

**AUTOMOTIVE INDUSTRY STANDARD**

**Provisions concerning the Approval of  
Retro-Reflecting Devices for  
Power Driven Vehicles and their Trailers**

**(Revision 1)**

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ON BEHALF OF  
AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER  
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

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

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**INTRODUCTION**

- 0 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 erstwhile 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.
- 0.1 Accordingly AIS-057 covering mandatory requirements regarding performance of retro-reflecting devices for motor vehicles and their trailers has been published in 2004 and has been implemented thereafter in 2005.
- 0.2 With technological developments in lighting & light signalling devices, AIS-057 was taken up for revision.
- 0.3 This part is based on ECE R3 Revision 3 - Amendment 1 (Supplement 10 to the 02 series of amendments - Date of entry into force: 2 February 2007)
- 0.4 While preparing this standard attempts have been made to align with the above ECE regulation. However, certain changes were necessary in the Indian context.
- 0.5 The following standards contain provisions, which through reference in this text constitute provisions of the standard.
  - AIS-008 Installation Requirements of Lighting and Light –Signalling Devices for Motor Vehicle having more than Three Wheels, Trailer and Semi -Trailer excluding Agricultural Tractor and Special Purpose Vehicle
  - AIS-009 Automotive Vehicles - Installation Requirements of Lighting and Light - Signalling Devices for 2 and 3 Wheelers, their Trailers and Semi-Trailers
  - AIS-010 (Part 5) (Rev. 1):2010 Requirements of Chromaticity co-ordinates of light emitted from Lighting and Light-Signalling Devices
  - AIS-037 Procedure for Type Approval and Establishing Conformity of Production for Safety Critical Components
  - AIS-053 Automotive Vehicles – Types – Terminology
  - AIS-057:2004, Performance Requirements for Retro-Reflecting Devices for Power-Driven Vehicles and their Trailers
  - IS 269:1989 Ordinary Portland Cement, 33 Grade - Specification
  - ASTM C 150-84 Standard specification for Portland cement
- 0.6 The composition of AIS panel and AIS Committee responsible for preparation of this standard are given in Annex V and Annex W respectively.

**Provisions concerning the Approval of Retro-Reflecting Devices for  
Power Driven Vehicles and their Trailers**

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## Provisions concerning the Approval of Retro-Reflecting Devices for Power Driven Vehicles and their Trailers

### 1. SCOPE

This standard applies to retro-reflecting devices for vehicles of categories L, M, N, A, and T as defined in AIS-053.

### 2. DEFINITIONS

For the purpose of this standard,

- 2.1. The definitions given in AIS-008 and AIS-009 and their amendments in force at the time of application for type approval shall apply to this standard.
- 2.2. "**Retro-reflection**" means the reflection in which light is reflected in directions close to the direction from which it came. This property is maintained over wide variations of the illumination angle.
- 2.3. "**Retro-reflecting optical unit**" means a combination of optical components producing retro-reflection.
- 2.4. "**Retro-reflecting device**" (also called "**Retro reflector**") means an assembly ready for use and comprising one or more retro-reflecting optical units.
- 2.5. "**Angle of divergence**" means the angle between the straight lines connecting the centre of reference to the centre of the receiver and to the centre of the source of illumination.
- 2.6. "**Illumination angle**" means the angle between the axis of reference and the straight line connecting the centre of reference to the centre of the source of illumination.
- 2.7. "**Angle of rotation**" means the angle through which the retro-reflecting device is rotated about its axis of reference starting from one given position.
- 2.8. "**Angular diameter of the retro-reflecting device**" means the angle subtended by the greatest dimension of the visible area of the illuminating surface, either at the centre of the source of illumination or at the centre of the receiver.
- 2.9. "**Illumination of the retro-reflecting device**" is the abbreviated expression used conventionally to designate the illumination measured in a plane perpendicular to the incident rays and passing through the centre of reference.
- 2.10. "**Coefficient of luminous intensity (CIL)**" means the quotient of the luminous intensity reflected in the direction considered, divided by the illumination of the retro-reflecting device for given angles of illumination, divergence and rotation.
- 2.11. The symbols and units used in this standard are given in Annex A to this standard
- 2.12. A type of "**retro-reflecting device**" is defined by the models and descriptive literature submitted with the application for approval. Retro-reflecting devices shall be considered as belonging to the same

type if they have one or more "retro-reflecting optical units" which are identical with those of the standard model, or if not identical are symmetrical and suitable for mounting one on the left and one on the right side of the vehicle, and if their other parts differ from those of the standard model only in ways not affecting the properties to which this standard applies.

2.13. Retro-reflecting devices are divided into three classes according to their photometric characteristics: Class IA or IB, Class IIIA or IIIB, and Class IVA.

2.14. Retro-reflecting devices of Class IB and IIIB are devices combined with other signal lamps which are not watertight according to H-1.1 of Annex H, and which are integrated into the body of a vehicle.

**Note:** The definitions of the technical terms (excluding the ones in AIS-008 and AIS-009) are those adopted by the International Commission on Illumination (CIE).

### **3. APPLICATION FOR APPROVAL**

3.1. Information to be submitted at the time of applying for type approval of retro reflecting device shall be as given in Annex B.

At the choice of the applicant, it will specify that the device may be installed on a vehicle with different inclinations of the reference axis in respect to the vehicle reference planes and to the ground or, in the case of Class IA, IB and IVA retro-reflectors, rotate around its reference axis; these different conditions of installation shall be indicated in the test report. It shall be accompanied by:

3.1.1. Reserved.

3.1.2. Reserved.

3.1.3. samples of the retro-reflecting device of a colour specified by the manufacturer and, if necessary, the means of fixation; the number of samples to be submitted is specified in Annex D to this standard;

3.1.4. if necessary, two samples in other colour(s) for simultaneous or subsequent extension of the approval to devices in other colour(s);

3.1.5. in the case of devices of Class IVA: samples of the retro-reflecting device and, if necessary, the means of fixation; the number of samples to be submitted is specified in Annex P to this standard.

### **4. MARKINGS**

4.1. Every retro-reflecting device submitted for approval shall bear:

4.1.1. the trade name or mark of the device manufacturer;

4.1.2. the word "TOP" inscribed horizontally on the highest part of the illuminating surface, if such an indication is necessary to determine without ambiguity the angle or angles of rotation prescribed by the manufacturer.

4.2. A space of sufficient size to accommodate the approval mark shall be provided on every device. This space shall be shown on the drawings referred to in B-4.

- 4.3. The markings shall be applied on the illuminating surface, or on one of the illuminating surfaces, of the retro-reflecting device and shall be visible from the outside when the retro-reflecting device is fitted on the vehicle.
- 4.4. The markings shall be clearly legible and be indelible.
- 4.5. On the prototype for type approval, the markings may be provided by suitable temporary methods and need not necessary be obtained from the tools used for series production.

**5. APPROVAL**

- 5.1. If all the samples submitted meet the requirements of this standard, approval shall be granted.
- 5.2. If the approval granted in respect of a retro-reflecting device is extended to other such devices differing only in colour, the two samples in any other colour submitted in conformity with 3.1.4 shall be required to meet only the colorimetric specifications (Annex F), the other tests no longer being required. 5.2 is not applicable to devices of Class IVA.
- 5.3. An approval number shall be assigned to each type approved device.
- 5.4. The approval number shall be as per AIS-037.
- 5.5. There shall be affixed to every retro-reflecting device conforming to a type approved under this standard, in the space referred to in 4.2. and in addition to the markings prescribed in 4.1.
  - 5.5.1. The approval mark consisting of:
    - 5.5.1.1. Reserved
    - 5.5.1.2. The approval number as per 5.4;
    - 5.5.1.3. a group of symbols IA, IB, IIIA, IIIB or IVA showing the class of the approved retro-reflecting device.
- 5.6. When two or more lamps are part of the same unit of grouped, combined or reciprocally incorporated lamps (including a retro-reflector), approval is granted only if each of these lamps satisfies the requirements of this standard or of another standard. Lamps not satisfying any one of those standards shall not be part of such a unit of grouped, combined or reciprocally incorporated lamps.
  - 5.6.1. Where grouped, combined or reciprocally incorporated lamps comply with the requirements of several standard, a single approval mark may be applied, the approval number and, if necessary, the required arrow. This approval mark may be placed anywhere on the grouped, combined or reciprocally incorporated lamps provided that:
    - 5.6.1.1. It is visible after their installation;
    - 5.6.1.2. No part of the grouped, combined or reciprocally incorporated lamps that transmits light shall be removable without at the same time removing the approval mark.
  - 5.6.2. The identification symbol for each lamp appropriate to each standard under which approval has been granted shall be marked.
    - 5.6.2.1. Either on the appropriate light-emitting surface,

- 5.6.2.2. Or in a group, in such a way that each lamp of the grouped, combined or reciprocally incorporated lamps may be clearly identified.
- 5.6.3. The size of the components of a single approval mark shall not be less than the minimum size required for the smallest of the individual marks by a standard under which approval has been granted.
- 5.6.4. An approval number shall be assigned to each type approved device as per AIS-037.
- 5.7. The approval mark shall be clearly legible and indelible.
- 5.8. Figure 1 of Annex 3 of the ECE R 3, Rev 3, and Amendment 1 (Supplement 10 to the 02 series of amendments) may be used for the relative location of approval marking and other marking for a single lamp and Figure 2 for grouped, combined or reciprocally incorporated lamps of same Annex with all the additional symbols referred to above.

## **6. GENERAL SPECIFICATIONS**

- 6.1 Retro-reflecting devices shall be so 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.

**Note:** Requirements of 6.1 above are deemed to be satisfied, if requirements specified in this standard are complied with.

- 6.2. The components of retro-reflecting devices shall not be capable of being easily dismantled.
- 6.3. Retro-reflecting optical units may not be replaceable (See also E-2.5.1).
- 6.4. The outer surface of retro-reflecting devices shall be easy to clean. Hence it shall not be a rough surface; any protuberances it may exhibit shall not prevent easy cleaning.
- 6.5. For devices of Class IVA their means of fixation shall be such that they allow a stable and durable connection between the device and the vehicle.
- 6.6. There shall be no access to the inner surface of the retro-reflectors when in normal use.

**Note:** Requirements of 6.2 to 6.6 above need be verified only by visual inspection.

## **7. SPECIAL SPECIFICATIONS (TESTS)**

- 7.1. Retro-reflecting devices shall also satisfy the conditions as to dimensions and shape, and the colorimetric, photometric, physical and mechanical requirements set forth in Annexes E, F, G, H, K and N as applicable to this standard. The test procedures are described in Annex-D (Class IA, IIIA), Annex P (Class IVA) and Annex S (Class IB, IIIB).
- 7.2. Depending on the nature of the materials of which the retro-reflecting devices and, in particular, their optical units, are made, the testing agency may omit certain unnecessary tests, subject to the express reservation that such omission shall be mentioned in the test report.



**8. CONFORMITY OF PRODUCTION**

The conformity of production procedures shall comply with those set out in AIS-037

- 8.1. Retro-reflectors approved under this standard shall be so manufactured as to conform to the type approved by meeting the requirements set forth in 6 and 7.
- 8.2. The minimum requirements for conformity of production control procedures set forth in Annex T to this standard shall be complied with.
- 8.3. The minimum requirements for sampling by an inspector set forth in Annex U to this standard shall be complied with.
- 8.4. The normal frequency of these verifications shall be once every two years.

**9. PENALTIES FOR NON-CONFORMITY OF PRODUCTION**

- 9.1. Procedure for dealing with non-conformity of production shall be as prescribed in AIS-037.
- 9.2. Reserved.

**10.** Reserved

**11.** Reserved

**12. TRANSITIONAL PROVISIONS**

12.1 At the request of the applicant, type approvals for compliance to AIS-057 (Rev.1):2010, shall be granted by test agencies from 27<sup>th</sup> October 2010 (date of adoption in CMVR-TSC). Such type approvals shall be deemed to be compliance to AIS-057:2004.

12.2 At the request of applicant, type approval to the compliance to AIS-057:2004 shall be granted up to the notified date of implementation of AIS-057 (Rev.1): 2010.

12.3 Type approvals issued for compliance to AIS-057:2004 shall be extended to approval of AIS-057 (Rev.1):2010 subject to satisfactory compliance of the following:

- 12.3.1 Markings as per 4.
- 12.3.2 In case of “E/e” approved devices, requirements specified in 14.
- 12.3.3 Resistance to Corrosion test as per H-2 for the retro reflecting devices with metallic parts.

**Note:** Additional verification for the above need not be carried out, if compliance to the above requirements has already been established during the type approval as per AIS-057:2004.

12.4 Extension of Approvals for engineering and administrative changes:

- 12.4.1 In the case of 12.1, extensions shall be granted subject to the conditions of AIS-057 (Rev.1):2010. Such extensions shall be deemed to be compliance to AIS-057:2004.

12.4.2 In the case of 12.2, extensions shall be granted subject to conditions of AIS-057:2004 till the notified date of implementation of AIS-057 (Rev.1):2010.

12.5 Type approvals for compliance to AIS-037, already been granted, shall continue to be valid for AIS-057 (Rev.1):2010.

**Note** : Necessary corrections to the reference of verification reports as per this standard shall be incorporated while issueing the next COP certificate. In the meantime for issueing of vehicle certificate, test/verification report as per this standard shall deemed to be the proof of compliance of AIS-037.

**13. EXTENSION OF TYPE APPROVAL**

13.1 Every modification pertaining to the information, even if the changes are not technical in nature declared in accordance with 3 shall be intimated by the manufacturer to the testing agency.

If the changes are in parameters not related to the provisions, no further action need be taken.

If the changes are in parameters related to the provisions, the testing agency, which has issued the certificate of compliance, shall then consider, whether,

13.1.1 the retro reflecting device with the changed specifications still complies with provisions, or

13.1.2 Any further verification is required to establish compliance.

13.2 For considering whether testing is required or not, guidelines given in 13.5 (Criteria for Extension of Approval) shall be used.

13.3 In case of 13.1.2, tests for only those parameters which are affected by the modifications need be carried out

13.4 In case of fulfilment of criterion of 13.1.1 or after results of further verification as per 13.1.2 are satisfactory, the approval of compliance shall be extended for the changes carried out.

**13.5 Criteria for extension of approval**

The Criteria shall be as agreed between the testing agency and applicant.

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

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

14.1.1 Photometric requirements specified in tables G-1 and G-2 of Annex G as applicable for an angle of divergence of 20’ and an illumination angle  $V = H = 0^\circ$  or if necessary, in the position defined in G-4 and G-4.1 of Annex G. The CIL value shall not deviate from the prescribed values by more than 20% in the unfavourable direction

14.1.2 Colorimetric requirements as per Annex F.

14.1.3 Resistance To Water And Dirt Penetration as per H-1.1 or H1.2 of Annex H as applicable

14.1.4 Resistance to heat test as per Annex K.

**15 AMENDMENTS TO ECE REGULATIONS AFTER THE LEVEL DESCRIBED IN 0.3 OF FOREWORD**

15.1 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.

15.2 Series of amendments

Changes in ECE regulation, which are issued as series of amendments (series of amendments may affect the earlier type approvals) will not be considered for issuing approval to this 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.

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

## ANNEX A

(See 2.11)

## RETRO-REFLECTING DEVICES

## Symbols and units

A	=	Area of the illuminating surface of the retro-reflecting device (cm <sup>2</sup> )
C	=	Centre of reference
NC	=	Axis of reference
Rr	=	Receiver, observer or measuring device
Cr	=	Centre of receiver
Ør	=	Diameter of receiver Rr if circular (cm)
Se	=	Source of illumination
Cs	=	Centre of source of illumination
Øs	=	Diameter of source of illumination (cm)
De	=	Distance from centre Cs to centre C (m)
D'e	=	Distance from centre Cr to centre C (m)

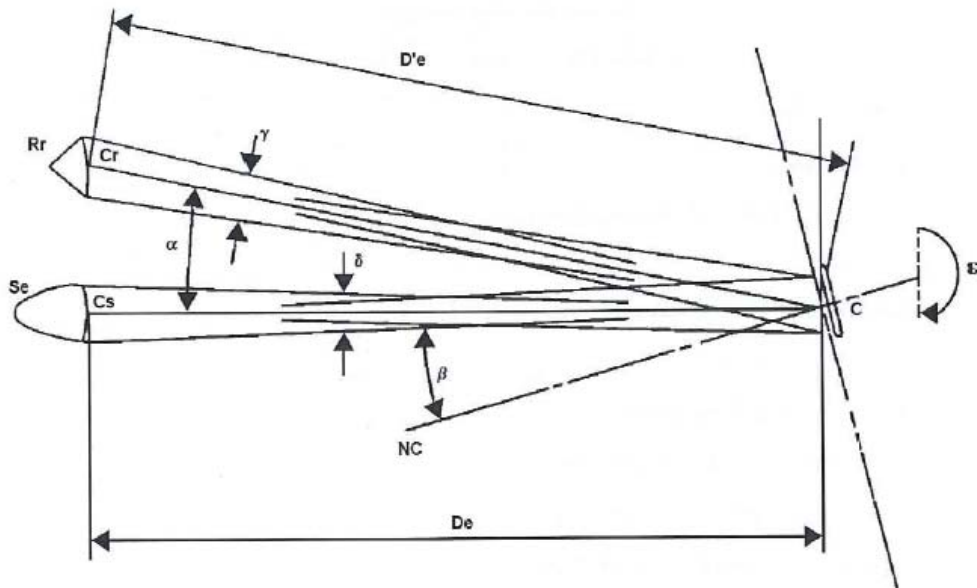
**Note:** In general, De and D'e are very nearly the same and under normal conditions of observation it may be assumed that De = D'e.

D	=	Observation distance from and from beyond which the illuminating surface appears to be continuous.
$\alpha$	=	Angle of divergence
$\beta$	=	Illumination angle. With respect to the line CsC which is always considered to be horizontal, this angle is prefixed by the signs - (left), + (right), + (up) or - (down), according to the position of the source Se in relation to the axis NC, as seen when looking towards the retro-reflecting device. For any direction defined by two angles, vertical and horizontal, the vertical angle is always given first.
$\gamma$	=	Angular diameter of the measuring device Rr as seen from point C

- $\delta$  = Angular diameter of the source Se as seen from point C
- $\epsilon$  = Angle of rotation. This angle is positive when the rotation is clockwise as seen when looking towards the illuminating surface. If the retro-reflecting device is marked "TOP", the position thus indicated is taken as the origin.
- E = Illumination of the retro-reflecting device (lux)
- CIL = Coefficient of luminous intensity (millicandelas/lux)
- Angles are expressed in degrees and minutes.

RETRO-REFLECTORS

Symbols



ELEVATION

**ANNEX B**

(See 3.1)

**INFORMATION AND SAMPLES TO BE SUBMITTED  
AT THE TIME OF TYPE APPROVAL**

- B-1** Details of the applicant
  - B-1.1 Trade name or mark of the device
  - B-1.2 Manufacturer's name for the type of device
  - B-1.3 Manufacturer's name and address
  - B-1.4 Telephone No
  - B-1.5 FAX. No.
  - B-1.6 E mail address
  - B-1.7 Contact person
  - B-1.8 If applicable, name and address of manufacturer's representative:
- B-2** Plant/(s) of manufacture.
- B-3** A brief description giving the technical specifications of the materials of which the retro-reflecting optical unit is made;
- B-4** Drawings, in triplicate, in sufficient detail to permit identification of the type, showing geometrically the position(s) in which the retro-reflecting device may be fitted to the vehicle, and in case of Class IB or IIIB retro-reflectors details of installation. The drawings shall show the position intended for class indicator in relation the approval mark;
- B-5** Colour of light emitted: white/red/amber
- B-6** Installation as an integral part of a lamp which is integrated into the body of a vehicle: yes/no
- B-7** Geometric conditions of installation and relating variations, if any
- B-8** Position of the approval mark:
- B-9** Class of Retro reflector.
- B-10** Effective area of Retro reflecting device for photometric measurement.

## ANNEX C (Reserved)

## ANNEX D

(See 3.1.3)

**TEST PROCEDURE - CLASS IA AND CLASS IIIA**

**D-1.** The applicant shall submit for approval six samples which shall be tested in the chronological order indicated in Annex M.

**D-2.** After verification of the general specifications as per 6 and the specifications of shape and dimensions as per Annex E, the six samples shall be subjected to the heat resistance test described in Annex K and at least one hour after this test examined as to their colorimetric characteristics as per Annex F and CIL (Annex G) for an angle of divergence of 20' and an illumination angle  $V = H = 0^\circ$  or if necessary, in the position defined in G-4. and G-4.1 of Annex G. The two retro-reflecting devices giving the minimum and maximum values shall then be fully tested as shown in Annex G. These two samples shall be kept by the laboratories for any further checks which may be found necessary. The other four samples shall be divided into two groups of two samples.

First group: The two samples shall be subjected successively to the water penetration test as per H-1.1 of Annex H and then, if this test is satisfactory, to the tests for resistance to fuels and lubricants as per H-3. and H-4 of Annex H.

Second group: The two samples shall, if necessary, be subjected to the corrosion test as per H-2 of Annex H and then to the abrasive-strength test of the rear face of the retro-reflecting device as per H-5 of Annex H.

**D-3.** After undergoing the tests referred to in the D-2, the retro-reflecting devices in each group shall have:

D-3.1. a colour which satisfies the conditions laid down in Annex F. This shall be verified by a qualitative method and, in case of doubt, confirmed by a quantitative method.

D-3.2. a CIL which satisfies the conditions laid down in Annex G. The verification shall be performed only for an angle of divergence of 20' and an illumination angle of  $V = H = 0^\circ$  or, if necessary, in the position specified in G-4 and G-4.1 of Annex G.

**ANNEX E**

(See 7.1)

**SPECIFICATIONS OF SHAPE AND DIMENSIONS****E-1. Shape and dimensions of retro-reflecting devices in Class IA or IB**

- E-1.1. The shape of the illuminating surfaces shall be simple, and not easily confused at normal observation distances, with a letter, a digit or a triangle.
- E-1.2. The preceding notwithstanding, a shape resembling the letters or digits of simple form O, I, U or 8 is permissible.

**E-2. Shape and dimensions of retro-reflecting devices in Classes IIIA and IIIB: (see Figure E-1)**

- E-2.1. The illuminating surfaces of retro-reflecting devices in Classes IIIA and IIIB shall have the shape of an equilateral triangle. If the word "TOP" is inscribed in one corner, the apex of that corner shall be directed upwards.
- E-2.2. The illuminating surface may or may not have at its centre a triangular, non-retro-reflecting area, with sides parallel to those of the outer triangle.
- E-2.3. The illuminating surface may or may not be continuous. In any case, the shortest distance between two adjacent retro-reflecting optical units shall not exceed 15 mm.
- E-2.4. The illuminating surface of a retro-reflecting device shall be considered to be continuous if the edges of the illuminating surfaces of adjacent separate optical units are parallel and if the said optical units are evenly distributed over the whole solid surface of the triangle.
- E-2.5. If the illuminated surface is not continuous, the number of separate retro-reflecting optical units including the corner units shall not be less than four on each side of the triangle.
  - E-2.5.1. The separate retro-reflecting optical units shall not be replaceable unless they consist of approved retro-reflecting devices in Class IA.
- E-2.6. The outside edges of the illuminating surfaces of triangular retro-reflecting devices in Classes IIIA and IIIB shall be between 150 and 200 mm long. In the case of devices of hollow-triangle type, the width of the sides, measured at right angles to the latter, shall be equal to at least 20 per cent of the effective length between the extremities of the illuminating surface.

**E-3. Shape and dimensions of retro-reflecting devices in Class IVA**

- E-3.1. The shape of the light emitting surfaces shall be simple and not easily confused at normal observation distances with a letter, a digit or a triangle. However, a shape resembling the letters and digits of simple form, O, I, U and 8 is permissible.
- E-3.2. The light emitting surface of the retro-reflecting device shall be at least 25 cm<sup>2</sup>.

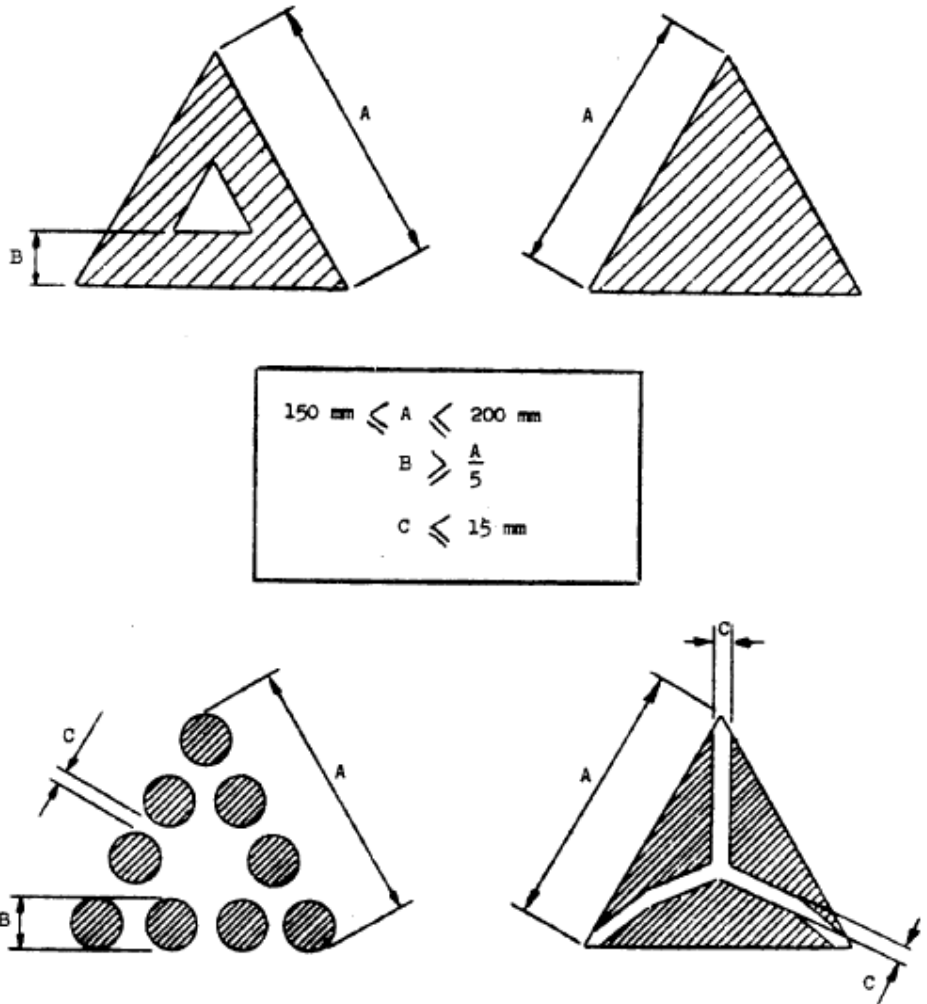


- E-4.** Compliance to the requirements given in E-1 to E-3 shall be verified by visual inspection.

**Figure E-1**

(See E-2)

**RETRO-REFLECTORS FOR TRAILERS - CLASSES IIIA AND IIIB**



**Note:** These sketches are for illustration purposes only.

## ANNEX F

(See 7.1)

## COLORIMETRIC SPECIFICATIONS

- F-1.** These specifications shall apply only to white, red or amber retro-reflecting devices.
- F-1.1. Retro-reflecting devices may consist of a combined retro-reflecting optical unit and filter, which shall be so designed that it is not possible to separate them under normal conditions of use.
- F-1.2. The colouring of retro-reflecting optical units and filters by means of paint or varnish is not permitted.
- F-2.** When the retro-reflecting device is illuminated by ICI standard illuminant A, with an angle of divergence of  $1/3^\circ$  and an illumination angle of  $V = H = 0^\circ$ , or, if this produces a colourless surface reflection, an angle  $V = \pm 5^\circ$ ,  $H = 0^\circ$ , the chromaticity coordinates of the reflected luminous flux shall be within the limits prescribed in AIS-010 (Part 5) (Rev.1):2010.
- F-2.1. In the case of red and amber, compliance with the colorimetric specifications shall be verified by a visual comparison test.
- F-2.2. If any doubt remains after this test, compliance with the colorimetric specifications shall be verified by determining the chromaticity coordinates of the most doubtful sample and shall be within limits prescribed in AIS-010 (Part 5) (Rev.1):2010.
- F-3.** White retro-reflecting devices shall not produce a selective reflection, that is to say, the Chromaticity coordinates "x" and "y" of the standard illuminant "A" used to illuminate the retro-reflecting device shall not undergo a change of more than 0.01 after reflection by the retro-reflecting device.
- F-3.1. Requirement of F-3 shall be verified by the visual comparison test indicated, above, the control field being illuminated by a light source of which the Chromaticity coordinates differ by 0.01 from that of standard illuminant A.
- F-3.2. In case of doubt, the Chromaticity coordinates for the most selective sample shall be determined.

**ANNEX G**

(See 7.1)

**PHOTOMETRIC SPECIFICATIONS**

**G-1.** When applying for approval, the applicant shall specify one or more or a range of axis of reference, corresponding to the illumination angle  $V = H = 0^\circ$  in the table of coefficients of luminous intensity (CIL).

In the case where more than one or a range of different axis of reference are specified by the manufacturer, the photometric measurements shall be repeated making reference each time to a different axis of reference or to the extreme axis of reference of the range specified by the manufacturer.

**G-2.** For photometric measurements, only the illuminating surface defined by the planes contiguous to the outermost parts of the optical system of the retro-reflecting device as indicated by the manufacturer and contained within a circle of 200 mm diameter for Class IA or IB shall be considered, and the illuminating surface itself shall be limited to 100 cm<sup>2</sup> though the surfaces of the retro-reflecting optical units need not necessarily attain this area. The manufacturer shall specify the perimeter of the area to be used. In the case of Class IIIA, Class IIIB and Class IVA, the whole of the illuminating surfaces shall be considered without limitation as to size.

**G-3. CIL values**

G-3.1. Class IA, Class IB, Class IIIA and Class IIIB

G-3.1.1. The CIL values for red retro-reflecting devices shall be at least equal to those in the Table G1 expressed in millicandelas per lux, for the angles of divergence and illumination shown.

**Table G1**

(See G-3.1.1)

**CIL values for red retro-reflecting devices**

Class	Angle of divergence $\alpha$	Illumination angles (in degrees)			
		Vertical V Horizontal H	$0^\circ$ $0^\circ$	$\pm 10^\circ$ $0^\circ$	$\pm 5^\circ$ $\pm 20^\circ$
IA, IB	20'		300	200	100
	1°30'		5	2.8	2.5
IIIA, IIIB	20'		450	200	150
	1°30'		12	8	8

CIL values lower than those shown in the last two columns of the table G1 are not permissible within the solid angle having the reference centre as its apex and bounded by the planes intersecting along the following lines:

$$(V = \pm 10^\circ, H = 0^\circ), \quad (V = \pm 5^\circ, H = \pm 20^\circ).$$

- G-3.1.2. CIL values for amber retro-reflecting devices in Class IA or IB shall be at least equal to those in the table G-3.1.1, multiplied by the coefficient 2.5.
- G-3.1.3 CIL values for colourless retro-reflecting devices in Class IA or IB shall be at least equal to those in the table G-3.1.1, multiplied by the coefficient 4.
- G-3.2. For devices of Class IVA the CIL values shall be at least equal to those in the Table G-2,, expressed in millicandelas per lux, for the angles of divergence and illumination shown.

**Table G-2**

(See G-3.2)

**CIL values for class IVA**

Colour	Angle of divergence $\alpha$	Illumination angles (in degrees)						
		Vertical V Horizontal H	0	$\pm 10$	0	0	0	0
			0	$\pm 10$	0	0	0	0
			0	0	$\pm 20$	$\pm 30$	$\pm 40$	$\pm 50$
White	20'		1,800	1,200	610	540	470	400
	1°30'		34	24	15	15	15	15
Amber	20'		1,125	750	380	335	290	250
	1°30'		21	15	10	10	10	10
Red	20'		450	300	150	135	115	100
	1°30'		9	6	4	4	4	4

- G-4. When the CIL of a retro-reflecting device is measured for an angle  $\beta$  of  $V = H = 0^\circ$ , it shall be ascertained whether any mirror effect is produced by slightly turning the device. If there is any such effect, a reading shall be taken with an angle  $\beta$  of  $V = \pm 5^\circ, H = 0^\circ$ . The position adopted shall be that corresponding to the minimum CIL for one of these positions.
  - G-4.1. With an illumination angle  $\beta$  of  $V = H = 0^\circ$ , or the angle specified in G-4 and an angle of divergence of 20', retro-reflecting devices which are not marked "TOP" shall be rotated about their axes of reference to the position of minimum CIL, which shall conform to the value specified in G-3. When the CIL is measured for the other angles of illumination and divergence, the retro-reflecting device shall be placed in the position corresponding to this value of  $\epsilon$ . If the specified values are not attained, the device may be rotated about its axis of reference  $\pm 5^\circ$  from that position.
  - G-4.2. With an illumination angle  $\beta$  of  $V = H = 0^\circ$ , or the angle specified in 4 and an angle of divergence of 20', retro-reflecting devices marked "TOP" shall be rotated about their axes  $\pm 5^\circ$ . The CIL shall not fall below the prescribed value in any position assumed by the device during this rotation.
  - G-4.3. If for the direction  $V = H = 0^\circ$ , and for  $\epsilon = 0^\circ$  the CIL exceeds the specified value by 50 per cent or more, all measurements for all angles of illumination and divergence shall be made for  $\epsilon = 0^\circ$ .

**ANNEX H**

(See 7.1)

**RESISTANCE TO EXTERNAL AGENTS****H-1. Resistance to water and dirt penetration****H-1.1. Water submersion test**

H-1.1.1. Retro-reflecting devices whether part of a lamp or not, shall be stripped of all removable parts and immersed for 10 minutes in water at a temperature of  $50 \pm 5$  °C, the highest point of the upper part of the illuminating surface being 20 mm below the surface of the water. This test shall be repeated after turning the retro-reflecting device through 180°, so that the illuminating surface is at the bottom and the rear face is covered by about 20 mm of water. These optical units shall then be immediately immersed in the same conditions in water at a temperature of  $25 \pm 5$  °C.

H-1.1.2. No water shall penetrate to the reflecting surface of the retro-reflecting optical unit. If visual inspection clearly reveals the presence of water, the device shall not be considered to have passed the test.

H-1.1.3. If visual inspection does not reveal the presence of water or in case of doubt, the CIL shall be measured by the method described in D-3.2 of Annex D, or, P-4.2 of Annex P the retro-reflecting device being first lightly shaken to remove excess water from the outside.

**H-1.2. Alternative test procedure for Classes IB and IIIB devices**

As an alternative, at the request of the manufacturer, the following test (moisture and dust test) shall be applied instead of the submersion-test specified in H-1.1.

**H-1.2.1. Moisture test**

The test evaluates the ability of the sample device to resist moisture penetration from a water spray and determines the drainage capability of those devices with drain holes or other exposed openings in the device.

**H-1.2.1.1. Water spray test equipment**

A water spray cabinet with the following characteristics shall be used:

**H-1.2.1.1.1. Cabinet**

The cabinet shall be equipped with a nozzle(s) which provides a solid cone water spray of sufficient angle to completely cover the sample device. The centreline of the nozzle(s) shall be directed downward at an angle of  $45^\circ \pm 5^\circ$  to the vertical axis of a rotating test platform.

**H-1.2.1.1.2. Rotating test platform**

The rotating test platform shall have a minimum diameter of 140 mm and rotate about a vertical axis in the centre of the cabinet.

- H-1.2.1.1.3. **Precipitation rate**  
The precipitation rate of the water spray at the device shall be 2.5 (+ 1.6/-0) mm/min as measured with a vertical cylindrical collector centred on the vertical axis of the rotating test platform. The height of the collector shall be 100 mm and the inside diameter shall be a minimum of 140 mm.
- H-1.2.1.2. **Water spray test procedure**  
A sample device mounted on a test fixture, with initial CIL measured and recorded shall be subjected to a water spray as follows:
- H-1.2.1.2.1. **Device openings**  
All drain holes and other openings shall remain open. Drain wicks, when used, shall be tested in the device.
- H-1.2.1.2.2. **Rotational speed**  
The device shall be rotated about its vertical axis at a rate of  $4.0 \pm 0.5 \text{ min}^{-1}$ .
- H-1.2.1.2.3. **Lighting functions**  
If the retro-reflector is reciprocally incorporated or grouped with signalling or lighting functions, these functions shall be operated at design voltage according to a cycle of 5 min ON (in flashing mode, where appropriate), 55 min OFF.
- H-1.2.1.2.4. **Test duration**  
The water spray test shall last 12 h (12 cycles of 5/55 min).
- H-1.2.1.2.5. **Drain period**  
The rotation and the water spray shall be turned OFF and the device allowed to drain for 1 h with the cabinet door closed.
- H-1.2.1.2.6. **Sample evaluation**  
Upon completion of the drain period. The interior of the device shall be observed for moisture accumulation. No standing pool of water shall be allowed to be formed, or which may be formed by tapping or tilting the device. The CIL shall be measured according to the method specified in D-3.2 of Annex D after having dried the exterior of the device with a dry cotton cloth.
- H-1.2.2. **Dust exposure test**  
This test evaluates the ability of the sample device to resist dust penetration which could significantly affect the photometric output of the retro-reflector.
- H-1.2.2.1. **Dust exposure test equipment**  
The following equipment shall be used to test for dust exposure:
- H-1.2.2.1.1. **Dust exposure test chamber**  
The interior of the test chamber shall be cubical in shape in size 0.9 to 1.5 m per side. The bottom may be "hopper shaped" to aid in collecting the dust. The internal chamber volume, not including

a "hopper shaped" bottom shall be 2 m<sup>3</sup> maximum and shall be charged with 3 to 5 kg of the test dust. The chamber shall have the capability of agitating the test dust by means of compressed air or blower fans in such a way that the dust is diffused throughout the chamber.

H-1.2.2.1.2. The dust

The test dust used shall be fine powdered cement in accordance with standard ASTM C 150-84.

Alternatively, medium heat Portland cement according IS 269:1989 may be used.

H-1.2.2.2. **Dust exposure test procedure**

A sample device, mounted on a test fixture, with the initial CIL measured and recorded, shall be exposed to dust as follows:

H-1.2.2.2.1. Device openings

All drain holes and other openings shall remain open. Drain wicks, when used, shall be tested in the device.

H-1.2.2.2.2. Dust exposure

The mounted device shall be placed in the dust chamber no closer than 150 mm from a wall. Devices with a length exceeding 600 mm shall be horizontally centred in the test chamber. The test dust shall be agitated as completely as possible by compressed air or blower(s) at intervals of 15 min for a period of 2 to 15 s for the duration of 5 hours. The dust shall be allowed to settle between the agitation periods.

H-1.2.2.2.3. Measured sample evaluation

Upon completion of the dust exposure test, the exterior of the device shall be cleaned and dried with a dry cotton cloth and the CIL measured according to the method specified in D-3.2 of Annex D.

**H-2. Resistance to corrosion**

H-2.1. Retro-reflecting devices shall be so designed that they retain the prescribed photometric and colorimetric characteristics despite the humidity and corrosive influences to which they are normally exposed. The resistance of the front surface to tarnishing and of the protection of the rear face to deterioration shall be checked, particularly when an essential metal component seems liable to be attacked.

H-2.2. The retro-reflecting device, or the lamp if the device is combined with a light, shall be stripped of all removable parts and subjected to the action of a saline mist for a period of 50 hours, comprising two periods of exposure of 24 hours each, separated by an interval of two hours during which the sample is allowed to dry.

H-2.3. The saline mist shall be produced by atomizing, at a temperature of  $35^{\circ} \pm 2^{\circ}\text{C}$ , a saline solution obtained by dissolving  $20 \pm 2$  parts by weight of sodium chloride in 80 parts of distilled water containing not more than 0.02 per cent of impurities.

H-2.4. Immediately after completion of the test, the sample shall not show signs of excessive corrosion liable to impair the efficiency of the device.

**H-3. Resistance to fuels**

The outer surface of the retro-reflecting device and, in particular, of the illuminating surface, shall be lightly wiped with a cotton cloth soaked in a mixture of 70 vol. per cent of n-heptane and 30 vol. per cent of toluol. After about five minutes, the surface shall be inspected visually. It shall not show any apparent surface changes, except that slight surface cracks will not be objected to.

**H-4. Resistance to lubricating oils**

The outer surface of the retro-reflecting device and, in particular, the illuminating surface, shall be lightly wiped with a cotton cloth soaked in a detergent lubricating oil. After about 5 minutes, the surface shall be cleaned. The CIL shall then be measured (D-3.2 of Annex D or P-4.2 of Annex P).

**H-5. Resistance of the accessible rear face of mirror-backed retro-reflecting devices**

H-5.1. After having brushed the rear face of the retro-reflecting device with a hard nylon brush, a cotton cloth soaked in the mixture, defined in H-3 shall be applied to the said rear face for one minute. The cotton cloth is then removed and the retro-reflecting device left to dry.

H-5.2. As soon as evaporation is completed, an abrasion test shall be made by brushing the rear face with the same nylon brush as before.

H-5.3. The CIL shall then be measured (D-3.2 of Annex D. or P-4.2 of Annex P) after the whole surface of the mirror-backed rear face has been covered with Indian ink.



**ANNEX J** (Reserved)

**ANNEX K**

(See 7.1)

**RESISTANCE TO HEAT**

- K-1.** The retro-reflecting device shall be kept for 48 consecutive hours in a dry atmosphere at a temperature of  $65 \pm 2^{\circ}\text{C}$ .
- K-2.** After this test, no cracking or appreciable distortion of the retro-reflecting device and, in particular, of its optical component shall be visible.

ANNEX L (Reserved)

ANNEX M

(See D-1)

CHRONOLOGICAL ORDER OF TESTS

Number of the Annex	Number of paragraph	TESTS	SAMPLES					
			a	b	c	d	e	f
-	6 of this standard	General specifications: visual inspection	x	x	x	x	x	x
E	-	Shapes and dimensions: visual inspection	x	x	x	x	x	x
K	-	Heat: 48 h at 65° ± 2°C	x	x	x	x	x	x
		Visual inspection for distortion	x	x	x	x	x	x
F	-	Colorimetry: visual inspection Chromaticity coordinates in case of doubt	x	x	x	x	x	x
G	-	Photometry: limited to 20' and V = H = 0°	x	x	x	x	x	x
G	G-3.	Complete photometry	x	x				
H	H-1.	Water: 10 min. in normal position					x	x
		10 min. in inverted position					x	x
		visual inspection					x	x
D	D-3.1.	Colorimetry: visual inspection					x	x
		Chromaticity coordinates in case of doubt					x	x
D	D-3.2.	Photometry: limited to 20' and V = H = 0°					x	x
H	H-3.	Motor fuels: 5 min.					x	x
		visual inspection					x	x
H	H-4.	Oils: 5 min.					x	x
		visual inspection					x	x
D	D-3.1.	Colorimetry: visual inspection						
		Chromaticity coordinates in case of doubt					x	x
D	D-3.2.	Photometry: limited to 20' and V = H = 0°					x	x
H	H-2.	Corrosion: 24 hours			x	x		
		2 hours interval			x	x		
		24 hours			x	x		

Number of the Annex	Number of paragraph	TESTS	SAMPLES					
			a	b	c	d	e	f
		visual inspection			x	x		
H	H-5.	Rear face: 1 min. visual inspection			x	x		
D	D-3.1.	Colorimetry: visual inspection Chromaticity coordinates in case of doubt			x	x		
D	D-3.2.	Photometry: limited to 20' and V = H = 0°			x	x		

**Note:** The details given in the column “TESTS” are for general description.

**ANNEX N**

(See 7.1)

**RESISTANCE TO IMPACT - CLASS IVA**

- N-1.** The retro-reflecting device shall be mounted in a manner similar to the way in which it is mounted on the vehicle, but with the lens faced horizontal and directed upwards.
- N-2.** Drop a 13 mm diameter polished solid steel ball, once, vertically onto the central part of the lens from a height of 0.76 m. The ball may be guided but not restricted in free fall.
- N-3.** When a retro-reflecting device is tested at room temperature with this method, the lens shall not crack.

**ANNEX P**

(See 7.1)

**TEST PROCEDURE - CLASS IVA**

- P-1.** The applicant shall submit for approval six samples which shall be tested in the chronological order indicated in Annex R.
- P-2.** After verification of the specifications in 6.1. to 6.5 and the specifications of shape and dimensions (Annex E), the six samples shall be subjected to the heat resistance test (Annex K) and one hour minimum after this test examined as to their colorimetric characteristics (Annex F) and CIL (Annex G) for an angle of divergence of 20' and an illumination angle  $V = H = 0^\circ$  or, if necessary, in the positions defined in Annex G. The two retro-reflecting devices giving the minimum and maximum values shall then be fully tested as shown in Annex G. These two samples shall be kept by the laboratories for any further checks which may be found necessary.
- P-3.** Four samples out of the remaining four samples shall be selected at random and divided into two groups of two in each group.
- First group:
- The two samples shall be subjected successively to the water-penetration resistance test (H-1 of Annex H.) and then, if this test is satisfactory, to the tests for resistance to fuels and lubricating oils (H-3. and H-4 of Annex H).
- Second group:
- The two samples shall, if relevant, be subjected to the corrosion test (H-2 of Annex H), and then to the abrasive-strength test of the rear face of the retro-reflecting device (H-5 of Annex H.). These two samples shall also be subjected to the impact test (Annex N).
- P-4.** After undergoing the tests referred to in P-3, the retro-reflecting devices in each group shall have:
- P-4.1. A colour which satisfies the conditions laid down in Annex F. This shall be verified by a qualitative method and, in case of doubt, confirmed by a quantitative method;
- P-4.2. A CIL which satisfies the conditions laid down in Annex G. Verification shall be performed only for an angle of divergence of 20' and an illumination angle of  $V = H = 0^\circ$  or, if necessary, in the positions specified in Annex G.
- P-5.** The four remaining samples may be utilized, if necessary, for any other purpose.

**ANNEX R**

(See P-1)

**CHRONOLOGICAL ORDER OF TESTS FOR CLASS IVA**

Number of the Annex	Number of paragraph	TESTS	SAMPLES					
			a	b	c	d	e	f
-	6 of this standard	General specifications: visual inspection	x	x	x	x	x	x
E	-	Shape and dimensions: visual inspection	x	x	x	x	x	x
K	-	Heat: 48 h at 65° ±20°C	x	x	x	x	x	x
		Visual inspection for distortion	x	x	x	x	x	x
F	-	Colorimetry: visual inspection	x	x	x	x	x	x
		Chromaticity coordinates in case of doubt		x				
G	-	Photometry: limited to 20' and V = H = 0°	x	x	x	x	x	x
G	-	Complete photometry	x	x				
H	H -1.	Water: 10 min. in normal position			x	x		
		10 min. in inverted position			x	x		
		visual inspection			x	x		
H	H -3.	Motor fuels: 5 min.			x	x		
		visual inspection			x	x		
H	H -4.	Oils: 5 min.			x	x		
		visual inspection			x	x		
F	-	Colorimetry: visual inspection			x	x		
		Chromaticity coordinates in case of doubt			x	x		
G	-	Photometry: limited to 20' and V = H = 0°			x	x		
H	H -2.	Corrosion: 24 hours					x	x
		2 hours' interval					x	x
		24 hours					x	x
		visual inspection					x	x
H	H -5.	Rear face: 1 min.					x	x
		visual inspection					x	x
N	-	Impact					x	x
		visual inspection					x	x
F	-	Colorimetry: visual inspection					x	x

Number of the Annex	Number of paragraph	TESTS	SAMPLES					
			a	b	c	d	e	f
		Chromaticity coordinates in case of doubt					x	x
G	-	Photometry: limited to 20' and V = H = 0°					x	x

**Note:** The details given in the column “TESTS” are for general description.

**ANNEX S**

(See 7.1)

**TEST PROCEDURE FOR CLASSES IB AND IIIB DEVICES**

- S-1.** Retro-reflecting devices of Classes IB and IIIB shall be tested according to the test procedures specified in Annex D, following the chronological order of tests given in Annex M, with the exception of the test according to H-1 of Annex H., which for Classes IB and IIIB devices may be replaced by the test specified in, H-1.2 of Annex H



## ANNEX T

(See 8.2)

**MINIMUM REQUIREMENTS FOR CONFORMITY OF  
PRODUCTION CONTROL PROCEDURES**

**T-1. General**

- T-1.1. The conformity requirements shall be considered satisfied from a mechanical and geometric standpoint, if the differences do not exceed inevitable manufacturing deviations within the requirements of this standard.
- T-1.2. With respect to photometric performances, the conformity of mass-produced retro-reflectors shall not be contested if, when testing photometric performances of any retro-reflector chosen at random no measured value deviates unfavourably by more than 20 per cent from the minimum values prescribed in this standard .
- T-1.3. The chromaticity coordinates shall be complied with.

**T-2. Minimum requirement for verification of conformity by the manufacturer**

For each type of retro-reflector the holder of the approval mark shall carry out at least the following tests, at appropriate intervals. The tests shall be carried out in accordance with the provisions of this standard .

If any sampling shows non-conformity with regard to the type of test concerned, further samples shall be taken and tested. The manufacturer shall take steps to ensure the conformity of the production concerned.

**T-2.1. Nature of tests**

Tests of conformity in this standard shall cover the photometric and colorimetric characteristics and the resistance to penetration of water.

**T-2.2. Methods used in tests**

- T-2.2.1. Tests shall generally be carried out in accordance with the methods set out in this standard .
- T-2.2.2. In any test of conformity carried out by the manufacturer, equivalent methods may be used with the consent of the testing agency responsible for approval tests. The manufacturer is responsible for proving that the applied methods are equivalent to those laid down in this standard.
- T-2.2.3. The application of T-2.2.1 and T-2.2.2. requires regular calibration of test apparatus and its correlation with measurements made by a testing agency.
- T-2.2.4. In all cases the reference methods shall be those of this standard, particularly for the purpose of administrative verification and sampling.

**T-2.3. Nature of sampling**

Samples of retro-reflectors shall be selected at random from the production of a uniform batch. A uniform batch means a set of

retro-reflectors of the same type, defined according to the production methods of the manufacturer.

The assessment shall in general cover series production from individual factories. However, a manufacturer may group together records concerning the same type from several factories, provided these operate under the same quality system and quality management.

**T-2.4. Measured and recorded photometric characteristics**

The sampled retro-reflector shall be subjected to photometric measurements at the points and the chromaticity coordinates provided for in the standard.

**T-2.5. Criteria governing acceptability**

The manufacturer is responsible for carrying out a statistical study of the test results and for defining, in agreement with the testing agency, criteria governing the acceptability of his products in order to meet the specifications laid down for the verification of conformity of products in 8.1.

The criteria governing the acceptability shall be such that, with a confidence level of 95 per cent, the minimum probability of passing a spot check in accordance with Annex U (first sampling) would be 0.95.

ANNEX U

(See 8.3)

**MINIMUM REQUIREMENTS FOR SAMPLING  
BY TESTING AGENCY**

**U-1. General**

- U-1.1. The conformity requirements shall be considered satisfied from a mechanical and a geometric standpoint, in accordance with the requirements of this standard, if any, if the differences do not exceed inevitable manufacturing deviations.
- U-1.2. With respect to photometric performance, the conformity of mass-produced retro-reflectors shall not be contested if, when testing photometric performances of any retro-reflector chosen at random:
  - U-1.2.1. no measured value deviates unfavourably by more than 20 per cent from the minimum values prescribed in this standard.
  - U-1.2.2. Retro-reflectors with apparent defects are disregarded.
- U-1.3. The chromaticity coordinates shall be complied with.

**U-2. First sampling**

In the first sampling four retro-reflectors are selected at random. The first sample of two is marked A, the second sample of two is marked B.

**U-2.1. The conformity is not contested**

U-2.1.1. Following the sampling procedure shown in Figure U-1 of this Annex the conformity of mass-produced retro-reflectors shall not be contested if the deviation of the measured values of the retro-reflectors in the unfavourable directions are:

U-2.1.1.1. sample A

A1: one retro-reflector	0 per cent
one retro-reflector not more than	20 per cent
A2: both retro-reflectors more than	0 per cent
but not more than	20 per cent
go to sample B	

U-2.1.1.2. sample B

B1: both retro-reflectors	0 per cent
---------------------------	------------

**U-2.2. The conformity is contested**

U-2.2.1. Following the sampling procedure shown in Figure U-1 of this Annex the conformity of mass-produced retro-reflectors shall be contested and the manufacturer requested to make his production meet the requirements (alignment) if the deviations of the measured

values of the retro-reflectors are:

- U-2.2.1.1. sample A
  - A3: one retro-reflector not more than 20 per cent
  - one retro-reflector more than 20 per cent
  - but not more than 30 per cent
- U-2.2.1.2. sample B
  - B2: in the case of A2
    - one retro-reflector more than 0 per cent
    - but not more than 20 per cent
    - one retro-reflector not more than 20 per cent
  - B3: in the case of A2
    - one retro-reflector 0 per cent
    - one retro-reflector more than 20 per cent
    - but not more than 30 per cent
- U-2.3. **Non conformity established**

Conformity shall be contested and requirements of 9 applied if, following the sampling procedure in Figure U-1 of this Annex, the deviations of the measured values of the retro-reflectors are:
- U-2.3.1 sample A
  - A4: one retro-reflector not more than 20 per cent
  - one retro-reflector more than 30 per cent
  - A5: both retro-reflectors more than 20 per cent
- U-2.3.2. sample B
  - B4: in the case of A2
    - one retro-reflector more than 0 per cent
    - but not more than 20 per cent
    - one retro-reflector more than 20 per cent
  - B5: in the case of A2
    - both retro-reflectors more than 20 per cent
  - B6: in the case of A2
    - one retro-reflector 0 per cent
    - one retro-reflector more than 30 per cent

**U-3. Repeated sampling**

In the cases of A3, B2, B3 a repeated sampling, third sample C of two retro-reflectors and fourth sample D of two retro-reflectors, selected from stock manufactured after alignment, is necessary within two months' time after the notification.

**U-3.1. The conformity is not contested**

U-3.1.1. Following the sampling procedure shown in Figure U-1 of this Annex the conformity of mass-produced retro-reflectors shall not be contested if the deviations of the measured values of the retro-reflectors are:

U-3.1.1.1. sample C

C1: one retro-reflector	0 per cent
one retro-reflector not more than	20 per cent
C2: both retro-reflectors more than	0 per cent
but not more than	20 per cent
go to sample D	

U-3.1.1.2. sample D

D1: in the case of C2	
both retro-reflectors	0 per cent

**U-3.2. The conformity is contested**

U-3.2.1. Following the sampling procedure shown in Figure U-1 of this Annex the conformity of mass-produced retro-reflectors shall be contested and the manufacturer requested to make his production meet the requirements (alignment) if the deviations of the measured values of the retro-reflectors are:

U-3.2.1.1. sample D

D2: in the case of C2	
one retro-reflector more than	0 per cent
but not more than	20 per cent
one retro-reflector not more than	20 per cent

**U-3.3. Non conformity established:**

Conformity shall be contested and 9 applied if, following the sampling procedure in Figure U-1 of this Annex, the deviations of the measured values of the retro-reflectors are:

U-3.3.1 sample C

- |                                       |             |
|---------------------------------------|-------------|
| C3: one retro-reflector not more than | 20 per cent |
| one retro-reflector more than         | 20 per cent |
| C4: both retro-reflectors more than   | 20 per cent |

U-3.3.2. sample D

- |                                    |             |
|------------------------------------|-------------|
| D3: in the case of C2              |             |
| one retro-reflector 0 or more than | 0 per cent  |
| one retro-reflector more than      | 20 per cent |

**U-4. Resistance to penetration of water**

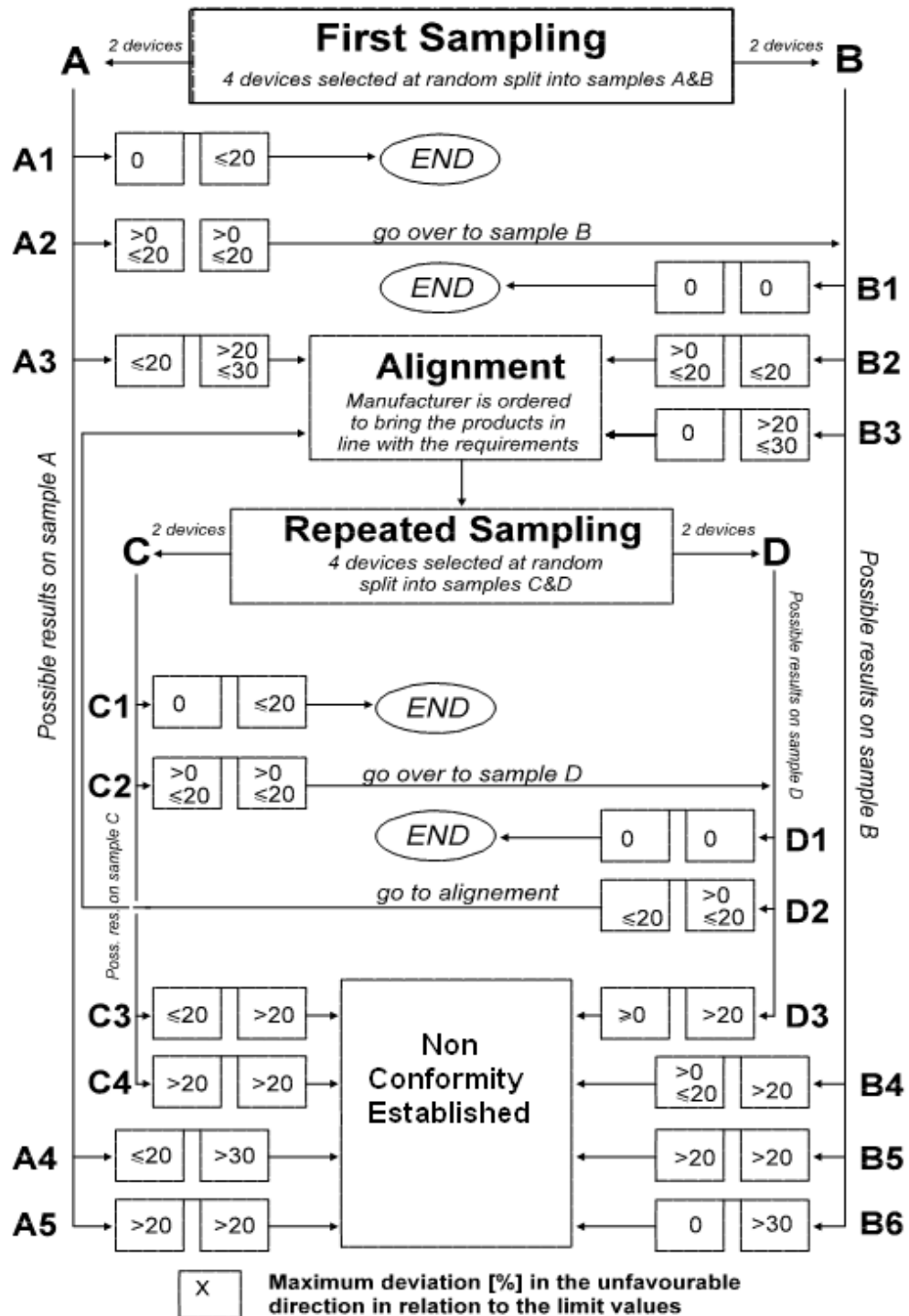
With respect to the verification of the resistance to penetration of water, the following procedure shall be applied:

One of the retro-reflectors of sample A, after sampling procedure in Figure U-1 of this Annex, shall be tested according to the procedure described in H-1 of Annex H, respectively P-3. of Annex P for Class IVA reflectors.

The retro-reflectors shall be considered as acceptable if the test has been passed.

However, if the test on sample A is not complied with, the two retro-reflectors of sample B shall be subjected to the same procedure and both shall pass the test.

Figure U-1



**ANNEX V**

(See Introduction)

**COMPOSITION OF AISC PANEL ON  
LIGHTING AND LIGHT SIGNALLING DEVICES\***

<b>Convener</b>	
Mr. T. M. Balaraman	Bajaj Auto Ltd., (SIAM)
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Mr. B. V. Shamsundara	The Automotive Research Association of India (ARAI)
Mr. D. P. Saste	Central Institute of Road Transport (CIRT)
Mr. V. D. Chavan	Central Institute of Road Transport (CIRT)
Dr. Madhusudan Joshi	International Centre for Automotive Technology (ICAT)
Mr. G.R.M. Rao	Vehicle Research & Dev. Estt. (VRDE)
Dr. N. Karuppaiah	National Automotive Testing and R&D Infrastructure Project (NATRIP)
Mr. K. K. Gandhi	Society of Indian Automobile Manufacturers (SIAM)
Mr. G. K. Binani	Society of Indian Automobile Manufacturers (SIAM) (Tata Motors Ltd)
Mr. P. K. Banerjee	Society of Indian Automobile Manufacturers (SIAM) (Tata Motors Ltd)
Mr. R. M. Kanitkar	Society of Indian Automobile Manufacturers (SIAM) (Force Motors Ltd.)
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Mr. Jitendra Malhotra	Society of Indian Automobile Manufacturers (SIAM) (Maruti Suzuki India Ltd)
Mr. Sumit Sharma	Society of Indian Automobile Manufacturers (SIAM) (Volkswagen India Private Ltd.)
Mr. Harjeet Singh	Society of Indian Automobile Manufacturers (SIAM) (Hero Honda Motors Ltd)



Mr. Harsh Agrawal	Society of Indian Automobile Manufacturers (SIAM) (Hero Honda Motors Ltd)
Mr. S Ramiah	Society of Indian Automobile Manufacturers (SIAM) (TVS Motor Company Limited)
Mr. T.C. Gopalan,	Tractor Manufacturers Association (TMA)
Mr. K. N. D. Nambudiripad	Automotive Component Manufacturers Association (ACMA)
Mr. G. V. George	FIEM Industries Ltd. (ACMA)
Mr. Rajagopalan	FIEM Industries Ltd. (ACMA)
Mr. Virendra Sachdev	Lumax Industries Ltd. (ACMA)
Mr. Sagar Kulkarni	Rinder India Pvt. Ltd. (ACMA)
Mr. T. V. Singh	Bureau of Indian Standards (BIS)
Mr. Rajiv Agarwal	All India Auto & Miniature Bulbs & Component Mfrs. Association
Mr. C. K. Choudhari	All India Auto & Miniature Bulbs & Component Mfrs. Association

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

**ANNEX W**  
(See Introduction)

**COMMITTEE COMPOSITION \***  
**Automotive Industry Standards Committee**

<b>Chairman</b>	
Shri Shrikant R. Marathe	Director The Automotive Research Association of India, Pune
<b>Members</b>	<b>Representing</b>
Representative from	Ministry of Road Transport & Highways (Dept. of Road Transport & Highways), New Delhi
Representative from	Ministry of Heavy Industries & Public Enterprises (Department of Heavy Industry), New Delhi
Shri S. M. Ahuja	Office of the Development Commissioner, MSME, Ministry of Micro, Small & Medium Enterprises, New Delhi
Shri T. V. Singh	Bureau of Indian Standards, New Delhi
Director Shri D. P. Saste (Alternate)	Central Institute of Road Transport, Pune
Dr. M. O. Garg	Indian Institute of Petroleum, Dehra Dun
Shri C. P. Ramnarayanan	Vehicles Research & Development Establishment, Ahmednagar
Representatives from	Society of Indian Automobile Manufacturers
Shri T.C. Gopalan	Tractor Manufacturers Association, New Delhi
Shri K.N.D. Nambudiripad	Automotive Components Manufacturers Association of India, New Delhi

Member Secretary  
Mrs. Rashmi Urdhwareshe  
Deputy Director  
The Automotive Research Association of India, Pune

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