

**FINALIZED DRAFT**

Automotive Industry Standard

# **Approval of Rear Marking Plates for Heavy and Long Vehicles**

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

<b>Sr. No.</b>	<b>Corr- igenda</b>	<b>Amend- ment</b>	<b>Revision</b>	<b>Date</b>	<b>Remark</b>	<b>Misc.</b>

**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 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.

The standard purports to enhance visibility of vehicles, even in darkness. It will aid the trailing / following vehicles to judge the length of this vehicle and thus facilitate right decisions while overtaking.

Rain simulation test specified vide clause 1.4.3 in Annex-6 to be exempted during component approval till such time the test method and acceptance criteria are clarified.

While preparing this standard considerable assistance has been derived from following ECE regulation.

ECE R 70 Addendum 69 - Revision 1 - Amendment 3 Supplement 9 to the 01 series of amendments – Date of entry into force: 15 June 2015	Uniform provisions concerning the approval of rear marking plates for heavy and long vehicles
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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 Automotive Industry Standards Committee responsible for preparation of this standard is given in Annex: 13

## Approval of Rear Marking Plates for Heavy and Long Vehicles

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## Approval of Rear Marking Plates for Heavy and Long Vehicles

<b>1.0</b>	<b>SCOPE</b>	
	This standard applies to the approval of marking plates used to increase the visibility of the rear of certain heavy and long motor vehicles and their trailers and semi trailers. The applicability is as follows:	
1.1	Category N2, with a maximum mass exceeding 7.5 tonnes and N3, with the exception of tractors for semi-trailers.	
1.2	Category T1, T2 and T3 - Trailers and semi-trailers whose length exceed 8m (including the draw bar)	
1.3	Category T4	
1.4	Articulated buses.	
<b>2.0</b>	<b>REFERENCES</b>	
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	
<b>3.0</b>	<b>DEFINITIONS</b>	
3.1	For the purpose of these provisions, the following definitions shall apply:	
3.1.1	<b>"Rear marking plate"</b> , a plate faced with retro-reflective and fluorescent material or devices intended to increase the visibility and permit easy identification of heavy and long vehicles	
3.1.2	<b>"Sample unit"</b> a complete, finished marking plate ready to be mounted on a vehicle and representative of current production;	
3.1.3	<b>Class (es) of rear marking plates</b>	
	Class 1:	Rear marking plates for heavy motor vehicles (trucks and tractors) with red fluorescent and yellow retro-reflective alternative stripes.
	Class 2:	Rear marking plates for long motor vehicles (trailers and semi trailers) with red fluorescent border and yellow retro-reflective centre.

	Class 3:	Rear marking plates for heavy motor vehicles (trucks and tractors) with red retro-reflective and yellow retro-reflective alternative stripes
	Class 4 :	Rear marking plates for long vehicles (trailers and semi trailers ) with red retro reflective border and yellow retro-reflective centre
	Class 5:	Rear marking plates for motor vehicles or trailers with red and white retro-reflective alternative stripes
<b>3.2</b>	<b>“Retro reflection”</b>	
	Reflection in which radiation 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 incident radiation:	
3.2.1	<b>"Retro reflective material"</b> a surface or device from which, when directionally irradiated, a relatively large portion of the incident radiation is retro reflected;	
3.2.2	<b>"Retro reflecting device"</b> an assembly ready for use and comprising one or more retro reflecting optical units;	
<b>3.3</b>	<b>Geometric definitions</b> (See Annex 1, Figure 1 )	
3.3.1	<b>"Reference centre"</b> 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	<b>"Illumination axis"</b> a line segment from the reference centre to the light source;	
3.3.3	<b>"Observation axis"</b> a line segment from the reference centre to the photometer head;	
3.3.4	<b>"Observation angle (symbol <math>\alpha</math> )"</b> 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.  Maximum range: $0 \leq \alpha \leq 180^\circ$ ;	
3.3.5	<b>"Observation half-plane"</b> the half-plane which originates on the illumination axis and which contains the observation axis;	
3.3.6	<b>"Reference axis"</b> a designated line segment originating on the reference centre which is used to describe the angular position of the retro reflector;	
3.3.7	<b>"Entrance angle (symbol <math>\beta</math> )"</b> the angle from the illumination axis to the reference axis. The entrance angle is usually not larger than $90^\circ$ but, for completeness, its full range is defined as $0 \leq \beta \leq 180^\circ$ In order to specify the orientation in full, this angle is characterized by two components, $\beta_1$ and $\beta_2$	

3.3.8	<b>"First axis"</b> an axis through the reference centre and perpendicular to the observation half-plane;
3.3.9	<b>"First component of the entrance angle (symbol <math>\beta_1</math>)"</b> the angle from the illumination axis to the plane containing the reference axis and the first axis. Range: $-180^\circ < \beta_1 \leq 180^\circ$ ;
3.3.10	<b>"Second component of the entrance angle (symbol <math>\beta_2</math>)"</b> the angle from the plane containing the observation half-plane to the reference axis.  Range: $-90^\circ \leq \beta_2 \leq 90^\circ$ ;
3.3.11	<b>"Second axis"</b> 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 $-90^\circ < \beta_1 < 90^\circ$ ; as shown in Annex 1, Figure 1;
3.3.12	<b>"Angle of rotation <math>\varepsilon</math>"</b> angle through the which the sample is turned about its mean vertical from any arbitrary established position counter clock ( $+\varepsilon$ ) or clockwise ( $-\varepsilon$ ) viewed in the direction of illumination. If retro-reflective materials or devices have a marking (e.g TOP), this marking governs the starting position. The angle of rotation $\varepsilon$ lies in the range $-180^\circ < \varepsilon \leq 180^\circ$ .
<b>3.4</b>	<b>Definition of photometric terms</b>
3.4.1	"Coefficient of retro-reflection ( $R'$ )", the quotient of the coefficient of luminous intensity $R$ of a plane retro-reflecting surface by its area $A$ . The symbol is $R'$  $(R' = \frac{I}{E_{\perp} \cdot A}).$ The coefficient ( $R'$ ) is expressed in candelas per lux per m <sup>2</sup> (cd.lx <sup>-1</sup> .m <sup>-2</sup> );
3.4.2	<b>"Angular diameter of the retro reflector sample (symbol <math>\eta</math>)"</b> 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;
3.4.3	<b>"Luminance factor"</b> the ratio of the luminance of the body under consideration to the luminance of a perfect diffuser under identical conditions of illumination and observation.
3.4.4	<b>"Colour of the reflected light of the device"</b> The definitions of the colour of the reflected light as per AIS 010 (Part 5) Rev 2 as amended from time to time.
<b>3.5</b>	<b>Fluorescence</b>
3.5.1	When certain substances are brought near to a source of ultraviolet or blue radiations, they emit radiations, which are nearly always of longer wave-length than those producing the effect. This phenomenon is

	called fluorescence. By day and in twilight, fluorescent colours are brighter than normal colours because they reflect part of the light falling upon them, and in addition they emit light. At night they are not brighter than ordinary colours.
3.5.2	"Colour of the fluorescent light of the device" The definitions of the colour of the fluorescent light as per AIS 010 (Part 5) Rev 2 as amended from time to time.
<b>3.6</b>	<b>Description of Goniometer</b>
	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 is arbitrarily shown to be vertically above the source. 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.
<b>3.7</b>	<b>Definition of "type"</b>
	Rear marking plates of different types means marking plates, which differ, in such essential respects as:
3.7.1	The trade name or mark;
3.7.2	The characteristics of the retro reflective material;
3.7.3	The characteristics of the fluorescent material;
3.7.4	The parts affecting the properties of the retro reflective material or devices.
3.7.5.	Differences in the shape and dimensions of the rear marking shall not constitute a different type.
<b>4</b>	<b>APPLICATION FOR APPROVAL</b>
4.1.	The application for approval of a type of rear marking plate shall be submitted by the holder of the trade name or mark, or if necessary by his duly accredited representative, and shall be accompanied by:
4.1.1.	Drawings, in triplicate, sufficiently detailed to permit identification of the type. The drawings shall show geometrically the position in which the marking plate is to be fitted to the rear end of the vehicle. They shall also show the position intended for the approval number and the identification symbol in relation to the circle of the approval mark;
4.1.2.	A brief description giving the technical specifications of the materials of which the retro-reflective areas are made;
4.1.3.	A brief description giving the technical specifications of the materials of which the fluorescent areas are made;

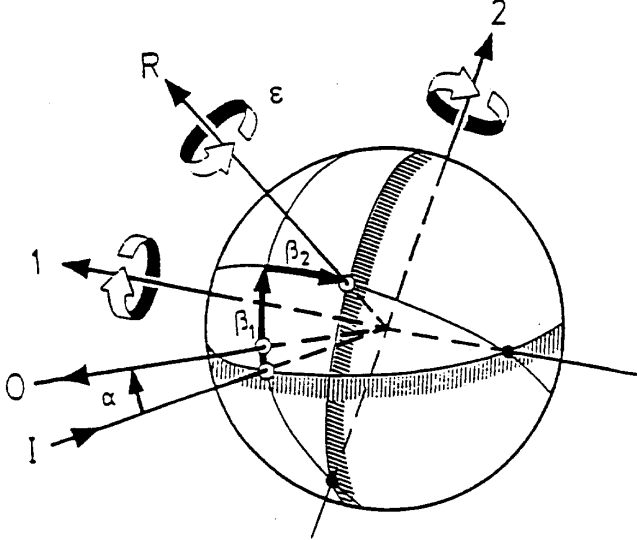


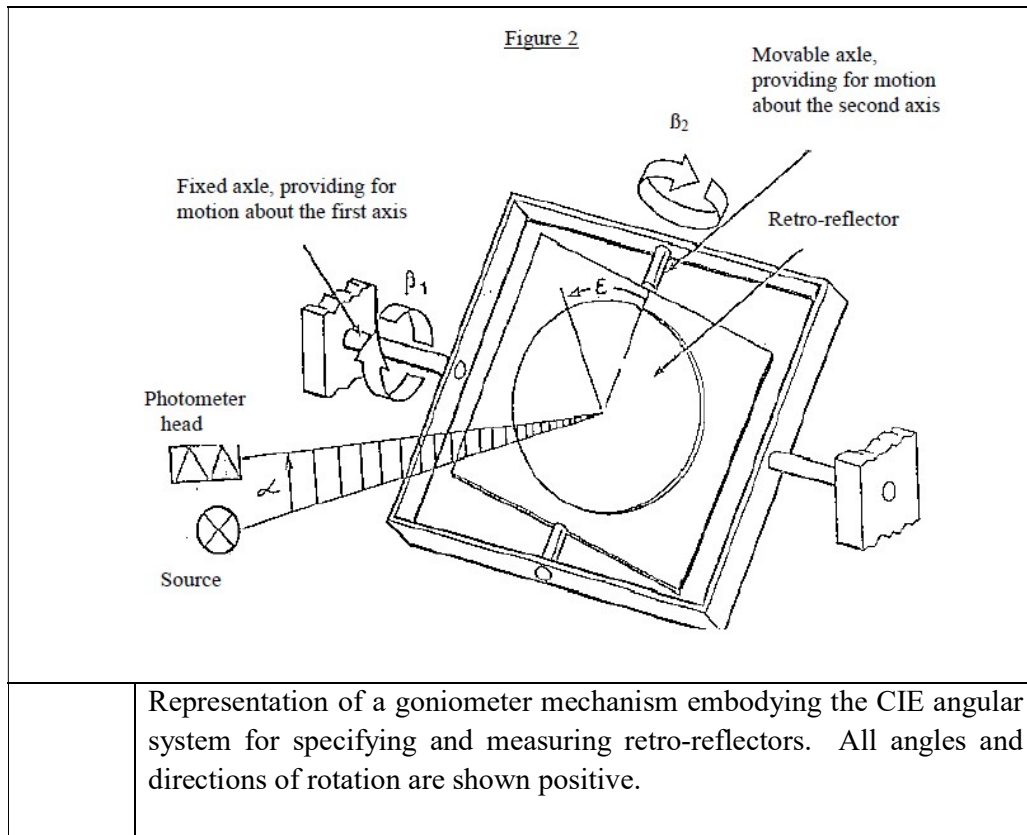
4.1.4.	Samples of the retro-reflective and of the fluorescent areas; the number of samples to be submitted is specified in Annex 2.
4.2	The Test Agency shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.
<b>5.</b>	<b>MARKINGS</b>
5.1	Every plate submitted for approval shall bear:
5.1.1	The trade name of the applicant and unique mark of type;
5.1.2	On the plates whose retro reflective system is not omni-rotational, the word "TOP" is inscribed horizontally on the part of the plates which is intended to be the highest part of the plate when mounted on the vehicle.
5.2	The markings shall be applied on either the retro reflective or the fluorescent area of the plate, or on the edge, and must be visible from the outside when the marking plate is fitted on the vehicle.
5.3	The markings shall be clearly legible and shall be indelible.
<b>6.</b>	<b>Clause reserved</b>
<b>7.</b>	<b>GENERAL SPECIFICATIONS</b>
7.1	Retro-reflective/fluorescent or retro-reflective only marking plates 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.
7.2	The components of retro-reflective/fluorescent or retro reflective only marking plates shall not be capable of being easily dismantled.
7.3	The means of attachment of the rear marking plate must guarantee a stable and durable connection between the rear marking plate and the rear end of vehicles, for instance by screws, rivets or adhesives
7.4	The outer surface of the retro reflective/ fluorescent or retro-reflective only marking plate(s) shall be easy to clean. The surface shall therefore not be rough and any protuberances it may exhibit shall not prevent easy cleaning.
<b>8.</b>	<b>SPECIAL SPECIFICATIONS (TESTS)</b>
	Rear marking plate(s) shall also satisfy the conditions as to shape and stripe slope and the colorimetric, photometric, physical and mechanical requirements set forth in Annexes 3 to 10 to this standard.

<b>9.</b>	<b>MODIFICATIONS AND EXTENSION OF APPROVAL OF REAR MARKING PLATES FOR HEAVY AND LONG VEHICLES</b>
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, 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.
<b>10.</b>	<b>CONFORMITY OF PRODUCTION</b>  The conformity of production procedures shall comply with those set out in the AIS-037 with following requirements;
10.1	Rear marking plate 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 minimum requirements for conformity of production control procedures set forth in Annex 11 to this standard shall be complied with.
10.3	The minimum requirements for sampling by an inspector set forth in Annex 12 to this standard shall be complied with.
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.

<b>11.</b>	<b>PENALTIES FOR NON-CONFORMITY OF PRODUCTION</b>
	Penalties for non-conformity of production shall be as prescribed in AIS-037.
<b>12.</b>	<b>Clause reserved</b>
<b>13</b>	<b>TRANSITIONAL PROVISIONS ( TO BE REVISED)</b>
13.1	At the request of the applicant, type approvals for compliance to AIS-089 (Rev.1) ---2018 shall be granted by test agencies on and after the ---.(date of adoption of CMVR TSC) Such type approvals shall be deemed to be compliance to previous standard unless otherwise stated.
13.2	At the request of applicant, type approval for the compliance to AIS-089:2005, shall be granted up to the ----- (date of implementation) of AIS 089 (Rev.1) ---2018.
<b>14.</b>	<b>ESTABLISHING COMPLIANCE OF “E”/“e” APPROVED RETRO REFLECTING DEVICE TO THIS STANDARD</b>
14.1	As an exception to clause 7.4 of AIS-037, (or related administrative decisions) for certifying compliance of “E”/”e” approved retroreflective markings to this standard, the test for the following shall be carried out by testing agency:
14.2	Photometric requirements shall be as specified in Annex 5 of this standard.
14.3	Colorimetric requirements shall be specified in Annex 4 of this standard.
<b>15.</b>	<b>AMENDMENTS TO ECE REGULATIONS AFTER THE LEVEL DESCRIBED IN 1.0 OF INTRODUCTION</b>
<b>15.1</b>	<b>Supplements</b>
	<p>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.</p> <p>Note : Such changes will be considered for inclusion in this standard at the time of its next amendment /revision.</p>

<b>15.2</b>	<b>Series of amendments</b>
	<p>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 .</p> <p>However, Chairman, AISC may, on a case to case basis, permit to accept latest series of amendments.</p> <p>This shall be incorporated in the test report.</p>

<p align="center"><b>ANNEX 1</b>  (See cl. No. 3.3)</p> <p align="center"><b>THE CIE CO-ORDINATE SYSTEM</b></p>						
 <p align="center"><b>Figure 1</b></p>						
1	First Axis	I	Illumination Axis	$\alpha$	Observation angle	
2	Second Axis	O	Observation Axis	$\beta_1$ , $\beta_2$	Entrance angles	
		R	Reference Axis	$\epsilon$	Rotation angle	
<p>The CIE angular system for specifying and measuring retro-reflectors. 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.</p>						
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-reflectors and moveable with $\beta_1$ and $\beta_2$ .					



	<b>ANNEX 2</b>  <b>TEST PROCEDURE</b>
	<b>TEST SAMPLES</b>
1.	Two large chevron rear marking plates for trucks and tractors and two large rear marking plates for trailers and semi-trailers (or their equivalent in smaller plates) shall be supplied to the testing laboratory for the various tests to be conducted.
2.	The test samples shall be representative of current production, fabricated in accordance with the recommendations of the manufacturer(s) of the retro-reflective or retro-reflective / fluorescent materials or devices.
3.	After verification of the general specifications (paragraph 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 Annex 7 to this standard, prior to the tests described in Annexes 4, 5 and 6.
4.	The photometric and colorimetric measurements may be made on the same sample.
5.	For the other tests, samples which have not undergone any testing should be used.

<p style="text-align: center;"><b>ANNEX 3</b></p> <p style="text-align: center;"><b>SPECIFICATIONS OF SHAPE AND DIMENSIONS SHAPE AND DIMENSIONS OF RETRO- REFLECTIVE / FLUORESCENT REAR MARKING PLATE(S)</b></p>		
1	<b>Shape:</b>	The plates shall be rectangular in shape for mounting at the rear of vehicles.
2	<b>Pattern:</b>	<p>For mounting on trailers and semi-trailers, the plates shall have a yellow retro reflective background with a red fluorescent or retro-reflective border;</p> <p>For mounting on non-articulated vehicles (tractors or trucks), the plates shall be of the chevron type with alternate, oblique stripes of yellow retro-reflective and red fluorescent or retro-reflective materials or devices.</p> <p>For mounting of Class 5 devices on non-articulated vehicles, the retro reflective material shall be made with alternate, oblique stripes of white and red colour.</p>
3	<b>Dimensions:</b>	The minimum total summarized length of a set of rear marking plates consisting only of one, two or four marking plates with retro reflective and fluorescent materials shall be 1,130 mm, the maximum total length shall be 2,300 mm.
3.1		<p>The width of a rear marking plate shall be:</p> <p>For trucks and tractors: <math>140 \pm 10</math> mm.</p> <p>For trailers and semi-trailers: <math>200 +30/-5</math> mm</p>
3.1		The length of the each rear marking plates in a set consisting of two plates for trucks and tractors, as illustrated in figures 1(b) and 1(c) of Annex. 10 may be reduced to a minimum of 130 mm, provided that the width is increased such that the area of each marking is at least $735 \text{ cm}^2$ , does not exceed $1725 \text{ cm}^2$ and the marking plates are rectangular.
		Class 5 devices shall incorporate a minimum of 9 standard areas as described in paragraph 3.4. below on large vehicles with available mounting space, but may be reduced to a minimum of 4 standard areas on vehicles with limited mounting space."
3.3		The width of the red fluorescent border of the rear marking plates for trailers and semi-trailers shall be $40 \text{ mm} \pm 1 \text{ mm}$ .
3.4		<p>The slope of the oblique stripes of the chevron band shall be <math>45^\circ \pm 5^\circ</math>. The width of the stripes shall be <math>100 \text{ mm} \pm 2.5 \text{ mm}</math>.</p> <p>Prescribed shapes, patterns and dimensional features are illustrated in figures 1 and 2 of Annex 10 to this standard</p> <p>Class 5 retro-reflective materials shall consist of red and white diagonal</p>



	<p>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.</p> <p>Prescribed shapes, patterns and dimensional features of Class 5 devices are illustrated in Figure 3 of Annex 10 to this standard</p>
3.5	<p>Rear marking plates or Class 5 devices supplied in sets shall form matching pairs.</p>

<b>ANNEX 4</b>	
<b>COLORIMETRIC SPECIFICATIONS</b>	
<b>1.</b>	Rear marking plates for heavy vehicles and trailers shall be composed of yellow retro reflective and red retro-reflective or yellow retro-reflective and red fluorescent materials or devices.
<b>2.</b>	<b>Yellow, red or white retro-reflective material</b>
2.1	When measured with a spectrophotometer in accordance with the provisions of CIE document No. 15 (1971) and illuminated with the CIE Standard illuminant D65 at an angle of 45° to the normal and viewed along the normal (45/0 geometry), the colour of the material in new condition shall be within the limits as specified in AIS:010 (Part 5)(Rev. 2) as amended from time to time.
2.1.1.	Luminance factor for: <ul style="list-style-type: none"> <li>(a) Yellow colour shall be <math>\geq 0.16</math>.</li> <li>(b) Red colour shall be <math>\geq 0.03</math>.</li> <li>(c) White colour shall be <math>\geq 0.25</math></li> </ul>
2.1.2	When illuminated by the CIE Standard Illuminant A at an entrance angle $\beta_1 = \beta_2 = 0^\circ$ or, if this produces a colourless surface reflection, an angle $\beta_1 = \pm 5^\circ$ , $\beta_2 = 0^\circ$ , and measured at an observation angle of 20°, the colour of the material in new condition shall be within the limits as specified in AIS:010 (Part 5)(Rev. 2) as amended from time to time.
	Note: The question of the night-time colours of retro reflective materials is at present being studied by CIE/TC/1.6; the above limits are therefore only provisional and will be revised later after CIE TC 1.6 has completed its work.
<b>3.</b>	<b>Red fluorescent material</b>
3.1.	When measured with a spectrophotometer in accordance with the provisions of CIE document No. 15 (1971) and illuminated polychromatically with the CIE Standard Illuminant D65 at an angle 45° to the normal and viewed along the normal (geometry 45/0), the colour of the material in new condition shall be within the limits as specified in AIS:010 (Part 5)(Rev. 2) as amended from time to time.
3.1.1.	"Luminance factor for red colour shall be $\geq 0.30$
<b>4.</b>	<b>Compliance with the colorimetric specification shall be verified by a visual comparison test.</b>
	If any doubt remains after this test, conformity with the colorimetric specification shall be verified by determining the trichromatic co-ordinates of the most doubtful sample.

	<b>ANNEX 5</b>					
	<b>PHOTOMETRIC SPECIFICATIONS</b>					
1.	Photometric properties					
1.1	When illuminated with a CIE standard d Illuminant A and measured as recommended by CIE TC 2.3 (CIE Publication No. 54, 1982), the coefficient of retro reflection R' in candelas per lux per square metre of the yellow retro reflective area in new condition shall be at least as indicated in Table 1 or 2, according to the class. Devices of Class 1 and Class 2 shall fulfil the values in Table1, devices of Class 3 and Class 4 those in Table 2.					
	<b>Table 1</b>					
	<b>Coefficient of Retro-reflection R' (cd.m<sup>-2</sup>.lx<sup>-1</sup>)</b>					
	<b>Observation angle <math>\alpha</math> ( ' )</b>	<b>Entrance Angle <math>\beta</math> ( ° )</b>				
	20'	$\beta$ 1	0°	0°	0°	0°
		$\beta$ 2	5°	30°	40°	60°
	Coefficient R' (cd.m <sup>-2</sup> . lx <sup>-1</sup> )	Colour : yellow	300	180	75	10
	<b>Table 2</b>					
	<b>Coefficient of Retro-reflection R' (cd.m<sup>-2</sup>.lx<sup>-1</sup>)</b>					
	<b>Observation angle <math>\alpha</math> ( ' )</b>	<b>Entrance Angle <math>\beta</math> ( ° )</b>				
	20'	$\beta$ 1	0°	0°	0°	0°
		$\beta$ 2	5°	30°	40°	60°
	Coefficient R' (cd . m <sup>-2</sup> . lx <sup>-1</sup> )	Colour				
		Yellow	300	180	75	10
		Red	10	7	4	--

	When illuminated with a CIE Standard Illuminant A and measured as recommended by CIE TC 2.3 (CIE Publication No. 54, 1982), the coefficient of retro-reflection R' in candelas per square meter per lux of the yellow, white or red retro-reflective area in new condition shall be at least as indicated in Tables 1, 2 or 3, according to the Class. Devices of Class 1 and Class 2 shall fulfil the values in Table 1, devices of Class 3 and Class 4 those in table 2, devices of Class 5 those in Table 3.																												
	<div>Table 3</div> <div>Coefficient of retro-reflection R' [cd.m<sup>-2</sup>.lx<sup>-1</sup>]</div> <table><tr><th>Observation angle <math>\alpha</math> [°]</th><th colspan="5">Entrance angle <math>\beta</math> [°]</th></tr><tr><td rowspan="2">20'</td><td><math>\beta_1</math></td><td>0°</td><td>0°</td><td>0°</td><td>0°</td></tr><tr><td><math>\beta_2</math></td><td>5°</td><td>30°</td><td>40°</td><td>60°</td></tr><tr><td rowspan="2">Coefficient R' [cd.m<sup>-2</sup>.lx<sup>-1</sup>]</td><td>Colour: White</td><td>450</td><td>200</td><td>90</td><td>16</td></tr><tr><td>Red</td><td>120</td><td>30</td><td>10</td><td>2</td></tr></table>	Observation angle $\alpha$ [°]	Entrance angle $\beta$ [°]					20'	$\beta_1$	0°	0°	0°	0°	$\beta_2$	5°	30°	40°	60°	Coefficient R' [cd.m <sup>-2</sup> .lx <sup>-1</sup> ]	Colour: White	450	200	90	16	Red	120	30	10	2
Observation angle $\alpha$ [°]	Entrance angle $\beta$ [°]																												
20'	$\beta_1$	0°	0°	0°	0°																								
	$\beta_2$	5°	30°	40°	60°																								
Coefficient R' [cd.m <sup>-2</sup> .lx <sup>-1</sup> ]	Colour: White	450	200	90	16																								
	Red	120	30	10	2																								
1.2	The subtended angle at the sample shall not be larger than 80'.																												
1.3	<b>Luminance factor</b>																												
	The Luminance factor $\beta$ shall be at least as indicated in Table 4																												
	<div>"Table 4</div> <div>Luminance factor <math>\beta</math></div> <table><tr><th>Colour</th><th>Luminance factor <math>\beta</math></th></tr><tr><td>Red</td><td><math>\geq 0.03</math></td></tr><tr><td>Yellow</td><td><math>\geq 0.16</math></td></tr><tr><td>White</td><td><math>\geq 0.25</math></td></tr></table>	Colour	Luminance factor $\beta$	Red	$\geq 0.03$	Yellow	$\geq 0.16$	White	$\geq 0.25$																				
Colour	Luminance factor $\beta$																												
Red	$\geq 0.03$																												
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White	$\geq 0.25$																												

<p style="text-align: center;"><b>ANNEX 6</b></p> <p style="text-align: center;"><b>RESISTANCE TO EXTERNAL AGENTS</b></p>	
<b>1.</b>	<b>Resistance to weathering</b>
1.1	<p><b>Procedure</b> - For each test, two specimens of a sample unit (see paragraph 3.1.2 of this standard) are taken. One specimen shall be stored in a dark and dry container for subsequent use as "reference unexposed specimen".</p> <p>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 and the fluorescent material until blue standard No. 5 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.</p>
1.2	<p><b>Visual appearance</b> - No area of the exposed specimen shall show any evidence of cracking, scaling, pitting, blistering, delamination, distortion, chalking, staining or corrosion.</p> <p>There shall be no shrinkage in excess of 0.5 percent in any linear direction and no evidence of adhesion failure such as edge lifting from the substrate.</p>
1.3.	<b>Colour fastness</b> – The colours of the exposed specimen shall still meet the requirements specified in Annex 4."
1.4	Effect on the coefficient of retro reflection of the retro reflective material:
1.4.1	For this check, measurement shall be made only at an observation angle of 20' and an entrance angle of 5° 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 per cent of the value in Annex 5, Table 1.
<b>2.</b>	<b>Resistance to corrosion (ISO Standard 3768)</b>
2.1	<p>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.</p> <p>The saline mist shall be produced by atomizing at a temperature of 35° ± 2°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.</p>
2.2	Immediately after completion of the test, the sample shall show no sign of corrosion liable to impair the efficiency of the device.
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 5° and an observation angle of 20', shall be not less than the value in Annex 5, Table 1. Before measuring, the surface shall be cleaned to remove salt deposits from the saline mist.

<b>3.</b>	<b>Resistance to fuels</b>  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.
<b>4.</b>	<b>Bonding strength</b> (in the case of adhesive materials)
4.1.	The adhesion of retro-reflective materials shall be determined after 24 hours curing time by utilizing a 90-degree peel on a tensile strength testing Machine.
4.2	The adhesion of laminated or coated retro reflective and fluorescent materials shall be determined.
4.3	The coated materials, of whatever kind, shall not be removable without tools or without damaging the material.
4.4	The laminated materials (adhesive films) shall need a force of at least 10 N per 25 mm width, at a speed of 300 mm per minute, to be removed from the substrate.
<b>5.</b>	<b>Resistance to water</b>  A section of a sample unit not less than 300 mm long shall be immersed in distilled water at a temperature of $23^{\circ} \pm 5^{\circ} \text{C}$ for a period of 18 hours; it shall then be left to dry for 24 hours under normal laboratory conditions.  After completion of the test, the section shall be examined. No part inside 10 mm from the cut edge shall show evidence of deterioration which would reduce the effectiveness of the plate.
<b>6.</b>	<b>Resistance to impact</b> (except for plastics corner-cube reflectors)  When a 25 mm diameter solid steel ball is dropped from a height of 2 m onto the retro reflective and fluorescent surfaces of a supported plate, at an ambient temperature of $23^{\circ} \pm 2^{\circ} \text{C}$ , the material shall show no cracking or separation from the substrate at a distance of more than 5 mm from the impacted area.
<b>7.</b>	<b>Resistance to cleaning</b>
<b>7.1</b>	<b>Manual cleaning</b>
7.1.2	A test example smeared with a mixture of detergent lubricating oil and graphite shall be easily cleaned without damage to the retro reflective or fluorescent surfaces when wiped with a mild aliphatic solvent such as n-heptane, followed by washing with a neutral detergent.

<b>7.2.</b>	<b>Power washing</b>
7.2.1.	<p>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:</p> <ul style="list-style-type: none"><li>(a) Water/wash solution pressure <math>8 \pm 0.2</math> MPa;</li><li>(b) Water/wash solution temperature <math>60^{\circ} - 5^{\circ}\text{C}</math>;</li><li>(c) Water/wash solution flow rate <math>7 \pm 1</math> l/min;</li><li>(d) The tip of the cleaning wand to be positioned at distance of <math>600 \pm 20</math> mm away from the retro-reflective surface;</li><li>(e) Cleaning wand to be held at no greater angle than 45 degrees from perpendicular to the retro-reflective surface;</li><li>(f) 40 degree nozzle creating wide fan pattern.</li></ul>

	<b>ANNEX 7</b> <b>RESISTANCE TO HEAT</b>
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 $65^{\circ} \pm 2^{\circ}\text{C}$ , 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 $-20^{\circ} \pm 2^{\circ}\text{C}$ .
1.1	The sample shall be examined after a recovery time of 4 hours under normal laboratory conditions.
2.	After this test, no cracking or appreciable distortion of the surfaces, particularly of the optical units, shall be evident.

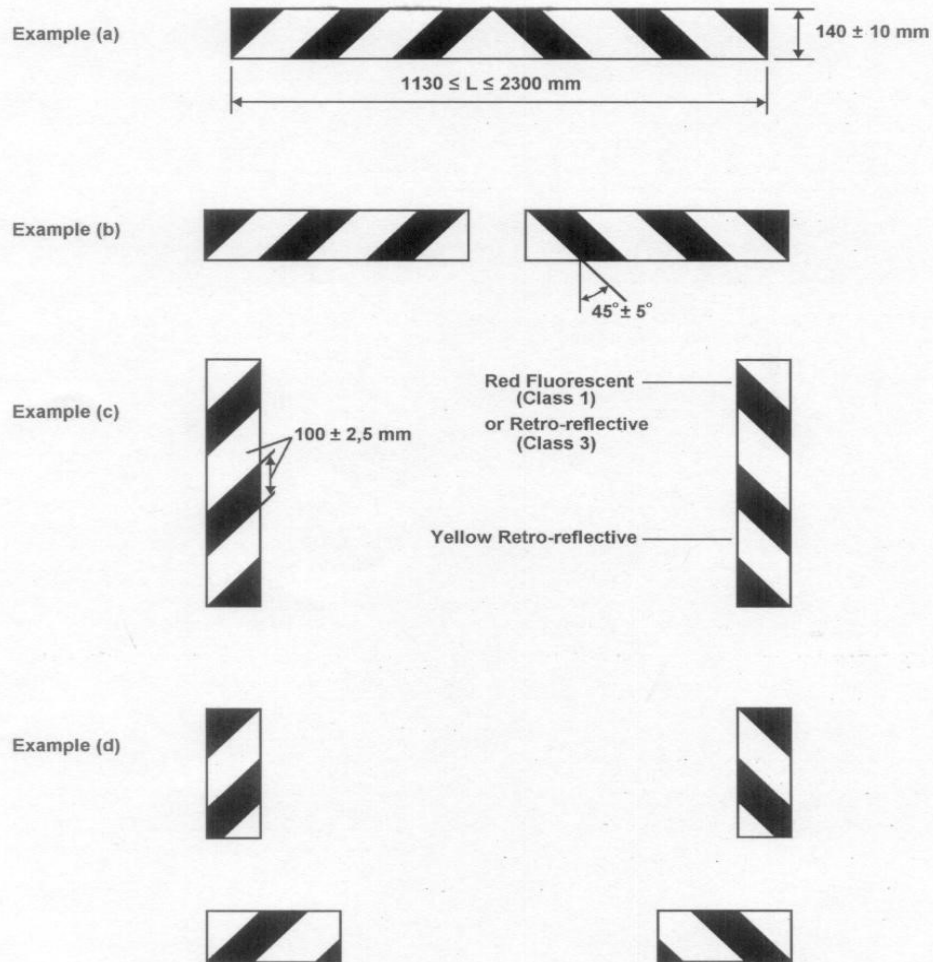


<b>ANNEX 8</b>	
<b>RIGIDITY OF THE PLATES</b>	
1.	The rear marking plate shall be placed on two supports in such a way that the supports are parallel to the shorter edge of the plate and the distance from either support to the adjacent edge of the plate shall not exceed $L/10$ , where $L$ is the greater overall dimension of the plate. The plate shall then be loaded with bags of shot or of dry sand to a uniformly distributed pressure of $1.5 \text{ kN/m}^2$ . The deflection of the plate shall be measured at a point midway between the supports.
2.	When tested as described in paragraph 1 above, the maximum deflection of the plate under the test load shall not exceed one twentieth of the distance between the supports in paragraph 1 and the residual deflection after removal of the load shall not exceed one fifth of the measured deflection under load.

**ANNEX 9**  
(Reserved)

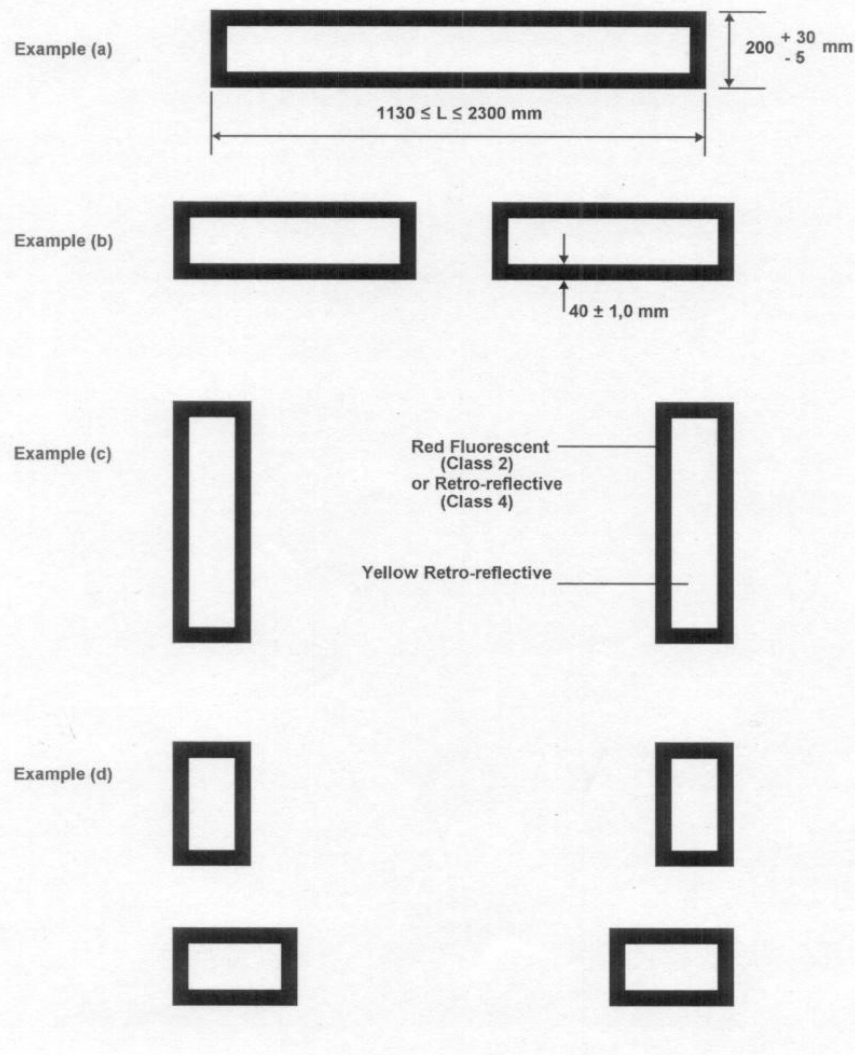
**ANNEX 10**  
( See Annex 3, cl. 3)

**REAR MARKING PLATES FOR TRUCKS AND TRACTORS**  
( Class1 and Class 3)



**Figure 1**

**REAR MARKING PLATES FOR TRAILERS AND SEMI-TRAILERS  
( Class 2 and Class 4)**



**Figure 2**

"Rear marking plates (Class 5)

Figure 3a

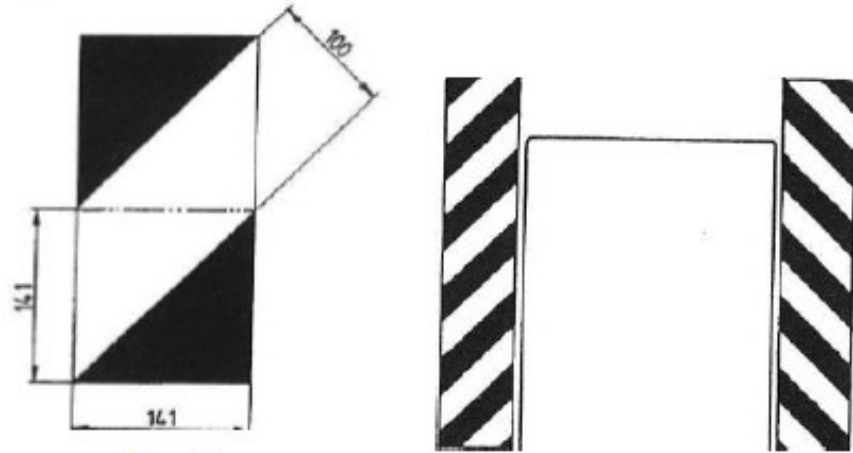
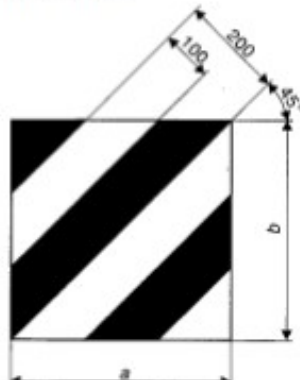


Figure 3b  
Example for a plate design



	<b>ANNEX 11</b>  <b>MINIMUM REQUIREMENTS FOR CONFORMITY OF PRODUCTION CONTROL PROCEDURES</b>
<b>1.</b>	<b>GENERAL</b>
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.
1.2.	With respect to photometric performances, the conformity of mass-produced rear marking plates shall not be contested if, when testing photometric performances of any rear marking plate chosen at random, no measured value deviates unfavourably by more than 20% from the values prescribed in this standard.
1.3.	The chromaticity coordinates shall be complied with.
<b>2.</b>	<b>MINIMUM REQUIREMENTS FOR VERIFICATION OF CONFORMITY BY THE MANUFACTURER</b>  For each type of rear marking plate the holder of the approval mark shall carry out at least at 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.
<b>2.1.</b>	<b>Nature of Tests</b>  Tests of conformity in this standard shall cover the photometric and colorimetric characteristics and the test of weather resistance of these characteristics.
<b>2.2.</b>	<b>Methods Used in Tests</b>
2.2.1.	Tests shall generally be carried out in accordance with the methods set out in this standard.
2.2.2.	In any test of conformity carried out by the manufacturer, equivalent methods may be used with the consent of the competent authority responsible for approval tests. The manufacturer is responsible for proving that the applied methods are equivalent to those laid down in this standard.

2.2.3.	The application of paragraphs 2.2.1. and 2.2.2. requires regular calibration of test apparatus and its correlation with measurements made by a competent authority.
2.2.4.	In all cases the reference methods shall be those of this standard, particularly for the purpose of administrative verification and sampling.
2.3.	<b>Nature of Sampling</b> Samples of rear marking plates shall be selected at random from the production of a uniform batch. A uniform batch means a set of rear marking plates 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.
2.4.	<b>Measured and Recorded Photometric Characteristics</b> The sampled rear marking plate shall be subjected to photometric measurements at the points and chromaticity coordinates provided for in the standard.
2.5.	<b>Criteria Governing Acceptability</b> The manufacturer is responsible for carrying out a statistical study of the test results and for defining, in agreement with the competent authority, criteria governing the acceptability of his products in order to meet the specifications laid down for verification of conformity of products in paragraph 10.1 of this standard.  The criteria governing the acceptability shall be such that, with a confidence level of 95%, the minimum probability of passing a spot check in accordance with Annex 12 (first sampling) would be 0.95.

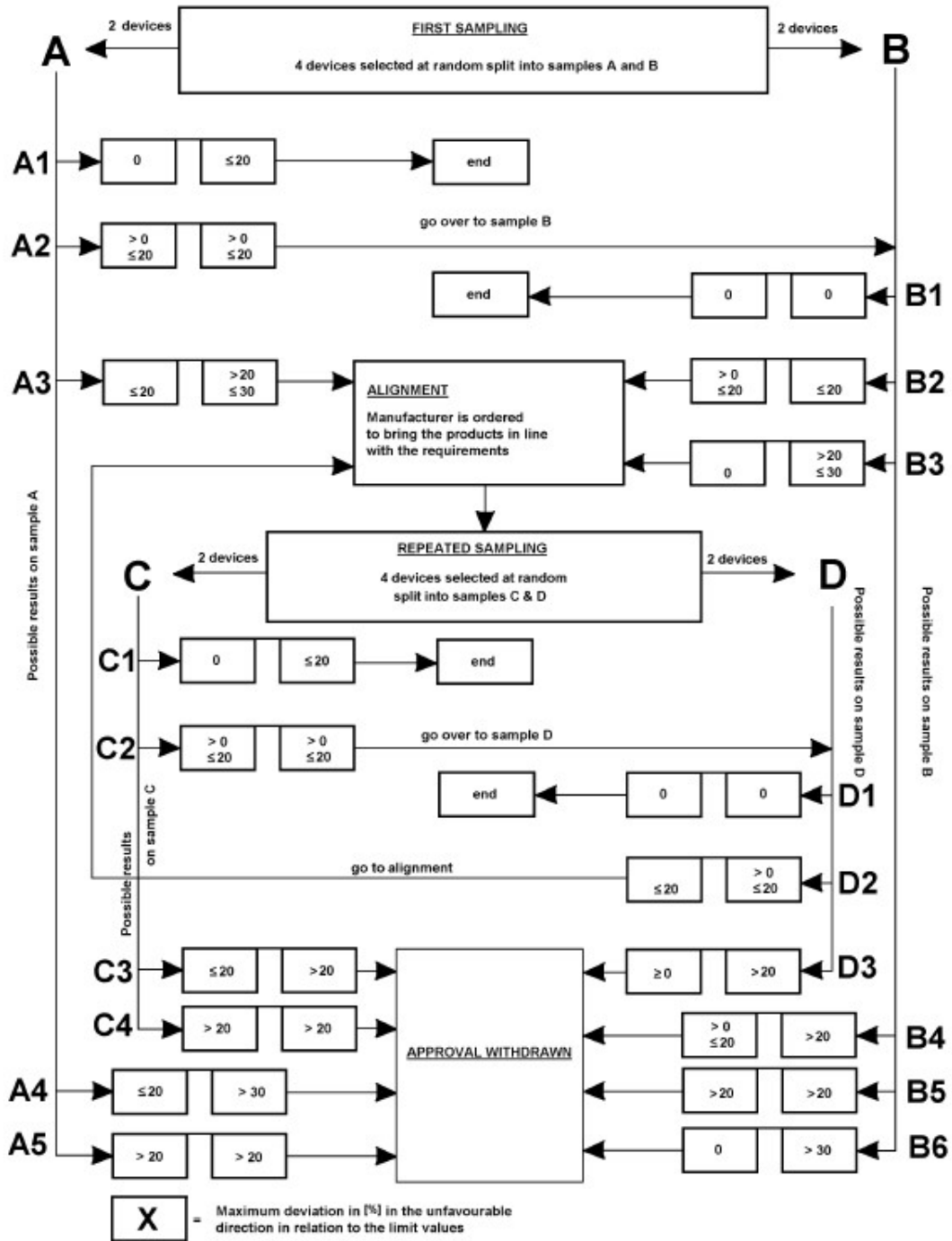
<b>ANNEX 12</b>			
<b>MINIMUM REQUIREMENTS FOR SAMPLING BY AN INSPECTOR</b>			
<b>1.</b>	<b>GENERAL</b>		
<b>1.1.</b>	The conformity requirements shall be considered satisfied from a mechanical and a geometric standpoint, in accordance with the requirements of this standard, if any, if the differences do not exceed inevitable manufacturing deviations.		
<b>1.2.</b>	With respect to photometric performance, the conformity of mass-produced rear marking plates shall not be contested if, when testing photometric performances of any rear marking plate chosen at random:		
1.2.1.	No measured value deviates unfavourably by more than 20% from the values prescribed in this standard.		
1.2.2.	Rear marking plates with apparent defects are disregarded.		
<b>1.3.</b>	The chromaticity coordinates shall be complied with.		
<b>2.</b>	<b>FIRST SAMPLING</b> In the first sampling four rear marking plates are selected at random. The first sample of two is marked A, the second sample of two is marked B.		
<b>2.1.</b>	<b>The Conformity is not Contested</b>		
2.1.1.	Following the sampling procedure shown in Figure 1 of this Annex the conformity of mass-produced rear marking plates shall not be contested if the deviation of the measured values of the rear marking plates in the unfavourable directions are:		
2.1.1.1.	Sample A		
	A1:	one rear marking plate	0%
		one rear marking plate not more than	20%
	A2:	both rear marking plates more than	0%
		but not more than	20%
		go to Sample B	
2.1.1.2.	Sample B		
	B1:	both rear marking plates	0%



<b>2.2</b>	<b>The Conformity is contested</b>		
2.2.1.	Following the sampling procedure shown in Figure 1 of this Annex the conformity of mass-produced rear marking plates shall be contested and the manufacturer requested to make his production meet the requirements (alignment) if the deviations of the measured values of the rear marking plates are:		
2.2.1.1	Sample A		
	A3:	one rear marking plate not more than	20%
		one rear marking plate more than	20%
		but not more than	30%
2.2.1.1.	Sample B		
	B2:	in the case of A2	
		one rear marking plate more than	0%
		but not more than	20%
		one rear marking plate not more than	20%
	B3:	in the case of A2	
		one rear marking plate	0%
		one rear marking plate more than	20%
		but not more than	30%
<b>2.3.</b>	<b>Approval Withdrawn</b> Conformity shall be contested and paragraph 10 applied if, following the sampling procedure in Figure 1 of this Annex, the deviations of the measured values of the rear marking plates are:		
2.3.1	Sample A		
	A4:	one rear marking plate not more than	20%
		one rear marking plate more than	30%
	A5:	both rear marking plates more than	0%
2.3.2	Sample B		
	B4:	in the case of A2	
		one rear marking plate more than	0%
		but not more than	20%
		one rear marking plate more than	20%
	B5:	in the case of A2	
		both rear marking plates more than	20%

	B6:	in the case of A2	
		one rear marking plate	0%
		one rear marking plate more than	30%
<b>3.</b>	<b>REPEATED SAMPLING</b> In the cases of A3, B2, B3 a repeated sampling, third Sample C of two rear marking plates and fourth Sample D of two rear marking plates, selected from stock manufactured after alignment, is necessary within two months time after the notification.		
<b>3.1.</b>	<b>The Conformity is not Contested</b>		
3.1.1.	Following the sampling procedure shown in Figure 1 of this Annex the conformity of mass-produced rear marking plates shall not be contested if the deviations of the measured values of the rear marking plates are:		
3.1.1.1	Sample C		
	C1:	one rear marking plate	0%
		one rear marking plate not more than	20%
	C2:	both rear marking plates more than	0%
		but not more than	20%
		go to Sample D	
3.1.1.2	Sample D		
	D1:	in the case of C2	
		both rear marking plates	0%
<b>3.2.</b>	<b>The Conformity is Contested</b>		
3.2.1.	Following the sampling procedure shown in Figure 1 of this Annex the conformity of mass-produced rear marking plates shall be contested and the manufacturer requested to make his production meet the requirements (alignment) if the deviations of the measured values of the rear marking plates are:		
3.2.1.1	Sample D		
	D2:	in the case of C2	
		one rear marking plate more than	0%
		but not more than	20%
		one rear marking plate not more than	20%

<b>3.3.</b>	<b>Approval Withdrawn</b> Conformity shall be contested and paragraph 10 applied if, following the sampling procedure in Figure 1 of this Annex, the deviations of the measured values of the rear marking plates are:		
3.3.1	Sample C		
	C3:	one rear marking plate not more than	20%
		one rear marking plate more than	20%
	C4:	both rear marking plates more than	20%
3.3.2.	Sample D		
	D3:	in the case of C2	
		one rear marking plate 0 or more than	0%
		one rear marking plate more than	20%
<b>4.</b>	<b>RESISTANCE TESTS</b>		
	<p>Specimens of one of the rear marking plates of Sample A, after sampling procedure in Figure 1 of this Annex, shall be tested according to the procedures described in Annexes 6 and 7 to this standard. The rear marking plate shall be considered acceptable if the tests were passed.</p> <p>However, if the tests on specimens of Sample A did not pass the tests, the two rear marking plates of Sample B shall be subjected to the same procedure and both shall pass the test.</p>		



**Figure 1**

**ANNEX 13**  
**PANEL COMPOSITION\***  
**(To be included)**

**ANNEX 14**  
(See Introduction)  
**COMMITTEE COMPOSITION\***  
**Automotive Industry Standards Committee**

<b>Chairperson</b>	
Mrs. Rashmi Urdhwareshe	Director The Automotive Research Association of India, Pune
<b>Members</b>	<b>Representing</b>
Shri Priyank Bharti	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 T. R. Kesavan	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)