

For comments only

Draft Indian Standard

**RETRO-REFLECTIVE MARKINGS FOR VEHICLES, THEIR
TRAILERS AND SEMI-TRAILERS - SPECIFICATION**

(ICS 13.340.01; 43.080.01)

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**Last date for receipt
of comments is 31 05 2020**

FOREWORD

(Formal clause to be added later)

Retro-reflective sheets and tapes are being increasingly used as a prime safety aid for easy, smooth and safe operation of automotive vehicles on both urban roads and highways. The affixing of these tapes adds to the existing safety pre-requisites fitted on the vehicles and is intended as auxiliary safety aid for warning the unwary vehicles, pedestrians and others of a hazard and as side markers indicating the outer limits and projections in the case of heavy vehicles. etc

In the preparation of this standard considerable assistance has been taken from AIS 090 (Rev 1):2019 'Approval of Retro-Reflective marking for Heavy and long vehicles, their Trailers and Semi-Trailers' issued by Automotive Industry Standards Committee.

The composition of committee responsible for formulation of this standard is given at Annex H.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1 SCOPE

This standard applies to approval of retro-markings for vehicles of category **M2, M3, N, T2, T3 and T4**.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

<i>Standard No.</i>	<i>Title</i>
IS 14272 (Part 1): 1995	Automotive Vehicles-Types - Terminology [<i>first revision of IS 14272 (Part 1)</i>]
AIS 008 (rev 2)	Installation requirements of lighting and light-signalling devices for motor vehicles having more than three wheels including quadricycles, trailer and semi-trailer excluding agricultural tractors
AIS 010 (Rev 2): Part 5	Requirements of chromaticity co-ordinates of colour of light emitted from lighting and light-signalling devices
IS/ ISO105 (Part B02):2014	Textiles — Tests for Colour Fastness Part B02: Colour Fastness to Artificial Light : Xenon Arc Fading Lamp Test

3 DEFINITIONS

For the purpose of this standard, besides the definition given in IS 14272, following shall apply:

3.1 General Terms

3.1.1 Marking — A rectangular strip or a series of such strips intended to be placed in such a way that it identifies the entire length and width of a motor vehicle and its trailer when viewed from the side (side marking) or rear (rear marking).

3.1.2 Conspicuity Marking — A device intended to increase the conspicuity of a vehicle, when viewed from the side or rear, by the reflection of light emanating from a light source not connected to the vehicle, the observer being situated near the source.

3.1.3 Contour Marking — A conspicuity marking intended to indicate the horizontal and vertical dimensions (length, width and height) of a vehicle.

3.1.4 Full Contour Marking — A contour marking that indicates the outline of the vehicle by a continuous line; horizontal dimension of the vehicle by a continuous line, and the vertical dimension by marking the upper corners.

3.1.6 Line Marking — A conspicuity marking intended to indicate the horizontal dimensions (length and width) of a vehicle by a continuous line.

3.1.7 Distinctive markings, Graphic — Coloured markings whose coefficient of retro-reflection is as defined in 7.2.1 and 7.2.2.

3.1.8 Sample unit — Part or all of the retro-reflective material intended to be used to achieve the

markings defined **3.1.3**, **3.1.2** and **3.1.3**.

3.1.9 Retro-reflection — Reflection in which luminous flux is returned in directions close to the direction from which it came, this property being maintained even over wide variations of the direction of the luminous flux.

3.1.10 Retro-Reflective Marking Material — A surface or a device from which, when directionally illuminated, a relatively large portion of the incident radiation is retro-reflected.

3.2 Geometric Terms (see Annex A, figure 1)

3.2.1 Reference Centre — A point on or near a retro-reflective area which is designated to be the centre of the device for the purpose of specifying its performance;

3.2.2 Illumination Axis (Symbol I) — A line segment from the reference centre to the light source.

3.2.3 Observation axis (symbol O) — A line segment from the reference centre to the photometer head.

3.2.4 Observation Angle (Symbol α) — The angle between the illumination axis and the observation axis. The observation angle is always positive and, in the case of retro-reflection, is restricted to small angles.

3.2.5 Observation on Half-Plane — The half-plane which originates on the illumination axis and which contains the observation axis.

3.2.6 Reference Axis (Symbol R) — A designated line segment originating on the reference centre which is used to describe the angular position of the retro-reflective device.

3.2.7 Entrance Angle (Symbol β) — The angle from the illumination axis to the reference axis. The entrance angle is usually not larger than 90° but, for completeness, its full range is defined as $0^\circ < \beta < 180^\circ$. In order to specify the orientation in full, this angle is characterised by two components, β_1 and β_2 .

3.2.8 Rotation Angle (Symbol ϵ) — The angle indicating the orientation of the retro-reflecting material by an appropriate symbol with respect to rotation about the reference axis.

3.2.9 First Axis (Symbol l) — An axis through the reference centre and perpendicular to the observation half-plane.

3.2.10 First Component of the Entrance Angle (Symbol β_1) — The angle from the illumination axis to the plane containing the reference axis and the first axis; range: $-180^\circ < \beta_1 < 180^\circ$.

3.2.11 Second Component of The Entrance Angle (Symbol β_2) — The angle from the plane

containing the observation half-plane to the reference axis; range $-90^\circ < \beta_2 < 90^\circ$.

3.2.12 Second Axis (Symbol 2) — An axis through the reference centre and perpendicular to both the first axis and the reference axis. The positive direction of the second axis lies in the observation half-plane when $-90^\circ < \beta_2 < 90^\circ$ as shown in Annex A, fig 1.

3.3 Definition of Photometric Terms

3.3.1 Coefficient of retro-reflection R' — The quotient of the coefficient of luminous intensity (R) of a plane retro-reflecting surface and its area

$R' = R / A$ The coefficient of retro-reflective R' is expressed in candela per square meter per lux ($\text{cd.m}^{-2} \cdot \text{lx}^{-1}$).

$R = I / E_{\perp}$ (Luminance/ Illumination)

$R' = I / E_{\perp} * A$

3.3.2 Angular Diameter of the Retro-Reflector Sample (Symbol η_1) — The angle subtended by the greatest dimension of the retro-reflective sample, either at the centre of the source of illumination or at the centre of the receiver ($\beta_1 = \beta_2 = 0^\circ$);

3.3.3 Angular Diameter of The Receiver (Symbol η_2) — The angle subtended by the greatest dimension of the receiver as seen from the reference centre ($\beta_1 = \beta_2 = 0^\circ$);

3.3.4 Luminance factor (symbol β) — The ratio of the luminance of the body to the luminance of a perfect diffuser under identical conditions of illumination and observation.

3.3.5 Colour of the Reflected Light of the Device — The definition of the colour of the reflected light are given in AIS 010 (Part 5) (Rev 1)

3.4 Description of Goniometer

A goniometer which can be used in making retro-reflection measurements in the CIE geometry is illustrated in Annex A, fig 2. In this illustration, the photometer head (O) is arbitrarily shown to be vertically above the source (I). The first axis is shown to be fixed and horizontal and is situated perpendicular to the observation half-plane. Any arrangement of the components which is equivalent to the one shown can be used.

3.5 Definition of Type

Marking materials of the different types means materials which differ in such essential respects as:

- a) The trade name or trade mark;
- b) The characteristics of the retro-reflective material;
- c) The parts affecting the properties of the retro-reflective materials or devices.

4 CLASS

The following symbols indicating the class of material:

- a) Class C for the material for contour/ strip marking;
- b) Class D for material for distinctive markings / graphics for a limited area;
- c) Class E for material for distinctive markings / graphics for extended area;
- d) Class D/E for materials for distinctive markings or graphics as base or background in printing process for fully coloured logos and markings of class “E” in use which fulfil the requirements of class “D” materials.
- e) Class F for materials for extremities marking with red and white retro-reflective alternate stripes.

5 TEST PROCEDURE

Retro-reflective material shall be subjected to testing in accordance with test procedure given in Annex B.

6 GENERAL REQUIREMENTS

6.1 Retro-reflective marking materials shall be that way constructed that they function satisfactorily and will continue to do so in normal use. In addition, they shall not have any defect in design or manufacture that is detrimental to their efficient operation or to their maintenance in good condition.

6.2 Retro-reflective marking materials or parts thereof shall not be capable of being easily dismantled.

6.3 The means of attachment of the marking materials shall be durable and stable.

6.4 The outer surface of the retro-reflective marking materials shall be easy to be cleaned. The surface shall therefore not be rough and any protuberances they may exhibit shall not prevent easy cleaning.

7 SPECIAL REQUIREMENTS

7.1 Retro-reflective marking materials shall also satisfy the conditions as to shape and dimensions, and the colorimetric, photometric, physical and mechanical requirements set forth in Annex C, D, E and F.

7.2 Advertising, consisting of retro-reflective logos, distinctive markings or letters/characters has to be decent.

It may be consists of marking materials of class "D" if the total retro-reflective area is less than 2 m² ; if the total retro reflective area is at least 2 m², class "E" shall be used.

7.2.1 For class "D" marking materials the maximum values of the coefficient of retro-reflection are less or equal to the value defined in Annex E, Table 2, and are intended to be used in distinctive markings, graphics.

7.2.2 For class "E" marking materials the maximum values of the coefficient of retro-reflection are less or equal to 33 per cent of the values defined in Annex E, Table 2.

7.2.3 White retro-reflective marking material intended as base or background in printing processes for fully coloured logos and markings of class "E" in use without unprinted blank areas, may fulfil the requirements in Annex E, Table 2 for class "D" materials and must be marked as class D or class E.

7.3 Depending on the nature of retro-reflective marking material, the **competent authority** may authorize laboratories to omit certain unnecessary tests, provided that such omission is mentioned under "Remarks" on the Test Report.

8 INFORMATION TO BE SUBMITTED BY THE MANUFACTURER

A Manufacturer is required to submit information as given in Annex G.

9 MARKINGS

9.1 Every Retro-reflective shall be marked with the following:

- a) Lot No/ Batch No.
- b) The trade name or trade mark of the manufacturer;
- c) An orientation mark "TOP" shall be inscribed on marking material whose retro-reflective system is not omni-rotational.

9.2 The markings shall be positioned at least at 0.5 m intervals on strips, on areas within 100 x 100 mm².

9.3 The marks shall be visible, clearly legible on the outside of the marking material and indelible.

9.4 BIS Certification Marking

The Retro-reflective markings may also be marked with the Standard Mark.

9.4.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the BIS Act, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

**THE CIE CO-ORDINATE ANGULAR SYSTEM; GONIOMETER MECHANISM
EMBODYING THE CIE ANGULAR SYSTEM**

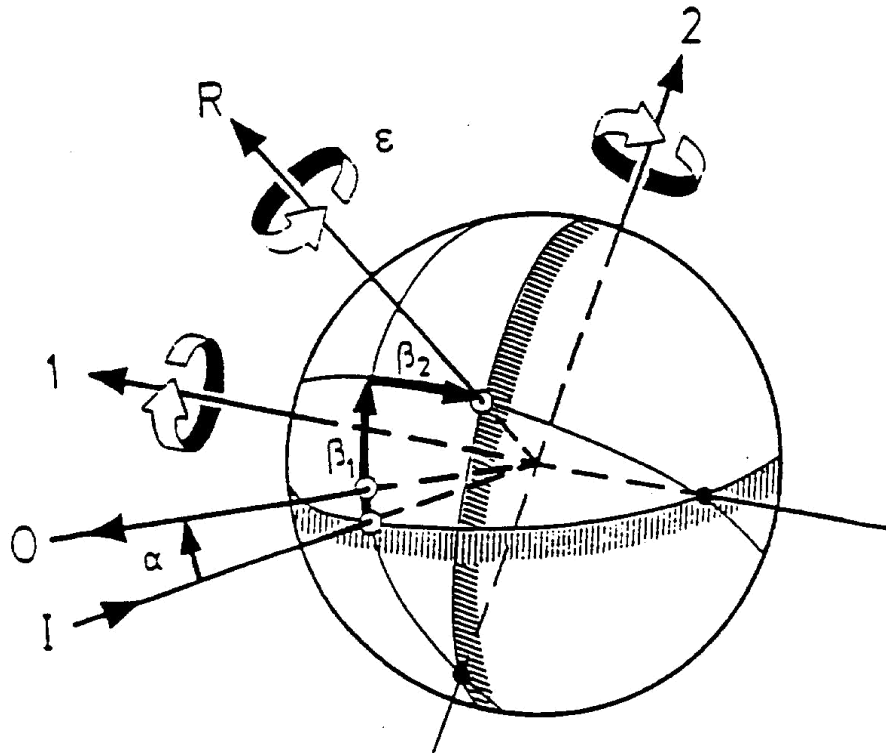


Figure 1

THE CIE CO-ORDINATE SYSTEM

1: First Axis	I: Illumination Axis	α : Observation angle
2: Second Axis	O: Observation Axis	β_1, β_2 : Entrance angles
	R: Reference Axis	ϵ : Rotation angle

A-1 The CIE angular system for specifying and measuring retro-reflective marking materials. The first axis is perpendicular to the plane containing the observation axis and the illumination axis. The second axis is perpendicular both to the first axis and to the reference axis. All axes, angles, and directions of rotation are shown positive.

- NOTES-**
- (a) The principle fixed axis is the illumination axis.
 - (b) The first axis is fixed perpendicular to the plane containing the observation and illumination axis.
 - (c) The reference axis is fixed in the retro-reflective material and moveable with β_1 and β_2 .

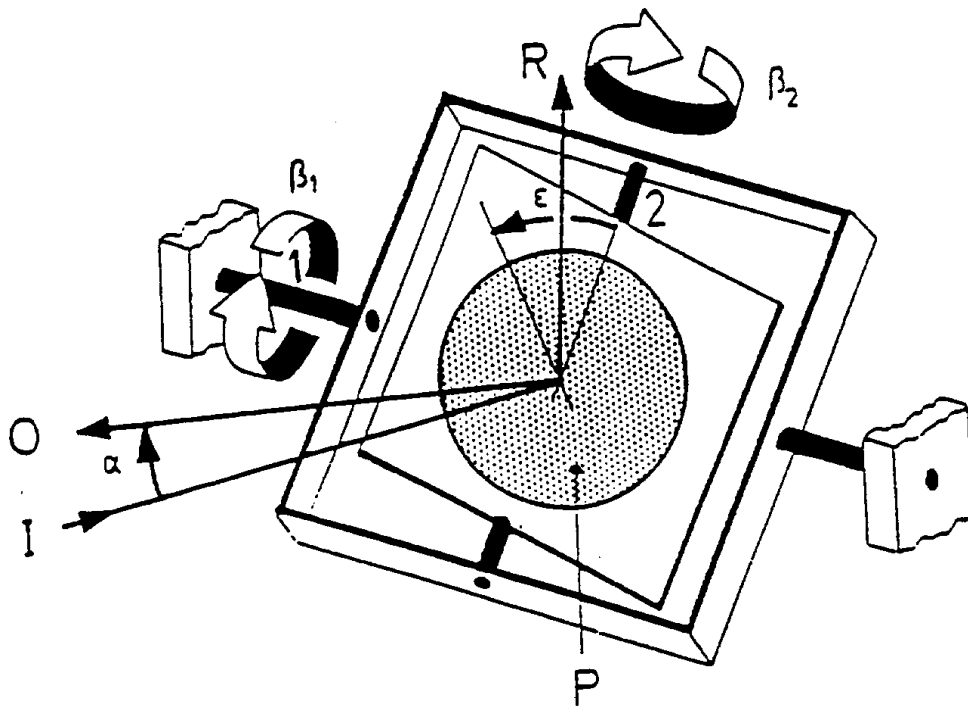


Figure 2

GONIOMETER MECHANISM EMBODYING THE CIE ANGULAR SYSTEM

1: First Axis	I: Illumination Axis	α : Observation angle
2: Second Axis	O: Observation Axis	β_1, β_2 : Entrance angles
3: Reference Centre	R: Reference Axis	ϵ : Rotation angle
	P: Retro-reflective material	

A-2 Representation of a Goniometer mechanism embodying the CIE angular system for specifying and measuring retro-reflective materials. All angles and directions of rotation are shown positive.

Annex B
(Clause 5)

TEST PROCEDURE

TEST SAMPLES

B-1 Five test samples representing either strips or planes of retro-reflective marking materials shall be submitted to the test laboratory. In the case of strips, at least a length of 3 meters shall be provided; in the case of planes, at least a surface of 500 x 500 mm² shall be provided.

B-2 After verification of the general requirements (cl 7) and the specifications of shape and dimensions (Annex C), the samples shall be subjected to the heat resistance test described in F - 4 of Annex F, prior to the tests described in Annex D and E.

B-3 The photometric and colorimetric measurements may be made on five samples. The mean values should be taken.

B-4 For other tests, samples which have not undergone any testing should be used.

NOTE- Test samples of retro-reflective marking materials shall be applied to edged and degreased aluminium panels of 2 mm thickness and shall be conditioned for 24 hours at 23°C ± 2°C at 50% ± 5% relative humidity prior to testing

Annex C
(Clause 7.1)

SPECIFICATION OF MARKING DIMENSIONS

C-1 SIDE AND REAR MARKING WITH STRIPS

C-1.1 General

The markings shall be made of strips of retro-reflective material.

C-1.2 Dimensions

C-1.2.1 The width of a side and/or rear marking material shall be 50 mm +10/-0 mm.

C-1.2.2 The minimum length of an element of a retro-reflective marking material shall be such that at least one approval mark is visible.

C-2 SIDE, REAR AND/ OR FRONT MARKING WITH STRIPS (CLASS F)

C-2.1 General

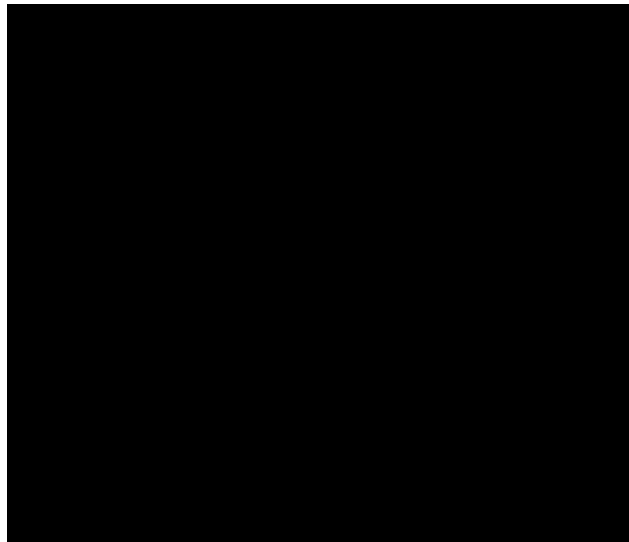
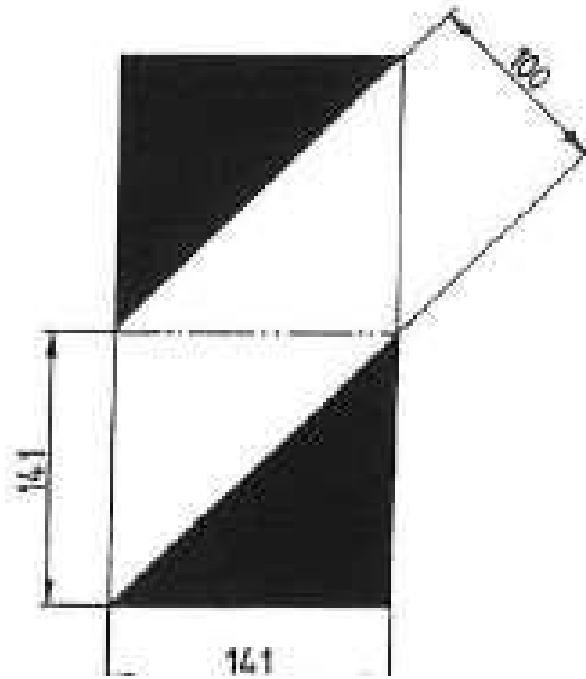
The markings shall be made of strips of retro-reflective material.

C-2.2 Dimensions

C-2.2.1 Class F retro-reflective material shall consist of red and white diagonal stripes each 100 mm wide sloping outwards and downwards at 45°. The basic standard area is a square of 141 mm in length subdivided diagonally into a white half and red half, which represents one standard area as shown in Figure 3.

C-2.2.2 The minimum length of an element of a retro-reflective marking material shall incorporate a minimum of 9 standard areas described in **C-2.2.1** on large vehicles with available mounting space, but may be reduced to a minimum of 4 standard areas on vehicles with limited mounting space.

Retro-reflective material marking of Class F



(Clause 7.1)

COLORIMETRIC SPECIFICATIONS

D-1 Retro-reflective marking materials (class C) shall be white, yellow or red. Retro reflective distinctive markings and/or graphics (class D and E) may be of any colour. Retro-reflective marking material (Class F) shall be white and red.

D-2 Class C, D and E Material

D-2.1 When illuminated by the CIE Standard Illuminant A at an entrance angle $\beta_1 = \beta_2 = 0^\circ$ or, if this produces a colourless surface reflection, an angle $\beta_1 = \pm 5^\circ$, $\beta_2 = 0^\circ$ and measured at an observation angle of $= 20'$, the colour of the material in new condition shall be within the limits defined by the chromaticity coordinates as given in AIS 010 (Part 5).

D-3 Class F Material

D-3.1 When measured with a spectrophotometer in accordance with the provisions of CIE document No. 15 (1971) and illuminated with the CIE Standard illuminant D65 at an angle of 45° to the normal and viewed along the normal ($45^\circ/0^\circ$ geometry), the colour of the material in new condition shall be within the limits defined by the chromaticity coordinates as given in AIS 010 (Part 5).

D-3.2 Luminance factor for red colour shall be ≥ 0.03 . For white colour, it shall be ≥ 0.25 .

(Clause 7.1)

PHOTOMETRIC SPECIFICATIONS

E-1 When illuminated with a CIE Standard illuminant A and measured as recommended by CIE Publication No. 54, 1982, the coefficient of retro-reflection R' in candelas per m^2 per lux [$cd/m^2/lux$] of the retro-reflective areas in new condition shall be at least as indicated in table 1 for yellow, white and red materials.

E-1.1 Minimum values for the coefficient of Retro-reflection Photometric specifications shall be as per Table 1 given below for retro-reflective markings of Class C:

TABLE 1

Minimum values for the Coefficient of Retro-reflection R' ($cd.m^{-2}.lx^{-1}$)

Observation angle α (°)	Entrance Angle β (°)					
	β_1	0	0	0	0	0
$\alpha = 0.33^\circ (20')$	β_2	5	20	30	40	60
Colour						
Yellow		300	----	130	75	10
White		450	----	200	90	16
Red		120	60	30	10	----

E-1.2 Maximum values for the coefficient of retro-reflection

Photometric specifications for distinctive markings or graphics of class D shall be as per Table 2 given below:

TABLE 2

Maximum values for the Coefficient of Retro-reflection R' ($\text{cd.m}^{-2}.\text{lx}^{-1}$)					
Observation angle α ($^\circ$)	Entrance Angle β ($^\circ$)				
$\alpha = 0.33^\circ$ ($20'$)	β_1	0	0	0	0
	β_2	5	30	40	60
Any colour		150	65	37	5

NOTE - If the sample is provided with an orientation mark, the specified values shall be observed for this orientation. Test samples without an orientation mark shall be observed for values at 0° and 90° orientations as well.

(Clause 7.1)

RESISTANCE TO EXTERNAL AGENTS

F-1 Resistance to weathering

F-1.1 Procedure - For each test, two specimens of a sample unit (see **3.1.8**) are taken. One specimen shall be stored in a dark and dry container for subsequent use as "reference unexposed specimen".

The second specimen shall be subjected to a source of illumination in accordance with IS/ ISO 105-B02, Section 4.3.1. The retro-reflective material shall be exposed until blue standard No. 7 has faded to No. 4 on the grey scale. After the test, the specimen shall be washed in a dilute neutral detergent solution, dried and examined for conformity with the requirements.

F-1.2 Visual appearance

No area of the exposed specimen shall show any evidence of cracking, scaling, splitting, blistering, delamination, distortion, chalking, staining or corrosion.

F-1.3 Colour fastness

The colour of the exposed specimen shall still meet the requirements in Annex D

F-1.4 Effect on the coefficient of retro-reflection of the retro-reflective material:

F-1.4.1 For this check, measurements shall be made only at an observation angle of $\alpha = 20'$ and an entrance angle of $\beta_2 = 5^\circ$ by the method given in Annex E.

F-1.4.2 The coefficient of retro-reflection of the exposed specimen when dry shall be not less than 80 % of the value in Annex E, Tables 1 and 2.

F-2 Resistance to corrosion

F-2.1 A specimen of the sample shall be subjected to the action of a saline mist for 48 hours comprising two periods of exposure of 24 hours each, separated by an interval of 2 hours during which the specimen is allowed to dry.

The saline mist shall be produced by atomizing at a temperature of $35 \pm 2^\circ \text{C}$ of saline solution obtained by dissolving 5 parts by weight of sodium chloride in 95 parts of distilled water containing not more than 0.02 per cent of impurities.

F-2.2 Immediately after completion of the test, the sample shall show no sign of corrosion liable to impair the efficiency of the marking.

F-2.2.1 The coefficient of retro-reflection R' of the retro-reflective areas, when measured after a recovery period of 48 hours as specified in **E-1**, at an entrance angle of $\beta_2 = 5^\circ$ and an observation angle of $\alpha = 20'$, shall be not less than the value in Annex E, table 1 or more than the value in table 2 respectively. Before measuring, the surface shall be cleaned to remove salt deposits from the saline mist.

F-3 Resistance to Fuels

A section of a sample unit not less than 300 mm long shall be immersed in a mixture of n-heptane and toluol, 70 per cent and 30 per cent by volume, for one minute.

After removal, the surface shall be wiped dry with a soft cloth and shall not show any visible change which would reduce its effective performance.

F-4 Resistance to heat

F-4.1 A section of a sample unit not less than 300 mm long shall be kept for 12 hours (in the case of moulded plastics reflectors this time shall be 48 hours) in a dry atmosphere at a temperature of $65 \pm 2^\circ\text{C}$ after which the sample shall be allowed to cool for 1 hour at $23 \pm 2^\circ\text{C}$. It shall then be kept for 12 hours at a temperature of $-20 \pm 2^\circ\text{C}$.

F-4.2 The sample shall be examined after a recovery time of 4 hours under normal laboratory conditions.

F-4.3 After this test, no cracking or appreciable distortion of the surface particularly of the optical units, shall be evident.

F-5 Resistance to cleaning

F-5.1 Manual Cleaning

F-5.1.1 A test sample smeared with a mixture of detergent lubricating oil and graphite shall be easily cleaned without damage to the retro-reflective material surfaces when wiped with a mild aliphatic solvent such as n-heptane, followed by washing with a neutral detergent.

F-5.2 Power Cleaning

F-5.2.2 When subjected to a continuous spraying action for 60 seconds on the test component in its normal mounting conditions, a test sample shall show no damage to the retro-reflective surface or delamination from the substrate or separation from the sample mounting surface under the following set-up parameters:

- a) Water/wash solution pressure 8 ± 0.2 MPa;
- b) Water/wash solution temperature $60^\circ - 5^\circ\text{C}$;
- c) Water/wash solution flow rate 7 ± 1 l/ min;

- d) The tip of the cleaning wand to be positioned at distance of 600 ± 20 mm. Away from the retro-reflective surface;
- e) Cleaning wand to be held at no greater angle than 45 degrees from perpendicular to the retro-reflective surface;
- f) 40 degree nozzle creating wide fan pattern.

F-6 Resistance to penetration of water

F-6.1 Sample unit of retro-reflective marking shall be immersed for 10 minutes in water at a temperature of $50 \pm 5^\circ \text{C}$, the highest point of the upper part of the retro-reflective surface being 20 mm below the surface of the water. This test shall be repeated after turning the sample unit through 180° , so that the retro-reflecting surface is at the bottom and the rear face is covered by about 20 mm of water. The sample unit(s) shall then be immediately immersed in the same conditions in water at a temperature of $25 \pm 5^\circ \text{C}$.

F-6.2 No water should penetrate to the reflecting surface of the sample unit. If visual inspection clearly reveals the presence of water, the retro-reflective marking shall not be considered to have passed the test.

F-6.3 If visual inspection does not reveal the presence of water or in case of doubt, the coefficient of retro-reflection R' shall be measured in conformity with Annex F, the sample unit being first lightly shaken to remove excess water from the outside

F-7 BONDING STRENGTH (IN THE CASE OF ADHESIVE MATERIALS OF CLASS C)

F-7 .1 The adhesion of retro-reflective materials shall be determined after 24 hours curing time by utilising a 90 degree peel on a tensile strength testing machine.

F-7 .2 The retro-reflective materials shall not be easily removable without damaging the material.

F-7 .3 The retro-reflective materials shall need a force of at least 10 N per 25 mm width at a constant speed of 300 mm per minute to be removed from their substrate.

F-8 FLEXING

F-8.1 For samples that are to be adhered to a flexible substrate, i.e. tarpaulin, the following shall apply:

F-8.1.1 A specimen of the sample unit that measures 50 mm by 300 mm shall be bent once lengthwise, around a 3.2 mm mandrel with adhesive contacting the mandrel for a period of 1 second. The test temperature shall be $23^\circ \text{C} \pm 2^\circ \text{C}$.

Note: For ease of testing, spread talcum powder on the adhesive to prevent sticking to the mandrel

F-8.2 After this test, specimen shall not have cracking of the surface and shall not show any visible change that would reduce its effective performance

Annex G
(Clause 8)

Sr. No.	Particulars
1.	Manufacturer's name & address
2.	Telephone No
3.	FAX. No.
4.	E mail address
5.	Contact person
6.	Plant/(s) of manufacture.
7.	The intended function(s) of the device.
8.	Drawings, in triplicate, sufficiently detailed to permit identification of the type. The drawings shall show geometrically the orientation in which the marking materials are to be fitted to a vehicle.
9.	A brief description giving the technical specifications of the retro reflective marking materials;
10.	Samples of the retro-reflective marking materials, as specified in Annex B;
11.	Colour of light emitted

Annex H
(Committee Composition)