AIS-090

Automotive Industry Standard

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

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ON BEHALF OF
AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

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

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

Sr. No.	Corr-igenda	Amend-ment	Revision	Date	Remark	Misc.

General remarks:

INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the 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.

While preparing this AIS considerable assistance is derived from:

1. ECE regulation 104 Amendment 1 (Supp.1 to Original version of the regulation- Date of entry into force Jan. 13, 2000) Uniform provisions concerning the Approval of Retro-Reflective Markings for Heavy and Long Vehicles and their trailer.

2. ECE R 48 (Rev 4, Amd. 1 -03 Series of amendments, Date of Entry into Force Oct. 10, 2006) (Cl. 2.7.17,5.15, 6.21, Annex: 11)
   Uniform provisions concerning the Approval of Vehicles with regard to the Installation of Lighting and Light-Signalling Devices

   - Contents of the standard does not have any deviation from ECE R 104, regarding the performance requirements. Appropriate changes have been incorporated to adapt to AIS format as well as Indian procedures.
   - ECE R 104 is a guideline regulation in Europe.
   - In order to achieve maximum benefits of conspicuity, as regards to cospicuity marking mounting requirements, this draft is aligned with ECE R 48 (Rev 4, Amd. 1 -03 Series of amendments, Date of Entry into Force Oct. 10, 2006) (Cl. 6.21) and included in Annex 7 of this standard.
   - The clause No. 7.4 of Annex 7 of this standard shall be effective as and when AIS-089: Approval of Rear Marking Plates for Heavy and Long Vehicles is implemented.

The Automotive Industry Standards Committee responsible for preparation of this standard is given in Annex: 9

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

CONTENTS

ANNEXES

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

1. SCOPE

These provisions apply to the approval of retro-reflective markings used to increase the visibility and recognition for heavy and long vehicles, 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 chassis-cabs, incomplete vehicles such as drive-away-chassis and tractors for semi-trailers.)

1.2 Category T3 and T4 - Trailers and semi-trailers

1.3 Prohibited on vehicles of categories M1 and T1

2. REFERENCES

2. 1 The definitions of technical terms are those adopted by the International Commission on Illumination (CIE) - see Technical Report on Retro reflection, CIE Publication No. 54.

2.2 IS 14272 (Part-1) : Automotive Vehicles-Types - Terminology - Part 1 Three and Four Wheelers

3. DEFINITIONS

3.1 For the purpose of these provisions, the following definitions shall apply:

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

3.1.2 **"Conspicuity marking"** means a device intended to increase the conspicuity of a vehicle, when viewed from the side or rear, by the reflection of light emanating from a light source not connected to the vehicle, the observer being situated near the source;

3.1.3 **"Contour marking"** means a conspicuity marking intended to indicate the horizontal and vertical dimensions (length, width and height) of a vehicle;

3.1.4 **"Full contour marking"** means a contour marking that indicates the outline of the vehicle by a continuous line;

3.1.5 **"Partial contour marking"** means a contour marking that indicates the horizontal dimension of the vehicle by a continuous line, and the vertical dimension by marking the upper corners.

3.1.6 **"Line marking"** means a conspicuity marking intended to indicate the horizontal dimensions (length and width) of a vehicle by a continuous line."

3.1.3 **"Distinctive markings, Graphics"** mean additional coloured markings intended to be placed within the contour marking, whose coefficient of retro-reflection is essentially lower than the coefficient of retro-reflective materials as defined in paragraphs 3.1.1. and 3.1.2.

3.1.4 **"Sample unit"** means part or all of the retro-reflective material intended 12to be used to achieve the markings defined in paragraphs 3.1.1., 3.1.2. and 3.1.3.

3.2.1.1 **"Retro-reflection"** 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 **"Retro-reflective marking material"** means a surface or a device from which, when directionally illuminated, a relatively large portion of the incident radiation is retro-reflected.

3.3 Geometric definitions (see annex 1, figure 1)

3.3.1 **"Reference centre"** means a point on or near a retro-reflective area which is designated to be the centre of the device for the purpose of specifying its performance;

3.3.2 **"Illumination axis (symbol I)"** means a line segment from the reference centre to the light source.

3.3.3 **"Observation axis (symbol O)"** means a line segment from the reference centre to the photometer head;

3.3.4 **"Observation angle (symbol α)"** means the angle between the illumination axis and the observation axis. The observation angle is always positive and, in the case of retro-reflection, is restricted to small angles;

3.3.5 **"Observation on half-plane"** means the half-plane which originates on the illumination axis and which contains the observation axis;

3.3.6 **“Reference axis (symbol R)”** means a designated line segment originating on the reference centre which is used to describe the angular position of the retro-reflective device;

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

3.3.8 **"Rotation angle (symbol ε)"** means the angle indicating the orientation of the retro-reflecting material by an appropriate symbol with respect to rotation about the reference axis;

3.3.9 **"First axis (symbol 1)"** means an axis through the reference centre and perpendicular to the observation half-plane;

3.3.10 **"First component of the entrance angle (symbol β_1)"** means the angle from the illumination axis to the plane containing the reference axis and the first axis; range: $-180° < \beta_1 < 180°$;

3.3.11 **"Second component of the entrance angle (symbol β_2)"** means the angle from the plane containing the observation half-plane to the reference axis; range $-90° < \beta_2 < 90°$;

3.3.12 **"Second axis (symbol 2)"** means an axis through the reference centre and perpendicular to both the first axis and the reference axis. The positive direction of the second axis lies in the observation half-plane when $-90° < \beta_2 < 90°$ as shown in annex 1, figure 1.

3.4. Definition of photometric terms

3.4.1 **"Coefficient of retro-reflection R' "** coefficient (R') obtained from the luminous intensity (I) of the retro-reflective area in the direction of observation and the illuminance ($E_\perp$) on the retro-reflective plane at right angles the direction of the incident light and the illuminated plane sample surface A,

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

The coefficient is of retro-reflective R' is expressed in candle per square meter per lux ($cd.m^2. lx^{-1}$).

3.4.2 **"Angular diameter of the retro-reflector sample (symbol η_1)"** means the angle subtended by the greatest dimension of the retro-reflective sample, either at the centre of the source of illumination or at the centre of the receiver ($ß_1=ß_2=0°$);

3.4.3 **"Angular diameter of the receiver (symbol η2)"** means the angle subtended by the greatest dimension of the receiver as seen from the reference centre ($\beta1 = \beta2 = 0°$);

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

3.5 Description of Goniometer

A goniometer which can be used in making retro-reflection measurements in the CIE geometry is illustrated in annex 1, figure 2. In this illustration, the photometer head (O) is arbitrarily shown to be vertically above the source (I). The first axis is shown to be fixed and horizontal and is situated perpendicular to the observation half-plane. Any arrangement of the components which is equivalent to the one shown can be used.

3.6 Definition of "type"

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

3.6.1 The trade name or trade mark;

3.6.2 The characteristics of the retro-reflective material;

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

4. TECHNICAL INFORMATION TO BE SUBMITTED BY THE MANUFACTURER

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

5. MARKINGS

5.1 Every marking material submitted for approval shall bear:

5.1.1 The trade name or trade mark of the applicant;

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

5.1.3 The following symbols indicating the class of material:

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

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

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

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

5.1.3.5 "D/E" for materials for distinctive markings or graphics as base or background in printing process for fully coloured logos and markings of class " E" in use which fulfil the requirements of class "D" materials.

5.2 The markings specified in 5.1.2 and 5.1.3 shall be positioned at least:
at 0.5 m intervals on strips,
on areas within 100 x 100 mm^2.

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

6. CLAUSE RESERVED

7. GENERAL SPECIFICATIONS

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

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

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

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

8. SPECIAL SPECIFICATIONS

8.1 Retro-reflective marking materials shall also satisfy the conditions as to shape and dimensions, and the colorimetric, photometric, physical and mechanical requirements set forth in annexes 3 to 6 to this standard.

8.2 Advertising, consisting of retro-reflective logos, distinctive markings or letters/characters has to be decent.
It may be consists of marking materials of class “D” if the total retro-reflective area is less than 2 m^2 ; if the total retro reflective area is at least 2 m^2 class “E” shall be used.

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

8.2.2 For class "E" marking materials the maximum values of the coefficient of retro-reflection are less or equal to 33 per cent of the values defined in annex 5, table 2.

8.2.3 White retro-reflective marking material intended as base or background in printing processes for fully coloured logos and markings of class “E” in use without unprinted blank areas, may fulfil the requirements in Annex 5, table 2 for class “D” materials and must be marked as class “D/E”.

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

8.4 Conspicuity marking & mounting requirements shall be as per Annex 7.

9. MODIFICATIONS AND EXTENSION OF APPROVAL FOR RETRO-REFLECTIVE MARKING MATERIALS

9.1 Every modification pertaining to the information, even if the changes are non-technical in nature declared in accordance to para 4 above, shall be intimated to the test agency by the manufacturer.

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

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

9.3.1 The type or model with the changed specification still complies with the provisions, or

9.3.2 Any further verification is required to establish compliance

9.4 For deciding whether testing is required or not : - till details are finalized, this will be as agreed between the test agency and the manufacturer.

9.5 In case of 9.3.2, only tests pertaining to the affected specification shall be performed.

9.6 In case of fulfillment of criterion as per 9.3, the approval of compliance shall be extended for the changes carried out.

10. CONFORMITY OF PRODUCTION

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

10.1 Retro-reflective marking material approved to this standard shall be so manufactured as to conform to the type approved by meeting the requirements set forth in paragraphs 7 and 8 above.

10.2 The conformity of production shall not be contested, if the mean value of photometric measurements of five specimens taken at random deviates unfavourably by not more than 20% from the prescribed values given in Annex:5 of this standard with.

10.3 The conformity of production shall not be contested, if the mean value of colorimetric properties of five specimens taken at random meets the specifications of Annex:4 of this standard, to be judged by visual inspection

10.4 The test agency may at any time verify the conformity control methods applied in each production facility as detailed in AIS-037. The normal frequency of these verification shall be as per AIS-037 or as decided by CMVR-TSC.

11. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

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

Annex 1
(See 3.3)

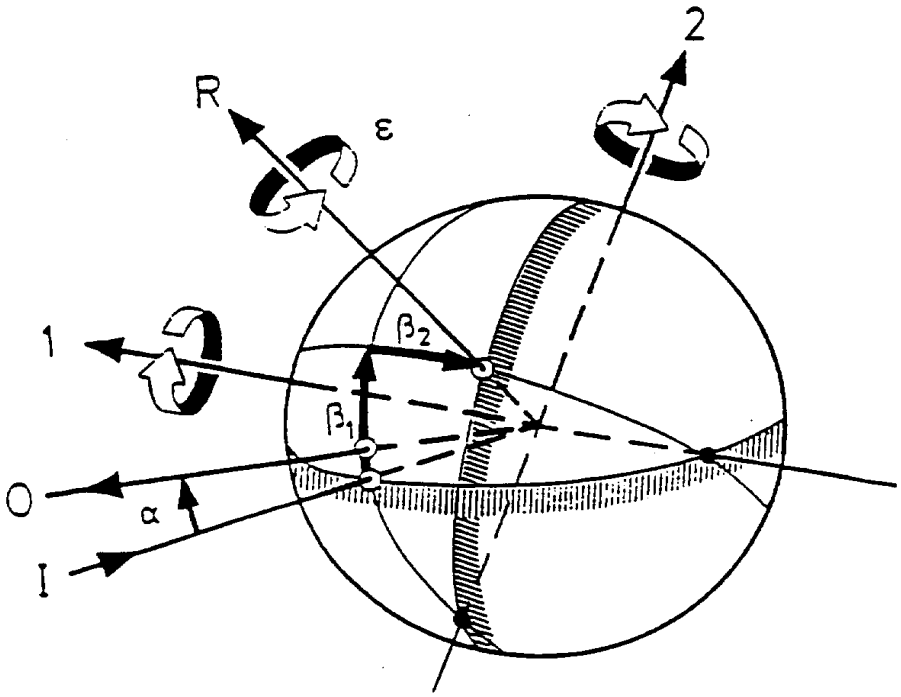


Figure 1

THE CIE CO-ORDINATE SYSTEM

1: First Axis	I: Illumination Axis	α: Observation angle
2: Second Axis	O: Observation Axis	$ß_1$, $ß_2$: Entrance angles
	R: Reference Axis	ε: Rotation angle

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

Notes: (a) The principle fixed axis is the illumination axis.
(b) The first axis is fixed perpendicular to the plane containing the observation and illumination axis.
(c) The reference axis is fixed in the retro-reflective material and moveable with $ß_1$ and $ß_2$.

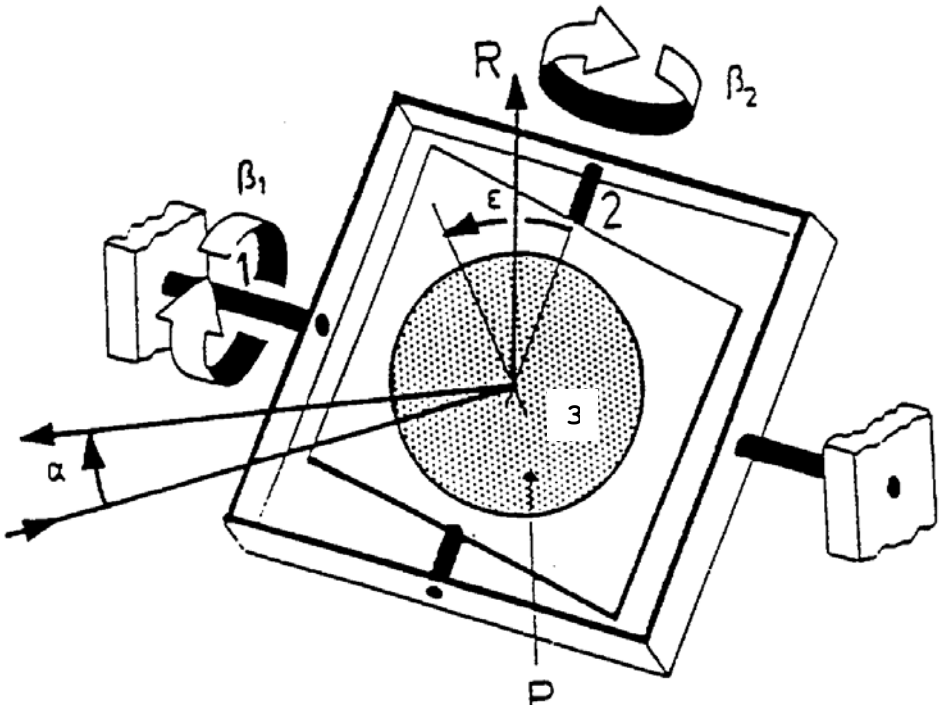


Figure 2

GONIOMETER MECHANISM EMBODYING THE CIE ANGULAR SYSTEM

1: First Axis	I: Illumination Axis	α: Observation angle
2: Second Axis	O: Observation Axis	$ß_1$, $ß_2$: Entrance angles
3: Reference Centre	R: Reference Axis	ε: Rotation angle
	P: Retro-reflective material	

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

Annex 2
(See 4.10)

TEST PROCEDURE

TEST SAMPLES

1. Five test samples representing either strips or planes of retro-reflective marking materials have to be submitted to the test laboratory. In the case of strips, at least a length of 3 meters shall be provided; in the case of planes, at least a surface of 500 x 500 mm^2 shall be provided.

2. The test samples shall be representative of current production, manufactured in accordance with the recommendation of the manufacturer(s) of the retro-reflective marking materials. [(1)]

3. After verification of the general specifications (clause 7 of the Standard) and the specifications of shape and dimensions (annex 3), the samples shall be subjected to the heat resistance test described in clause 4 of annex 6 to this Standard, prior to the tests described in annexes 4 and 5.

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

5. For other tests, samples which have not undergone any testing should be used.

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

Annex 3

(See 8.1)

SPECIFICATION OF MARKING DIMENSIONS

1. SIDE AND REAR MARKING WITH STRIPS

1.1. General

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

1.2. Dimensions

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

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

Annex 4
(See 8.1)

COLORIMETRIC SPECIFICATIONS

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

2. 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 located within the area defined by the chromaticity coordinates in Table 1 and comply with the luminance factor ß.

TABLE 1

Chromaticity Co-ordinates						
Colour		**1**	**2**	**3**	**4**	**Luminance factor ß**
Yellow	x	0.545	0.487	0.427	0.465	≥ 0.16
	y	0.454	0.423	0.483	0.534	
White	x	0.300	0.385	0.345	0.260	≥ 0.25
	y	0.270	0.355	0.395	0.310	
Red	x	0.690	0.595	0.560	0.650	≥ 0.03
	y	0.310	0.315	0.350	0.350	

3. When illuminated by the CIE Standard illuminant A at entrance angle $ß_1 = ß_2 = 0°$ or, if this produces a colourless surface reflection, angle $ß_1 = 0°$ $ß_2 = + 5°$ and measured at an observation angle of $\alpha = 20'$, the colour of the material in new condition shall be located within the area defined by the chromaticity coordinates in Table 2.

TABLE 2

Chromaticity Co-ordinates					
Colour		**1**	**2**	**3**	**4**
Yellow	x	0.585	0.610	0.520	0.505
	y	0.385	0.390	0.480	0.465
White	x	0.373	0.417	0.450	0.548
	y	0.402	0.359	0.513	0.414
Red	x	0.720	0.735	0.665	0.643
	y	0.258	0.265	0.335	0.335

Note: As the question of the night-time colours of retro-reflective marking materials is at present being studied by CIE TC 2.19, the above limits are therefore only provisional and will be revised later after CIE TC 2.19 has completed its work.

Annex 5
(See 8.1)

PHOTOMETRIC SPECIFICATIONS

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

1.1 Minimum values for the coefficient of Retro-reflection Photometric specifications for retro-reflective markings of Class C:

TABLE 1

Minimum values for the Coefficient of Retro-reflection R' ($cd.m^{-2}.lx^{-1}$)					
Observation angle α (°)	**Entrance Angle ß (°)**				
α = 0.33° (20´)	ß1	0	0	0	0
	ß2	5	30	40	60
Colour					
yellow		300	130	75	10
white		450	200	90	16

1.2 Maximum values for the coefficient of retro-reflection Photometric specifications for distinctive markings or graphics of class D:

TABLE 2

Maximum values for the Coefficient of Retro-reflection R' ($cd.m^{-2}.lx^{-1}$)					
Observation angle α (°)	**Entrance Angle ß (°)**				
α = 0.33° (20′)	ß1	0	0	0	0
	ß2	5	20	30	40
Colour red		120	60	30	10

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

Annex 6

(See 8.1)

RESISTANCE TO EXTERNAL AGENTS

1. Resistance to weathering

1.1 Procedure - For each test, two specimens of a sample unit (see paragraph 3.1.4. of this Standard) are taken. One specimen shall be stored in a dark and dry container for subsequent use as "reference unexposed specimen".

The second specimen shall be subjected to a source of illumination in accordance with ISO Standard 105 - B02 - 1978, Section 4.3.1; the retro-reflective material shall be exposed until blue standard No. 7 has faded to No. 4 on the grey scale. After the test, the specimen shall be washed in a dilute neutral detergent solution, dried and examined for conformity with the requirements specified in paragraphs 1.2. to 1.4.

1.2 Visual appearance

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

1.3 Colour fastness

The colour of the exposed specimen shall still meet the requirements in annex 4, tables 1 and 2.

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

1.4.1 For this check, measurements shall be made only at an observation angle of $\alpha = 20'$ and an entrance angle of $ß_2 = 5°$ 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 % of the value in annex 5, tables 1 and 2.

2. Resistance to corrosion

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

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

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

2.2.1 The coefficient of retro-reflection R' of the retro-reflective areas, when measured after a recovery period of 48 hours as specified in paragraph 1 of annex 5, at an entrance angle of $ß_2 = 5°$ and an observation angle of $\alpha = 20'$, shall be not less than the value in annex 5, table 1 or more than the value in table 2 respectively. Before measuring, the surface shall be cleaned to remove salt deposits from the saline mist.

3. Resistance to fuels

A section of a sample unit not less than 300 mm long shall be immersed in a mixture of n-heptane and toluol, 70 per cent and 30 per cent by volume, for one minute.
After removal, the surface shall be wiped dry with a soft cloth and shall not show any visible change which would reduce its effective performance.

4. Resistance to heat

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

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

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

5. Resistance to cleaning

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

6. Clause reserved

7. Resistance to penetration of water

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

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

7.3 If visual inspection does not reveal the presence of water or in case of doubt, the coefficient of retro-reflection R' shall be measured in conformity with annex 5, the sample unit being first lightly shaken to remove excess water from the outside.

Annex 7

(See 8.4)

CONSPICUITY MARKING & MOUNTING REQUIREMENTS

0. COLOUR OF CONSPICUITY MARKINGS

0.1 Yellow to the Side

0.2 Red to the Rear

1. PRESENCE

1.1 Prohibited: on vehicles of categories M1 and T1.

1.2. Mandatory:

1.2.1 to the rear:

full contour marking on vehicles exceeding 2,100 mm in width of the following categories:

a) N2 with a maximum mass exceeding 7.5 tonnes and N3 (with the exception of chassis-cabs, incomplete vehicles such as drive- away-chassis and tractors for semi-trailers.

b) T3 and T4 - Trailers and semi-trailers

1.2.2 to the side:

1.2.2.1 partial contour marking on vehicles exceeding 6,000 mm in length (including the drawbar for trailers) of the following categories:

a) N2 with a maximum mass exceeding 7.5 tonnes and N3 (with the exception of chassis-cabs, incomplete vehicles such as drive-away-chassis and tractors for semi-trailers.

b) T3 and T4 - Trailers and semi-trailers

1.2.3 However, where the shape, structure, design or operational requirements make it impossible to install the mandatory contour marking, a line marking may be installed.

1.3 Optional

1.3.1 on all other categories of vehicles, not otherwise specified in paragraphs 1.1. and 1.2. above, including the cab of tractor units for semi-trailers and the cab of chassis-cabs.

1.3.2 partial or full contour marking may be applied instead of mandatory line markings, and full contour marking may be applied instead of mandatory partial contour marking.

2. NUMBER: According to the presence.

3. ARRANGEMENT

The conspicuity markings shall be as close as practicable to horizontal or vertical, compatible with the shape, structure, design and operational requirements of the vehicle.

4. POSITION

4.1 Width

4.1.1 The conspicuity marking shall be as close as practicable to the edge of the vehicle.

4.1.2 The cumulative horizontal length of the conspicuity marking elements, as mounted on the vehicle, shall equate to at least 80 per cent of the overall width of the vehicle, excluding any horizontal overlap of individual elements.

4.1.3 However, if the manufacture**r** can prove to the satisfaction of the test agency responsible for type approval that it is impossible to achieve the value referred to in paragraph 4.1.2. above, the cumulative length may be reduced to 60 per cent and shall be indicated in the communication document and test report

4.2 Length

4.2.1 The conspicuity marking shall be as close as practicable to the ends of the vehicle and reach to within 600 mm of each end of the vehicle (or cab in the case of tractor units for semi-trailers).

4.2.1.1 for motor vehicles, each end of the vehicle, or in the case of tractors for semi-trailers the each end of the cab;

4.2.1.2 for trailers, each end of the vehicle (excluding the drawbar).

4.2.2 The cumulative horizontal length of the conspicuity marking elements, as mounted on the vehicle, excluding any horizontal overlap of individual elements, shall equate to at least 80 per cent of:

a. for motor vehicles, the length of the vehicle excluding the cab, or in the case of tractors for semi-trailers, if fitted, the length of the cab;
b. for trailers, the length of the vehicle (excluding the drawbar).

4.2.3 However, if the manufacture**r** can prove to the satisfaction of the test agency responsible for type approval that it is impossible to achieve the value referred to in paragraph 4.2.2. above, the cumulative length may be reduced to 60 percent and shall be indicated in the communication document and test report.

4.3 Height

4.3.1 Line markings and contour markings lower element(s):

As low as practicable within the range:

Minimum: not less than 250 mm above the ground.
Maximum: not more than 1,500 mm above the ground.

However, a maximum mounting height of 2,100 mm may be accepted where technical conditions prevent compliance with the maximum value of 1,500 mm or, if necessary, to fulfill the requirements of paragraphs 4.1.2., 4.1.3., 4.2.2. and 4.2.3., or the horizontal positioning of the line marking or the lower element(s) of the contour marking.

4.3.2 Contour markings upper element(s):
As high as practicable, but within 400 mm of the upper extremity of the vehicle.

5. VISIBILITY

The conspicuity marking shall be considered visible, if at least 80 per cent of the illuminating surface of the marking is visible when viewed by an observer positioned at any point within the observation planes defined below:

5.1 for rear conspicuity markings (see Annex 8, Figure 1) the observation plane is perpendicular to the longitudinal axis of the vehicle situated 25 m from the extreme end of the vehicle and bounded by:

5.1.1 in height, by two horizontal planes 1 m and 3.0 m respectively above the ground,

5.1.2 in width, by two vertical planes which form an angle of 15° outwards from the vehicle's median longitudinal plane and which pass through the intersection of the vertical planes parallel to the vehicle's median longitudinal plane delimiting the vehicle's overall width, and the plane perpendicular to the longitudinal axis of the vehicle that delimits the end of the vehicle.

5.2 for side conspicuity markings (see Annex 8, figure 2) the observation plane is parallel to the longitudinal median plane of the vehicles situated 25 m from the extreme outer edge of the vehicle and bounded by:

5.2.1 in height, by two horizontal planes 1 m and 3.0 m respectively above the ground,

5.2.2 in width, by two vertical planes which form an angle of 15° outwards from a plane perpendicular to the vehicle's longitudinal axis and which pass through the intersection of the vertical planes perpendicular to the vehicle's longitudinal axis delimiting the vehicle's overall length and the extreme outer edge of the vehicle.

6. ORIENTATION

6.1 To the side:
As close as practicable to being parallel to the median longitudinal plane of the vehicle, compatible with the shape, structure, design and operation requirements of the vehicle.

6.2 To the rear:
As close as practicable to being parallel to the transverse plane of the vehicle, compatible with the shape, structure, design and operation requirements of the vehicle.

7. OTHER REQUIREMENTS

7.1 Conspicuity markings shall be considered continuous if the distance between adjacent elements are as small as possible and do not exceed 50 per cent of the shortest adjacent element length.

7.2 In the case of a partial contour marking, each upper corner shall be described by two lines at 90° to each other and each at least 250 mm in length.

7.3 The distance between the conspicuity marking fitted to the rear of a vehicle and each mandatory stop lamp shall be greater than 200 mm.

7.4 Where rear marking plates conforming to AIS-089 are installed these may be considered, at the discretion of the manufacturer, as part of the conspicuity marking to the rear, for the purposes of calculating the length of the conspicuity marking and its proximity to the side of the vehicle.

7.5 The locations on the vehicle designated for conspicuity markings shall allow for the installation of markings of at least 60 mm in width.

8.0 GUIDELINES FOR THE DISTINCTIVE MARKINGS AND GRAPHICS (ADVERTISING)

8.1 Retro-reflective distinctive markings and/or graphics shall only be placed within the contour marking on the side of a vehicle, provided they do not impair the effectiveness of the contour marking and the mandatory lighting and light-signalling devices. Compared to the–contour marking, the distinctive markings and/or graphics shall be decent as specified in paragraph 8.2 below.

8.2 The condition of "decent" is fulfilled if:

8.2.1 The number of the letters/characters is less than 15;

8.2.2 The height of the letters/characters is between 300 mm and 1,000 mm;

8.2.3 The whole retro-reflective area is not larger than 2.0 m^2;

8.2.4 No long conceptions as e.g. addresses and phone numbers are used.

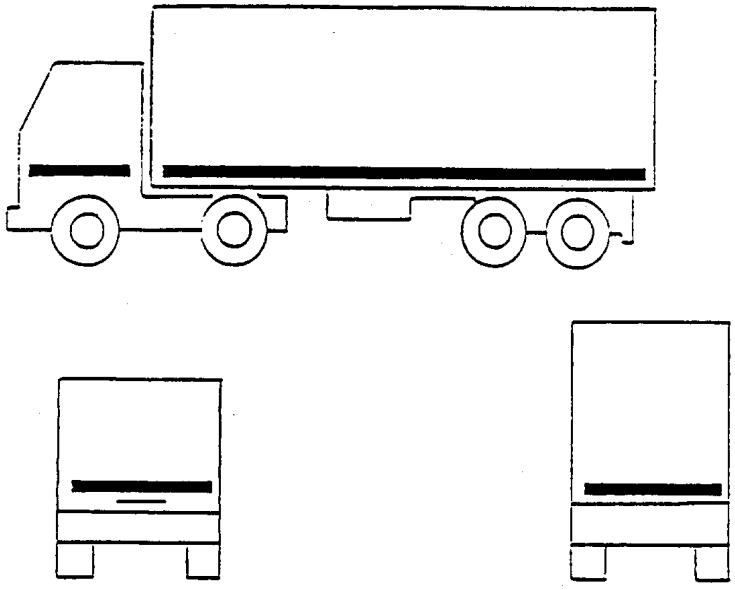
9. EXAMPLES OF RETRO-REFLECTIVE MARKINGS

Examples of retro-reflective markings are shown in Appendices 1 and 2.

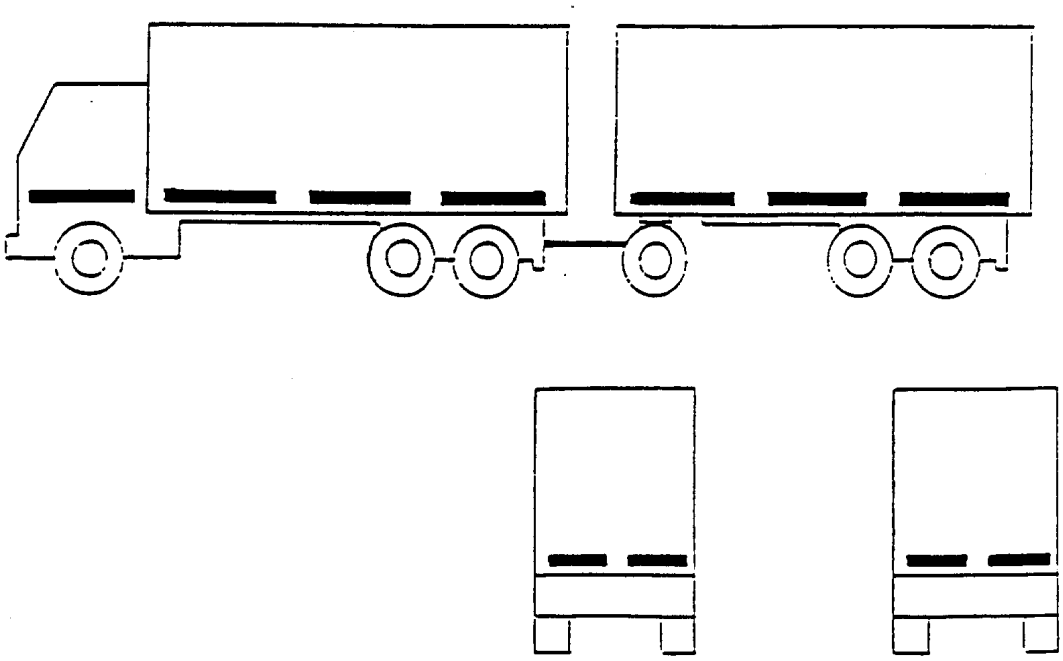
Annex 7 - Appendix 1

EXAMPLES OF RETRO-REFLECTIVE MARKINGS WITH STRIPS

Example A



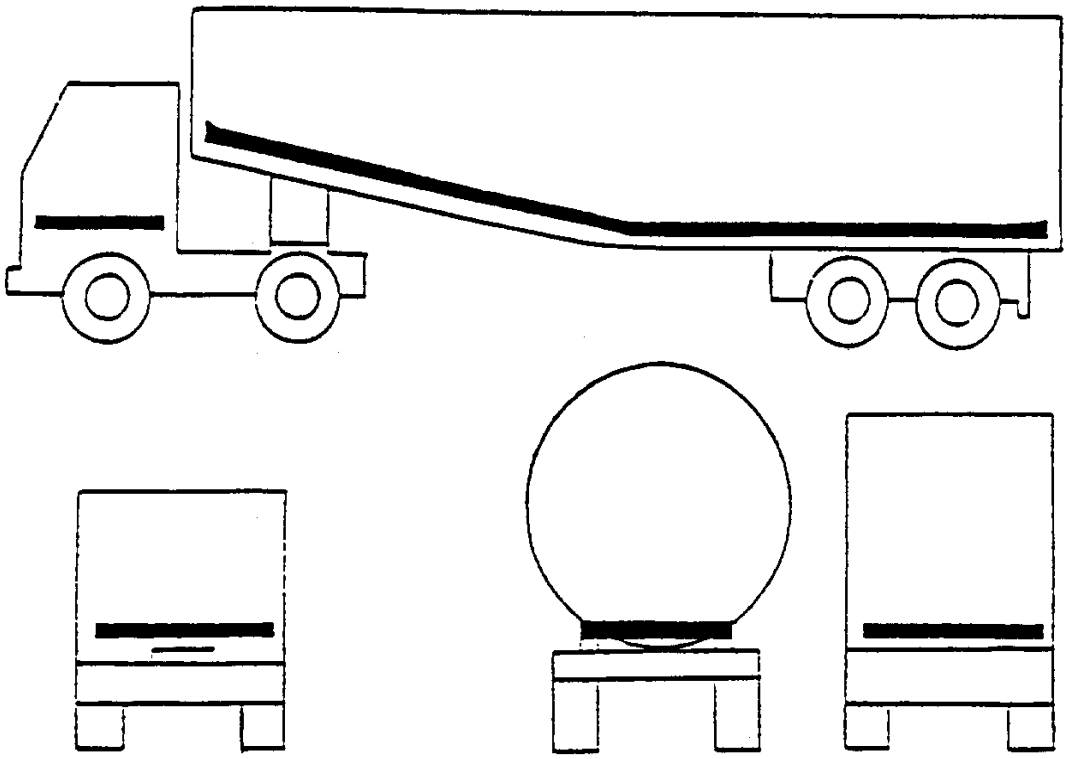
Example B



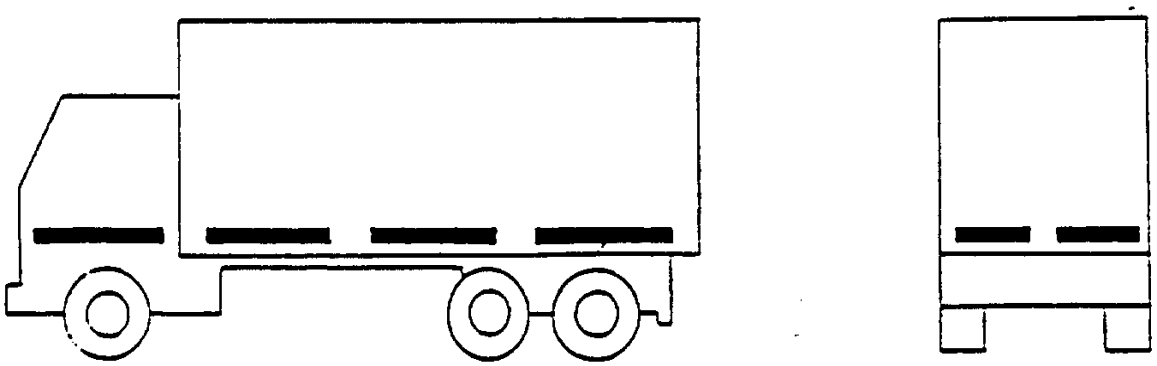
Annex 7 - Appendix 1 (cont'd)

EXAMPLES OF RETRO-REFLECTIVE MARKINGS WITH STRIPS

Example C



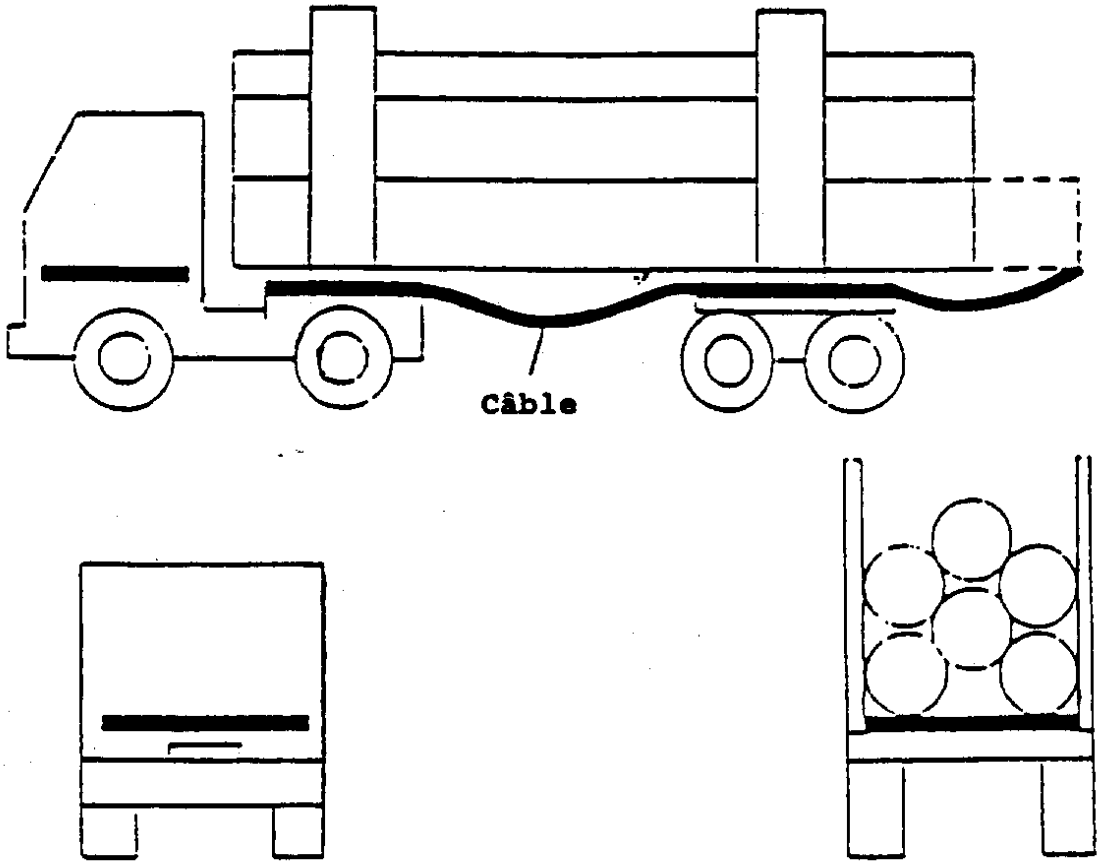
Example D



Annex 7 - Appendix 1 (cont'd)

EXAMPLES OF RETRO-REFLECTIVE MARKINGS WITH STRIPS

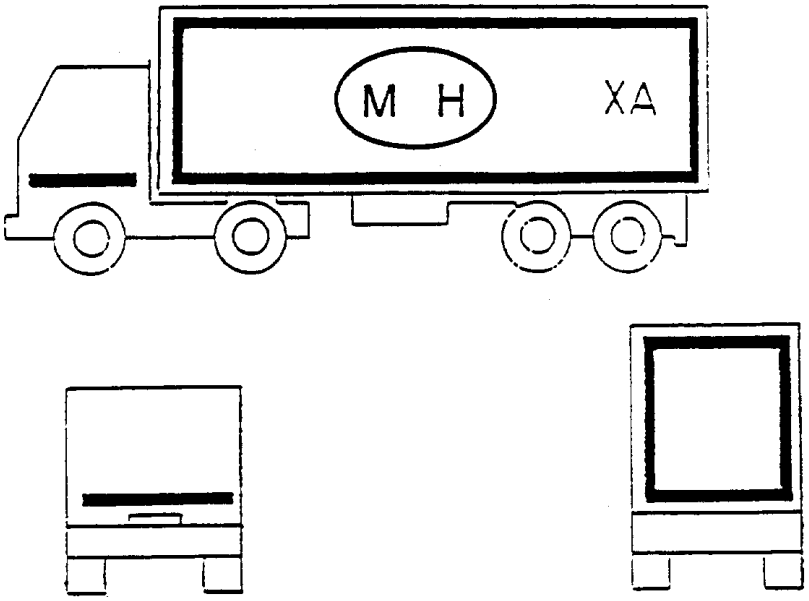
Example E



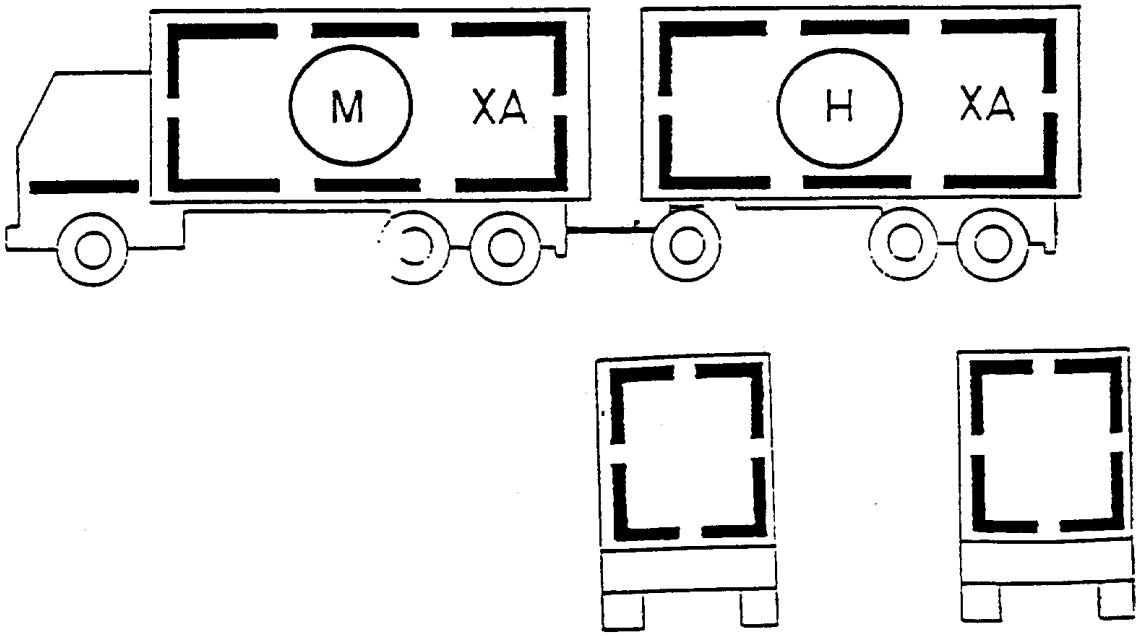
Annex 7 - Appendix 2

EXAMPLES OF RETRO-REFLECTIVE CONTOUR MARKINGS (WITH DISTINCTIVE MARKINGS AND GRAPHICS)

Example A



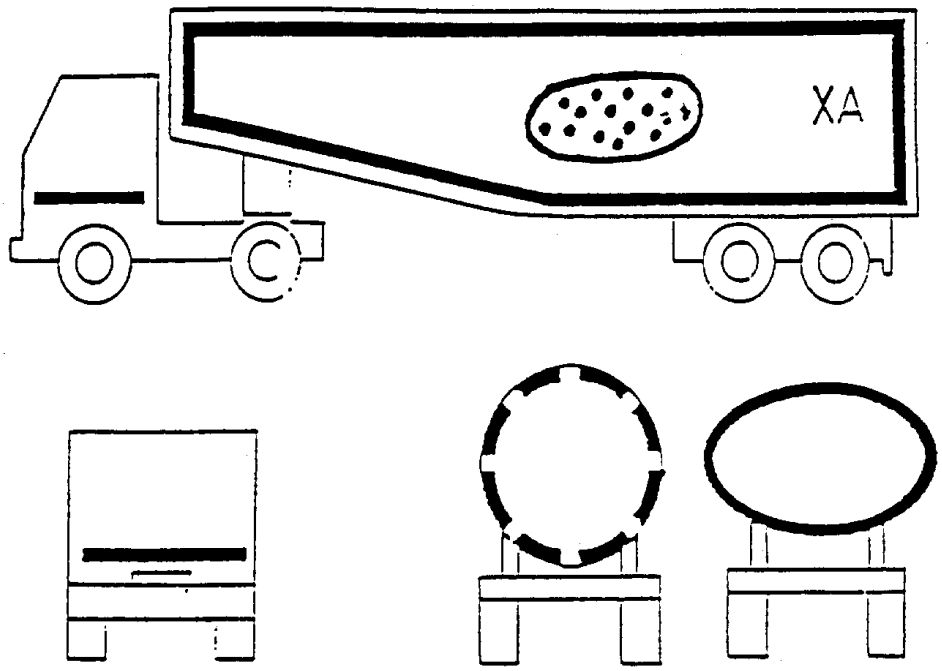
Example B



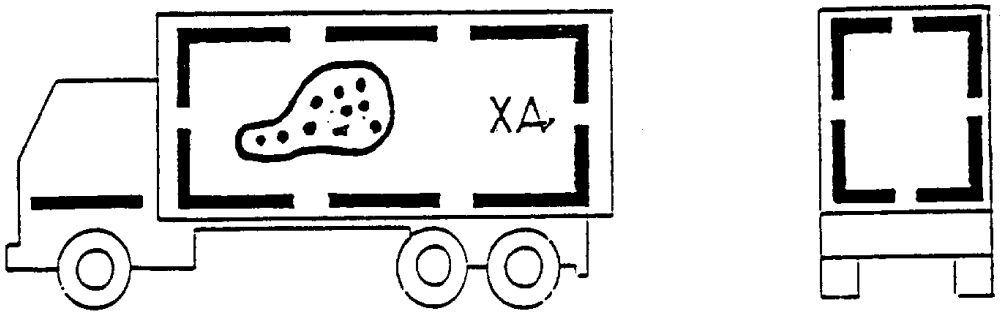
Annex 7 - Appendix 2 (cont'd)

EXAMPLES OF RETRO-REFLECTIVE CONTOUR MARKINGS (WITH DISTINCTIVE MARKINGS AND GRAPHICS)

Example C



Example D



Annex : 8
(See Annex 7, cl. 5)
VISIBILITY OF CONSPICUITY MARKINGS
TO THE REAR AND SIDE OF A VEHICLE

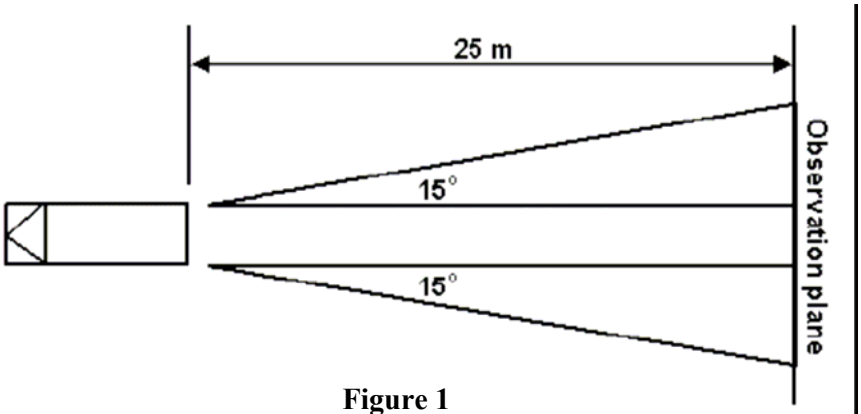


Figure 1

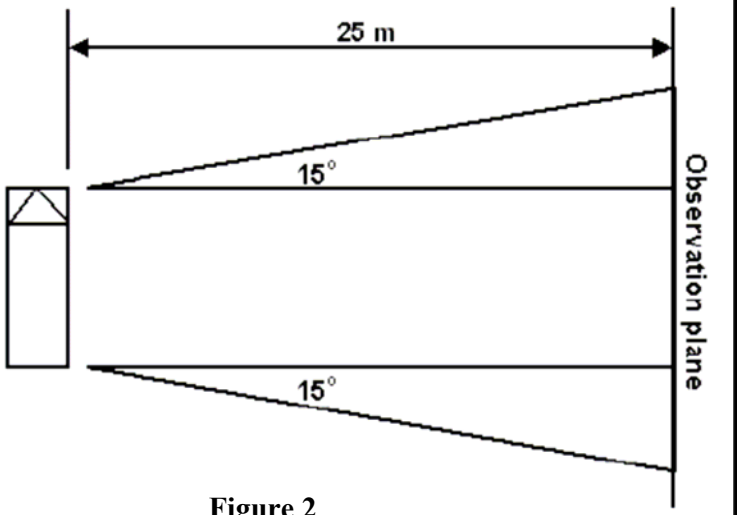


Figure 2

ANNEX 9
(See Introduction)
COMMITTEE COMPOSITION *
Automotive Industry Standards Committee

Chairman	
Shri B. Bhanot	Director The Automotive Research Association of India, Pune
Members	**Representing**
Shri Alok Rawat	Ministry of Shipping, Road Transport & Highways, New Delhi
Shri Sushil Kumar	Department of Heavy Industry, Ministry of Heavy Industries & Public Enterprises, New Delhi
Shri Chandan Saha	Office of the Development Commissioner, Small Scale Industries, Ministry of Small Scale Industries, New Delhi
Shri S. Dasgupta Shri P. C. Joshi (Alternate)	Bureau of Indian Standards, New Delhi
Shri. A. S. Lakra Shri D. P. Saste (Alternate)	Central Institute of Road Transport, Pune
Director	Indian Institute of Petroleum, Dehra Dun
Dr. C. L. Dhamejani Dr. N. Karuppaiah (Alternate)	Vehicles Research & Development Establishment, Ahmednagar
Shri Dilip Chenoy	Society of Indian Automobile Manufacturers
Shri T.C. Gopalan Shri Ramakant Garg (Alternate)	Tractor Manufacturers Association, New Delhi
Shri K.N.D. Nambudiripad	Automotive Components Manufacturers Association, New Delhi
Shri G. P. Banerji	Automotive Components Manufacturers Association, 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)