

AUTOMOTIVE INDUSTRY STANDARD

**Approval of Retro-Reflective
Markings for Motor Vehicles,
their Trailers and Semi-Trailers**

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UNDER
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

SET-UP BY
MINISTRY OF ROAD TRANSPORT & HIGHWAYS
(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)
GOVERNMENT OF INDIA

February 2019

Status chart of the standard to be used by the purchaser for updating the record

Sr. No.	Corrigenda.	Amendment	Revision	Date	Remark	Misc.
General remarks :						

INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the then Ministry of Surface Transport (MOST) has constituted a permanent Automotive Industry Standards Committee (AISC) vide order No.RT-11028/11/97-MVL dated September 15, 1997. The standards prepared by AISC will be approved by the permanent CMVR-Technical Standing Committee (CTSC). After approval, the Automotive Research Association of India, (ARAI), Pune, being the Secretariat of the AIS Committee, has published this standard. For better dissemination of this information ARAI may publish this document on their Web site.

AIS-090 was first published in December 2005.

While preparing AIS-090 (Rev.1), considerable assistance was derived from following –

1.	ECE regulation 104 (Rev 1, Amd.2 Supplement 8 to the 00 series of amendments - Date of entry into force Jun 15, 2015) Uniform provisions concerning the approval of retro-reflective markings for vehicles of category M, N and O
2.	ECE R 48 (Revision 12 – Amendment 3 Supplement 7 to 06 series of amendments - Date of entry into force Oct 8, 2016) Uniform provisions concerning the Approval of Vehicles with regard to the Installation of Lighting and Light-Signalling Devices
3.	The definitions of technical terms are those adopted by the International Commission on Illumination (CIE) - see Technical Report on Retro reflection CIE Publication No. 54. –

Contents of the standard does not have any deviation from ECE R 104, regarding the performance requirements. Appropriate changes have been incorporated to adapt to format as well as Indian procedures. ECE R 104 is a guideline regulation in Europe.

The installation requirements shall be as per AIS-008 (Rev.2) as amended from time to time and the limits of chromaticity co-ordinates shall be as per AIS-010 (Rev. 2) Part 5, as amended from time to time

The Standard was adopted by CMVR-TSC at its 52nd meeting held on 8th May 2018 at New Delhi.

The Composition/s of the AISC panel, Automotive Industry Standards Committee (AISC) for Vehicles with GVW of more than 3.5 tonnes and Permanent Automotive Industry Standards Committee (AISC) for Vehicles with GVW of less than 3.5 tonnes responsible for preparation of this standard are given in Annexure-A, B & C respectively.

CONTENTS

Paragraph No.	Contents	Page No.
1	Scope	1/20
2	References	1/20
3	Definitions	1/20
4	Application for Type Approval	4/20
5	Markings	4/20
6	Clause reserved	5/20
7	General specifications	5/20
8	Special specifications	5/20
9	Modifications and extension of approval for retro-reflective marking materials	6/20
10	Conformity of Production	6/20
11	Penalties For Non-Conformity Of Production	6/20
12	Transitional Provisions	7/20
13	Establishing Compliance Of “E”/“e” Approved Retro Reflecting Tape to this Standard	7/20
14	Amendments to ECE regulations after the level described in introduction	7/20
Annex 1	The CIE co-ordinate system; Goniometer mechanism embodying the CIE angular system	8/20
Annex 2	Test procedure	10/20
Annex 3	Specification of marking dimensions	11/20
Annex 4	Colorimetric specifications	13/20
Annex 5	Photometric specifications	14/20
Annex 6	Resistance to external agents	15/20
Annex 7	Panel Composition	18/20
Annex 8	Committee composition of AISC for Vehicles with GVW of more than 3.5 Tonnes	19/20
Annex 9	Committee composition of Automotive Industry Standards Committee	20/20

Approval of Retro-Reflective Markings for Motor Vehicles, their Trailers and Semi-Trailers

1.0 SCOPE

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

2.0 REFERENCES

- 2.1 AIS-053 (Amd. 1 to 5): Automotive Vehicles-Types – Terminology
- 2.2 AIS-010 (Rev. 2) Part 5: Requirements of Chromaticity Co-ordinates of Colour of Light emitted from Lighting and Light-Signalling Devices
- 2.3 AIS-008 (Rev.2): Installation Requirements of Lighting and Light - Signalling Devices for Motor Vehicle having more than Three Wheels including Quadricycles, Trailer and Semi-Trailer excluding Agricultural Tractors

3.0 DEFINITIONS

- 3.1. For the purpose of these provisions, the following definitions shall apply:
 - 3.1.1 "**Marking**" means 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**" means 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**" means a conspicuity marking intended to indicate the horizontal and vertical dimensions (length, width and height) of a vehicle;
 - 3.1.4 "**Full contour marking**" means 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.
 - 3.1.5 "**Line marking**" means a conspicuity marking intended to indicate the horizontal dimensions (length and width) of a vehicle by a continuous line."
 - 3.1.6 "**Distinctive markings, graphics**" mean coloured markings, whose coefficient of retro-reflection is as defined in paragraphs 8.2.1 & 8.2.2 below.
 - 3.1.7 "**Sample unit**" means part or all of the retro-reflective material intended to be used to achieve the markings defined in paragraphs 3.1.1., 3.1.2. and 3.1.3.

- 3.1.8 **"Retro-reflection"** means the 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.
- 3.1.9 **"Retro-reflective marking material"** means a surface or a device from which, when directionally illuminated, a relatively large portion of the incident radiation is retro-reflected.
- 3.3 **Geometric definitions (see annex 1, figure 1)**
- 3.3.1 **"Reference centre"** means 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;
- 3.3.2 **"Illumination axis (symbol I)"** means a line segment from the reference centre to the light source.
- 3.3.3 **"Observation axis (symbol O)"** means a line segment from the reference centre to the photometer head;
- 3.3.4 **"Observation angle (symbol α)"** means 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;
- 3.3.5 **"Observation on half-plane"** means the half-plane which originates on the illumination axis and which contains the observation axis;
- 3.3.6 **"Reference axis (symbol R)"** means a designated line segment originating on the reference centre which is used to describe the angular position of the retro-reflective device;
- 3.3.7 **"Entrance angle (symbol β)"** means 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 ;
- 3.3.8 **"Rotation angle (symbol ϵ)"** means the angle indicating the orientation of the retro-reflecting material by an appropriate symbol with respect to rotation about the reference axis;
- 3.3.9 **"First axis (symbol 1)"** means an axis through the reference centre and perpendicular to the observation half-plane;
- 3.3.10 **"First component of the entrance angle (symbol β_1)"** means the angle from the illumination axis to the plane containing the reference axis and the first axis; range: $-180^\circ < \beta_1 < 180^\circ$;
- 3.3.11 **"Second component of the entrance angle (symbol β_2)"** means the angle from the plane containing the observation half-plane to the reference axis; range $-90^\circ < \beta_2 < 90^\circ$;

3.3.12 **"Second axis (symbol 2)"** means 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 1, figure 1.

3.4. **Definition of photometric terms**

3.4.1 **"Coefficient of retro-reflection (symbol R')"** means the quotient of the coefficient of luminous intensity R of a plane retro-reflecting surface and its area A

$R' = R/A$ The coefficient of retro-reflection R' is expressed in candelas per m² per lx (cd.m⁻².lx⁻¹)

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

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

3.4.2 **"Angular diameter of the retro-reflector sample (symbol η_1)"** means 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 ($\beta_1 = \beta_2 = 0^\circ$);

3.4.3 **"Angular diameter of the receiver (symbol η_2)"** means the angle subtended by the greatest dimension of the receiver as seen from the reference centre ($\beta_1 = \beta_2 = 0^\circ$);

3.4.4. **"Luminance factor (symbol β)"** means the ratio of the luminance of the body to the luminance of a perfect diffuser under identical conditions of illumination and observation.

3.4.5 "Colour of the reflected light of the device" The definitions of the colour of the reflected light are given in AIS-010 (Part 5) (Rev. 1): 2010

3.5 **Description of Goniometer**

A goniometer which can be used in making retro-reflection measurements in the CIE geometry is illustrated in annex 1, figure 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.

3.6 **Definition of "type"**

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

3.6.1 The trade name or trade mark;

3.6.2 The characteristics of the retro-reflective material;

3.6.3 The parts affecting the properties of the retro-reflective materials or devices.

4.0 APPLICATION FOR TYPE APPROVAL

The manufacturer shall submit application for Type Approval in following format:

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 2;
11.	Colour of light emitted

Procedure for type approval shall be as per AIS-037, as amended from time to time.

5.0 MARKINGS

5.1 Every marking material submitted for approval shall bear:

5.1.1 The trade name or trade mark of the applicant;

5.1.2 An orientation mark "TOP" which must be inscribed on any marking material whose retro-reflective system is not omni-rotational.

5.1.3 The following symbols indicating the class of material:

5.1.3.1 "C" for the material for contour / strip marking

5.1.3.2 "D" for material for distinctive markings/graphics for a limited area.

5.1.3.3 "E" for material for distinctive markings / graphics for extended area.

5.1.3.4 "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.

5.1.3.5 "F" for materials for extremities marking with red and white retro-reflective alternative Stripes.

5.2 The markings specified in 5.1.2 and 5.1.3 shall be positioned at least at 0.5 m intervals on strips, on areas within 100 x 100 mm².

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

6.0 CLAUSE RESERVED

7.0 GENERAL SPECIFICATIONS

7.1 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.

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

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

7.4 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.

8.0 SPECIAL SPECIFICATIONS

8.1 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 annexes 3 to 6 to this standard.

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

It may 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.

8.2.1 For class "D" marking materials the maximum values of the coefficient of retro-reflection are less or equal to the value defined in annex 5, table 2, and are intended to be used in distinctive markings, graphics.

8.2.2 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 5, table 2.

8.2.3 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 5, table 2 for class "D" materials and must be marked as class "D OR E".

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

9.0 MODIFICATIONS AND EXTENSION OF APPROVAL FOR RETRO- REFLECTIVE MARKING MATERIALS

- 9.1 Every modification pertaining to the information, even if the changes are non-technical in nature declared in accordance to para 4 above, shall be intimated to the test agency by the manufacturer.
- 9.2 If the changes are in parameters not related to the provisions, no further action needs to be taken.
- 9.3 If the changes are in parameters related to the provisions, the testing agency, which has issued the certificate of compliance, may then consider, whether:
 - 9.3.1 The type or model with the changed specification still complies with the provisions, or
 - 9.3.2 Any further verification is required to establish compliance.
- 9.4 For deciding whether testing is required or not : - till details are finalized, this will be as agreed between the test agency and the manufacturer.
- 9.5 In case of 9.3.2, only tests pertaining to the affected specification shall be performed.
- 9.6 In case of fulfillment of criterion as per 9.3, the approval of compliance shall be extended for the changes carried out.

10.0 CONFORMITY OF PRODUCTION

- 10.1 The conformity of production procedures shall comply with those set out in the AIS-037 with following requirements;

Retro-reflective marking material approved to this standard shall be so manufactured as to conform to the type approved by meeting the requirements set forth in paragraphs 7 and 8 above.
- 10.2 The conformity of production shall not be contested, if the mean value of photometric measurements of five specimens taken at random deviates unfavorably by not more than 20% from the prescribed values given in Annex:5 of this standard.
- 10.3 The conformity of production shall not be contested, if the mean value of colorimetric properties of five specimens taken at random meets the specifications of Annex:4 of this standard, to be judged by visual inspection.
- 10.4 The test agency may at any time verify the conformity control methods applied in each production facility as detailed in AIS-037. The normal frequency of these verification shall be as per AIS-037 or as decided by CMVR-TSC.

11.0 PENALTIES FOR NON-CONFORMITY OF PRODUCTION

Penalties for non-compliance of conformity of production shall be as detailed in AIS-037.

12.0 TRANSITIONAL PROVISIONS

12.1 At the request of the applicant, type approvals for compliance to AIS-090 (Rev.1):2019 shall be granted by test agencies on and after the 6th February 2019. Such type approvals shall be deemed to be compliance to previous standard unless otherwise stated.

12.2 At the request of applicant, type approval for the compliance to AIS-090 :2005, shall be granted up to the date of implementation of AIS-090 (Rev.1): 2019.

13.0 ESTABLISHING COMPLIANCE OF “E”/“e” APPROVED RETRO REFLECTING DEVICE TO THIS STANDARD

13.1 As an exception to clause 7.4 of AIS-037, (or related administrative decisions) for certifying compliance of “E”/“e” approved retroreflective tape to this standard, the test for the following shall be carried out by testing agency

13.2 Photometric requirements shall be as specified in Annex 5 of this standards

13.3 Colorimetric requirements shall be specified in Annex 4 of this standards

14.0 AMENDMENTS TO ECE REGULATIONS AFTER THE LEVEL DESCRIBED IN INTRODUCTION

14.1 Supplements

In case of changes in ECE regulation, which are issued as supplements (Supplements do not affect the earlier type approvals) at the request of applicant, approval of compliance to this standard shall be issued taking into account the changes arising out of such supplement(s) to ECE regulation with approval from Chairman AISC. This shall be incorporated in the test report.

Note : Such changes will be considered for inclusion in this standard at the time of its next amendment /revision.

14.2 Series of amendments

Changes in UN regulation, which are issued as series of amendments (series of amendments may affect the earlier type approvals) shall not be considered for issuing approval to existing standard .

However, Chairman, AISC may, on a case to case basis, permit to accept latest series of amendments.

This shall be incorporated in the test report.

ANNEX 1

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

(See 3.3)

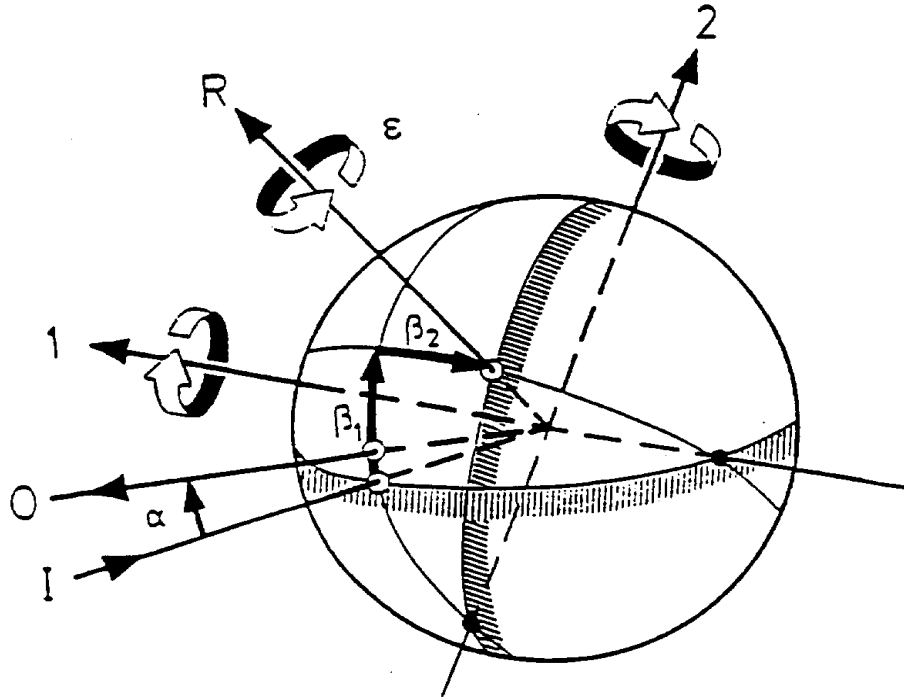


Figure 1
The CIE co-ordinate system

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

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

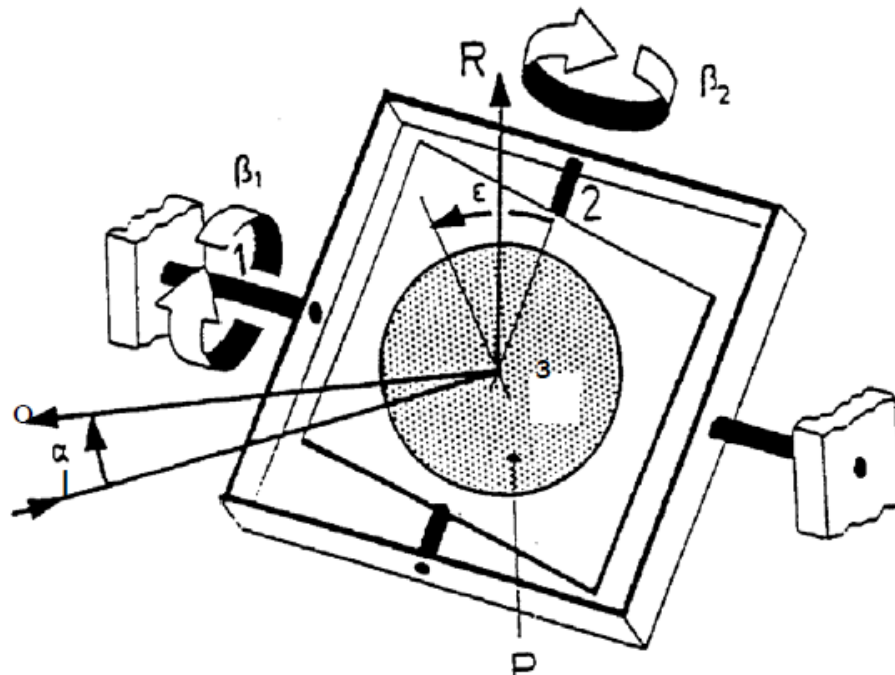


Figure 2

**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	R: Reference Axis	ϵ : Rotation angle
	Centre	P: Retro-reflective material	

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 2

(see Sl. No. 10 of Clause no. 4)

TEST PROCEDURE

TEST SAMPLES

1. Five test samples representing either strips or planes of retro-reflective marking materials have to 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.
2. The test samples shall be representative of current production, manufactured in accordance with the recommendation of the manufacturer(s) of the retro-reflective marking materials. (1)
3. After verification of the general specifications (clause 7 of the Standard) and the specifications of shape and dimensions (annex 3), the samples shall be subjected to the heat resistance test described in clause 4 of annex 6 to this Standard, prior to the tests described in annexes 4 and 5.
4. The photometric and colorimetric measurements may be made on five samples. The mean values should be taken.
5. For other tests, samples which have not undergone any testing should be used.

⁽¹⁾ 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 3

(See 8.1)

SPECIFICATION OF MARKING DIMENSIONS

1.0 SIDE AND REAR MARKING WITH STRIPS

1.1. General

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

1.2. Dimensions of test sample

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

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.

2.0 SIDE, REAR AND/OR FRONT MARKING WITH STRIPS (CLASS F)

2.1 General

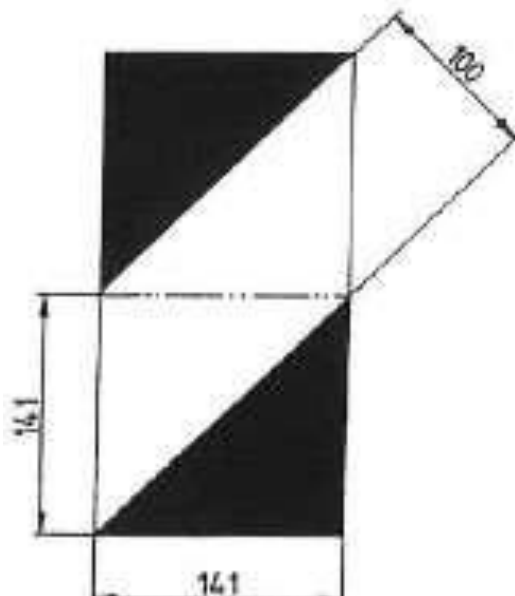
The markings shall be made of strips of retro-reflective material.

2.2. Dimensions

2.2.1. Class F retro-reflective materials 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.

2.2.2. The minimum length of an element of a retro-reflective marking material shall incorporate a minimum of 9 standard areas as described in paragraph 2.2.1. above 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



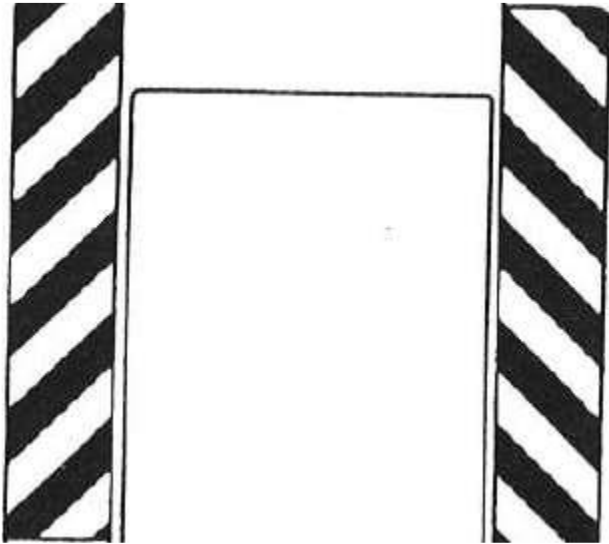


Figure 3

ANNEX 4

(See 8.1)

COLORIMETRIC SPECIFICATIONS

- 1.0** 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 materials (Class F) shall be white and red.
- 2.0** Class C, D and E materials, 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 $= 20^\circ$, 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) Rev 2 as amended from time to time.
- 3.0** For Class F materials, 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 (45/0 geometry), the colour of the material in new condition shall be within the limits according to Chromaticity Coordinates as given in AIS-010 (Part 5) Rev.2 as amended from time to time.
- 3.1** Luminance factor for red colour shall be ≥ 0.03 . For white colour, it shall be ≥ 0.25 ."

ANNEX 5

(See 8.1)

PHOTOMETRIC SPECIFICATIONS

1.0 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 m² per lux (cd/m²/lux) of the retro-reflective areas in new condition shall be at least as indicated in table 1 for yellow, white and red materials

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 [°]					
	$\beta 1$	0	0	0	0	0
$\alpha = 0.33^\circ (20')$	$\beta 2$	5	20	30	40	60
Colour						
Yellow	300	--	130	75	10	
White	450	--	200	95	16	
Red	120	60	30	10	--	

1.2 Maximum values for the coefficient of Retro-reflection:
Photometric specifications for distinctive markings or graphic of class D shall be as per Table 2 given below:

Table 2						
Maximum values for the Coefficient of Retro-reflection R' [cd.m⁻². lx⁻¹]						
Observation angle α (°)	Entrance Angle β (°)					
	$\alpha = 0.33^\circ (20')$	$\beta 1$	0	0	0	0
	$\beta 2$	5	30	40	60	
Any Colour		150	65	37	5	

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

ANNEX 6

(See 8.1)

RESISTANCE TO EXTERNAL AGENTS**1.0 RESISTANCE TO WEATHERING**

- 1.1 Procedure - For each test, two specimens of a sample unit (see paragraph 3.1.4. of this Standard) 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 ISO Standard 105 - B02 - 1978, 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 specified in paragraphs 1.2. to 1.4.

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.

1.3 Colour fastness

The colour of the exposed specimen shall still meet the requirements in annex 4,

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

- 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 5.

- 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 5, table 1 and 2.

2.0 RESISTANCE TO CORROSION

- 2.1 A specimen of the sample unit 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 $35 \pm 2^\circ \text{C}$ a 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.

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

- 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 paragraph 1 of annex 5, 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 5,

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.

3.0 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.

4.0 RESISTANCE TO HEAT

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 $-20 \pm 2^\circ\text{C}$.

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

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

5.0 RESISTANCE TO CLEANING

5.1. Manual cleaning

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 surface when wiped with a mild aliphatic solvent such as n-heptane, followed by washing with a neutral detergent.

5.2. Power washing

5.2.1. 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.

6.0 CLAUSE RESERVED**7.0 RESISTANCE TO PENETRATION OF WATER**

7.1 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 $25 \pm 5^\circ \text{C}$.

7.2 No water must 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.

7.3 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 5, the sample unit being first lightly shaken to remove excess water from the outside.

8.0 BONDING STRENGTH (IN THE CASE OF ADHESIVE MATERIALS OF CLASS C)

8.1. 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.

8.2. The retro-reflective materials shall not be easily removable without damaging the material.

8.3. 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.

9.0 FLEXING

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

9.1.1. 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.

9.1.2. 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 7

PANEL COMPOSITION*

Convener	
Shri Suderson S. V	General Manager, M/s Daimler India
Members	Representing
Shri B. V. Shamsundara / Mrs. Jyoti Kirve / Shri Kamalesh Patil	The Automotive Research Association of India (ARAI)
Shri V. D. Chavan/ Shri V P Godbole/ Shri Santosh Desai / Mrs. Shubhangi Dalvi	Central Institute of Road Transport (CIRT)
Shri GRM Rao	Vehicle Research & Dev. Estt. (VRDE)
Dr. Madhusudan	Centre for Automotive Technology (ICAT)
Director	Central Farm Machinery Training and Testing Institute
Dr. N. Karuppaiah	NATRIP
Shri K. K.Gandhi	SIAM
Shri Girish Kodolikar	SIAM (Force Motors Ltd.,)
Shri Sanjay Tank	SIAM (Mahindra & Mahindra Ltd.,
Shri Rajendra Petkar / Shri Shrikant V. Joshi /Shri Suhas Patil / Shri Gajanan Salunke / Shri Sharad S. Bhole,	SIAM (Tata Motors Ltd.,)
Shri V. G. Kulkarni	SIAM (Mahindra & Mahindra Ltd. (Truck & Buses Division))
Shri Uday Harite	ACMA
Shri Virendra Sachdev	ACMA
Shri Rajesh Bhatt	ACMA (Lumax Industries Ltd.,)
Shri Gaurav Bhatia	ACMA (Rinder India Pvt. Ltd.)
Shri G. V. George	ACMA (FIEM Industries Ltd.,)
Shri N. K. Sharma	Bureau of Indian Standards

* At the time of approval of this Automotive Industry Standard (AIS)

ANNEX 8
COMMITTEE COMPOSITION*
AISC for Vehicles with GVW of more than 3.5 Tonnes

Sr. No.	Composition	
i.	Director, Central Institute of Road Transport (CIRT)	Chairman
ii.	Representative from Automotive Research Association of India (ARAI)	Member
iii.	Representative from the Dept. of Heavy Industry, Ministry of Heavy Industry & Public Enterprises (DHI, MoHI & PE)	Member
iv.	Representative from ministry of Road Transport & Highways (MoRTH)	Member
v.	Representative from Ministry of Petroleum & Natural Gas (MoPNG)	Member
vi.	Representative from Ministry of Environment, Forest & Climate Change & (MoEF & CC)	Member
vii.	Representative from Bureau of Indian Standards (BIS)	Member
viii.	Representative from National Automotive Testing, Research and Infrastructure project (NATRiP)	Member
ix.	Representative from Vehicle Research & Development Establishment (VRDE)	Member
x.	Representative from International Centre of Automotive Technology (ICAT)	Member
xi.	Representative from Indian Institute of Petroleum (IIP)	Member
xii.	3 Representatives from Society of Indian Automobile Manufacturers (SIAM)	Members
xiii.	2 Representatives Automotive Component Manufacturers Association (ACMA)	Members
xiv.	2 Representatives from State Transport Department on rotation on bi annual basis	Members
xv.	Representative from Association of State Road Transport Undertakings (ASRTU)	Member
xvi.	Representative from Indian Construction Equipment Manufacturers Association (ICEMA)	Member
xvii.	Representative from Tractors Manufacturers Association (TMA)	Member
xviii.	3 Representatives from Association/Organisations of Bus Body Builders, Truck Body Builders and Trailer Builders	Members
xix.	2 Representatives from Associations/ Organisations of Fleet Operators of Buses and Trucks, respectively	Members
xx.	Representative from Central Institute of Road Transport (CIRT)	Member Secretary

* At the time of approval of this Automotive Industry Standard (AIS)

ANNEX 9
(See Introduction)

COMMITTEE COMPOSITION *

Automotive Industry Standards Committee

Chairperson	
Mrs. Rashmi Urdhwareshe	Director The Automotive Research Association of India, Pune
Members	Representing
Representative from	Ministry of Road Transport and Highways (Dept. of Road Transport and Highways), New Delhi
Representative from	Ministry of Heavy Industries and Public Enterprises (Department of Heavy Industry), New Delhi
Shri S. M. Ahuja	Office of the Development Commissioner, MSME, Ministry of Micro, Small and Medium Enterprises, New Delhi
Shri Shrikant R. Marathe	Former Chairman, AISC
Shri R.R. Singh	Bureau of Indian Standards, New Delhi
Director	Central Institute of Road Transport, Pune
Director	Global Automotive Research Centre
Director	International Centre for Automotive Technology, Manesar
Director	Indian Institute of Petroleum, Dehra Dun
Director	Indian Rubber Manufacturers Research Association
Director	Vehicles Research and Development Establishment, Ahmednagar
Representatives from	Society of Indian Automobile Manufacturers
Shri R. P. Vasudevan	Tractor Manufacturers Association, New Delhi
Shri Uday Harite	Automotive Components Manufacturers Association of India, New Delhi

Member Secretary
Shri Vikram Tandon
Dy. General Manager
The Automotive Research Association of India, Pune

* At the time of approval of this Automotive Industry Standard (AIS)