 150 mm wide × 425 mm long, as described in section 4.3 (A). Mount the panel firmly on the test apparatus and place the brush on the panel.

The block of the brush should be aluminium, 90 mm long x 40 mm wide and 12.5 mm thick. The brush stock should be stiff, black, butt-cut Chinese hog bristle. There should be 60 holes on the block, 4 mm in diameter, solidly filled with bristle. The bristles should extend 20 mm beyond the block to form an abrading surface as nearly planar as possible. The total weight of the brush should be 450 ± 15 g. Weights may be fastened to the top of the brush to attain this weight.

Start the motor. The apparatus should be adjusted so that the brush travels at a rate of 37 ± 2 cycles (74 ± 4 strokes) per minute. Remove the panel after 1,000 brush strokes and wipe with a clean soft cloth. Test the photometric performance of the material, as described in section 4.2.

4.13 Soil resistance and cleanability

Prepare a test panel 150 mm × 150 mm, as described in section 4.3 (A). Soil the panel by applying a film, 90 mm wide × 0.075 mm thick, of thoroughly mixed soiling medium across the middle of the test panel. The soiling medium should consist of a mixture of 8 g carbon black, 60 g mineral oil and 32 g odourless mineral spirits. Cover the soiled area for 24 hours with a laboratory watch glass or similar device. Uncover the material and wipe off the soiling medium with a clean, dry, soft cloth. Wet the material with mineral spirits and wipe with a cloth soaked in mineral spirits. Wash with a 1% (by weight) solution of detergent in warm water, rinse, and dry with a clean, soft, dry cloth. Examine the sample for compliance with section 3.12.