

1. SCOPE 1/

This Regulation applies to rear marking plates for the following vehicles²:

- 1.1. Articulated vehicles of category M, classes II and III;
- 1.2. Vehicles of categories N2 with a maximum mass exceeding 7.5 tonnes and N3, except tractors for semi-trailers;
- 1.3. Vehicles of category O1, O2 and O3 exceeding 8.0 m in length;
- 1.4. Vehicles of category O4.

2. DEFINITIONS 2/

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

- 2.1.1. "Rear marking plate", 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;
- 2.1.2. "Sample unit", a complete, finished marking plate ready to be mounted on a vehicle and representative of current production;
- 2.1.3. Classes of rear marking plates

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 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.

¹/ Nothing in this Regulation shall prevent a party to the Agreement applying this Regulation from prohibiting the rear marking plates of certain class(es).

²/ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.2, para. 2.

2.2. 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:

2.2.1. "Retro-reflective material", a surface or device from which, when directionally irradiated, a relatively large portion of the incident radiation is retro-reflected;

2.2.2. "Retro-reflecting device", an assembly ready for use and comprising one or more retro-reflecting optical units;

2.3. Geometric definitions (See Annex 1, figure 1)

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

2.3.2. "Illumination axis", a line segment from the reference centre to the light source;

2.3.3. "Observation axis", a line segment from the reference centre to the photometer head;

2.3.4. "Observation angle (symbol α)", the angle between the illumination axis and the observation axis. The observation angle is always positive and, in the case of retro-reflection, is restricted to small angles. Maximum range: $0 \leq \alpha \leq 180^\circ$;

2.3.5. "Observation half-plane", the half-plane which originates on the illumination axis and which contains the observation axis;

2.3.6. "Reference axis", a designated line segment originating on the reference centre which is used to describe the angular position of the retro-reflector;

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

2.3.8. "First axis", an axis through the reference centre and perpendicular to the observation half-plane;

2.3.9. "First component of the entrance angle (symbol β_1)", the angle from the illumination axis to the plane containing the reference axis and the first axis. Range: $-180^\circ < \beta_1 \leq 180^\circ$;

2.3.10. "Second component of the entrance angle (symbol β_2)", the angle from the plane containing the observation half-plane to the reference axis. Range: $-90^\circ \leq \beta_2 \leq 90^\circ$;

2.3.11. "Second axis", 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;

2.3.12. "Angle of rotation ε ", angle through which the sample is turned about its mean vertical from any arbitrarily established position counterclockwise (+ ε) or clockwise (- ε) 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 ε lies in the range $-180^\circ < \varepsilon \leq 180^\circ$.

2.4. Definition of photometric terms

2.4.1. "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^2 ($cd \cdot lx^{-1} \cdot m^{-2}$);

2.4.2. "Angular diameter of the retro-reflector sample (symbol η)", 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;

2.4.3. "Luminance factor", the ratio of the luminance of the body considered to the luminance of a perfect diffuser under identical conditions of illumination and observation.

2.4.4. "Colour of the reflected light of the device" The definitions of the colour of the reflected light are given in paragraphs 2.30. and 2.31. of Regulation No. 48.

2.5. Fluorescence

2.5.1. 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.

2.5.2. "Colour of the fluorescent light of the device" The definitions of the colour of the fluorescent light are given in paragraph 2.32. of Regulation No. 48.

2.6. 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 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.

2.7. Definition of "type"

Rear marking plates of different types means marking plates which differ in such essential respects as:

- 2.7.1. The trade name or mark;
- 2.7.2. The characteristics of the retro-reflective material;
- 2.7.3. The characteristics of the fluorescent material;
- 2.7.4. The parts affecting the properties of the retro-reflective material or devices.
- 2.7.5. Differences in the shape and dimensions of the rear marking shall not constitute a different type

3. APPLICATION FOR APPROVAL

- 3.1. 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:
 - 3.1.1. 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;
 - 3.1.2. A brief description giving the technical specifications of the materials of which the retro-reflective areas are made;
 - 3.1.3. A brief description giving the technical specifications of the materials of which the fluorescent areas are made;
 - 3.1.4. Samples of the retro-reflective and of the fluorescent areas; the number of samples to be submitted is specified in Annex 4.
- 3.2. The Competent Authority shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.

4. MARKINGS

- 4.1. Every plate submitted for approval shall bear:
 - 4.1.1. The trade name or mark of the applicant;
 - 4.1.2. 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.

4.2. 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.

4.3. The markings shall be clearly legible and shall be indelible.

5. APPROVAL

5.1. If the marking plates submitted for approval in accordance with paragraph 4. above meet the requirements of this Regulation, approval for this type of marking plate shall be granted.

5.2. An approval number shall be assigned to each type approved. Its first two digits (at present 01) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The symbol above the circle indicates the classes of rear marking plate, "RF" in case of classes 1 and 2 (retro-reflective and fluorescent materials) and "RR" in the case of class 3 and 4 (retro-reflective only materials). The same Contracting Party may not assign the same number to another type of rear marking plate.

5.3. Notice of approval or refusal or extension of approval of a type of rear marking plate under this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 2 to this Regulation and of a drawing annexed thereto supplied by the applicant for approval, in a format not exceeding A4 (210 x 297 mm) or folded to that format and if possible on a scale of 1 : 1.

5.4. Every marking plate conforming to a type approved under this Regulation shall bear, in addition to the marking prescribed in paragraph 4.1:

5.4.1. An international approval mark consisting of:

5.4.1.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval; 3/

5.4.1.2. An approval number.

5.5. The approval mark shall be clearly legible and shall be indelible.

5.6. Annex 3 to this Regulation gives an example of the arrangement of the approval mark.

6. GENERAL SPECIFICATIONS

6.1. 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.

6.2. The components of retro-reflective/fluorescent or retro-reflective only marking plate(s) shall not be capable of being easily dismantled.

6.3. 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.

6.4. 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.

7. SPECIAL SPECIFICATIONS (TESTS)

3/ 1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for the Czech Republic, 9 for Spain, 10 for Serbia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa, 48 for New Zealand, 49 for Cyprus, 50 for Malta, 51 for the Republic of Korea, 52 for Malaysia, 53 for Thailand, 54 and 55 (vacant), 56 for Montenegro, 57 (vacant) and 58 for Tunisia. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

- 7.1. 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 5 to 12 to this Regulation.

8. MODIFICATIONS AND EXTENSION OF APPROVAL OF REAR MARKING PLATES FOR HEAVY AND LONG VEHICLES

- 8.1. Every modification of the rear marking plate type shall be notified to the Administrative Department which granted the type approval. The department may then either:
 - 8.1.1. Consider that the modifications made are unlikely to have appreciable adverse effects and that in any case the type of device still complies with the requirements; or
 - 8.1.2. Require a further test report from the Technical Service responsible for conducting the tests.
- 8.2. Confirmation or refusal of approval, specifying the alterations, shall be notified by the procedure specified in paragraph 5.3. above to the Parties to the Agreement applying this Regulation.
- 8.3. The Competent Authority issuing the extension of approval shall assign a series number for such an extension and inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

9. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, Appendix 2 (E/ECE/324-E/ECE/TRANS/505/Rev.2), with the following requirements:

- 9.1. Rear marking plates shall be so manufactured as to conform to the type approved under this Regulation.
The compliance with the requirements set forth in paragraphs 6. and 7. above shall be verified as follows:
 - 9.1.1. The minimum requirements for conformity of production control procedures set forth in Annex 13 to this Regulation shall be complied with.
 - 9.1.2. The minimum requirements for sampling by an inspector set forth in Annex 14 to this Regulation shall be complied with.
- 9.2. The authority which has granted type approval may at any time verify the conformity control methods applied in each production facility. The normal frequency of these verifications shall be once every two years.

10. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

- 10.1. The approval granted in respect of a type of marking plate pursuant to this Regulation may be withdrawn if the requirements set forth above are not met or if a marking plate bearing the approval mark does not conform to the type approved.
- 10.2. If a Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

11. PRODUCTION DEFINITELY DISCONTINUED

If the holder of an approval completely ceases the manufacture of a rear marking plate approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the Agreement applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

12. REMARK CONCERNING DIMENSIONS

The Parties to the Agreement to which this Regulation is annexed are not precluded by article 3 of that Agreement from restricting the total summarized length of rear marking plates installed on vehicles registered by them to a smaller range or even a fixed value within the range prescribed in Annex 5, paragraph 3. and in Annex 12 to this Regulation, taking into account a production tolerance of ± 5 per cent.

13. TRANSITIONAL PROVISIONS

- 13.1. As from 24 months after the official date of entry into force of UN Regulation No. [RRD]⁴, Contracting Parties applying this Regulation shall cease to grant approvals to this Regulation.
- 13.2. Contracting Parties applying this Regulation shall not refuse to grant extensions of approval to this and any previous series of amendments of this Regulation.
- 13.3. Contracting Parties applying this Regulation shall continue to grant approvals for devices on basis of this and any previous series of amendments to this Regulation, provided that the devices are intended as replacements for fitting to vehicles in use.
- 13.4. Contracting Parties applying this Regulation shall continue to allow fitting or use on a vehicle in use of a device approved to this Regulation as amended by any previous series of amendments, provided that the device is intended for replacement.

⁴ The new UN Regulation on Retro-Reflective Devices (RRD) (ECE/TRANS/WP.29/2018/159/Rev.1).

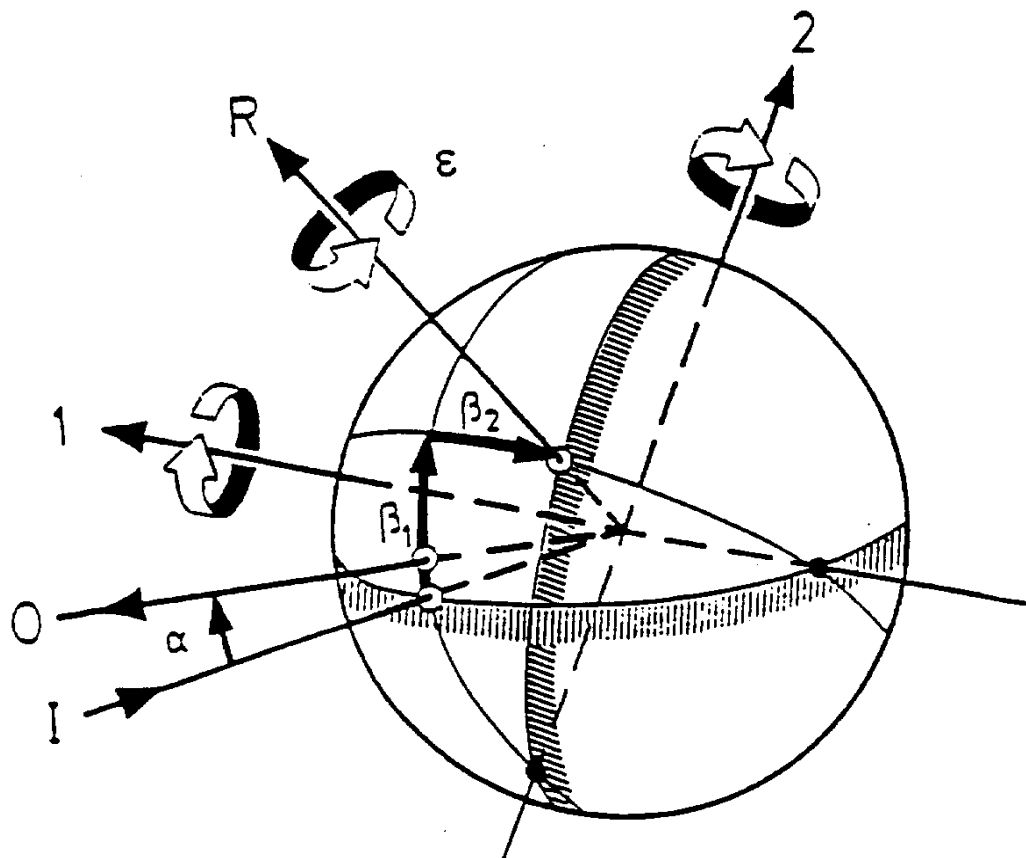
14. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF ADMINISTRATIVE DEPARTMENTS

The Parties to the Agreement which apply this Regulation shall communicate to the United Nations Secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Administrative Departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, issued in other countries, are to be sent.

Annex 1

THE CIE CO-ORDINATE SYSTEM

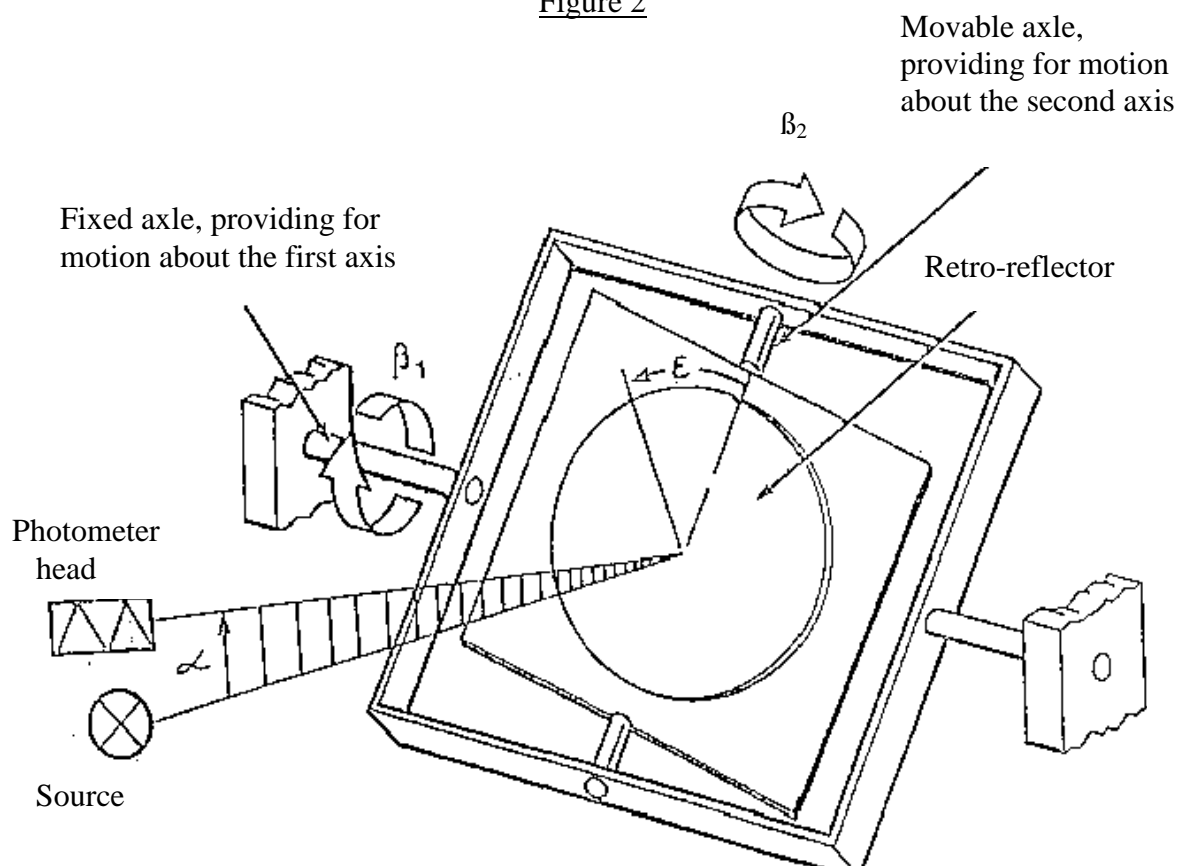
Figure 1



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

The CIE angular system for specifying and measuring retro-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.

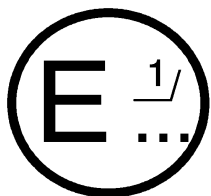
- Notes:
- (a) The principal fixed axis is the illumination axis.
 - (b) The first axis is fixed perpendicular to the plane containing the observation and illumination axis.
 - (c) The reference axis is fixed in retro-reflector and movable with β_1 and β_2 .

Figure 2

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

Annex 2**COMMUNICATION**

(Maximum format: A4 (210 x 297 mm))



issued by :

Name of administration:

.....

.....

.....

concerning: 2/

APPROVAL GRANTED

APPROVAL EXTENDED

APPROVAL REFUSED

APPROVAL WITHDRAWN

PRODUCTION DEFINITELY DISCONTINUED

of a type of rear marking plate, pursuant to Regulation No. 70

Approval No. :

Extension No. :

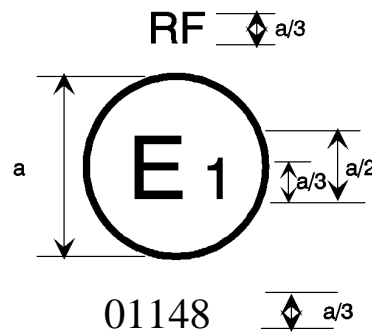
1. Trade name or mark of the rear marking plate:
2. Rear marking plate type:
- 2.1. Rear marking plate class:
3. Manufacturer's name and address:
4. If applicable, name and address of manufacturer's representative:
5. Submitted for approval on:
6. Technical Service responsible for conducting approval tests:
7. Date of test report:
8. Number of test report:
9. Remarks:
10. Vehicles to which the device is intended to be fitted (if applicable):
11. Position and nature of the marking:

Annex 2

12. Approval granted/refused/extended/withdrawn 2/
13. Reason(s) for extension (if applicable):
14. Place:
15. Date:
16. Signature:
17. The list of documents deposited at the Administrative Service which has granted approval is annexed to this communication.

1/ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).

2/ Strike out what does not apply.

Annex 3**ARRANGEMENT OF THE APPROVAL MARK**

$a = 5 \text{ mm min.}$

The rear marking plate bearing the above approval mark has been approved in the Netherlands (E4) under approval number 01148. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of this Regulation as amended by the 01 series of amendments. The symbol "RF" indicates rear marking plate of class 1 or 2 (retro-reflective/fluorescent materials). Rear marking plates of classes 3 or 4 (retro-reflective only materials) shall be marked by symbol "RR".

Note: The approval number and the additional symbol must be placed close to the circle and either above or below the letter "E" or to the left or right of that letter. The digits of the approval number must be on the same side of the letter "E" and face in the same direction. The approval number and the additional symbol must be placed diametrically opposite one another. The use of Roman numerals as approval numbers should be avoided so as to prevent any confusion with other symbols.

Annex 4**TEST PROCEDURE****TEST SAMPLES**

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 of the retro-reflective or retro-reflective/fluorescent materials or devices.
3. After verification of the general specifications (paragraph 6. of the Regulation) and the specifications of shape and dimensions (Annex 5) the samples shall be subjected to the heat resistance test described in Annex 9 to this Regulation, prior to the tests described in Annexes 6, 7 and 8.
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.

Annex 5**SPECIFICATIONS OF SHAPE AND DIMENSIONS****SHAPE AND DIMENSIONS OF RETRO-REFLECTIVE/FLUORESCENT REAR MARKING PLATE(S)****1. Shape**

The plates shall be rectangular in shape for mounting at the rear of vehicles.

2. Pattern

For mounting on trailers and semi-trailers, the plates shall have a yellow retro-reflective background with a red fluorescent or retro-reflective border;

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.

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.

3. Dimensions

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. The width of a rear marking plate shall be:

For trucks and tractors: 140 ± 10 mm.

For trailers and semi-trailers: 200^{+30}_{-5} mm.

3.2. The length of each rear marking plate in a set consisting of two plates for trucks and tractors, as illustrated in figures 1(b) and 1(c) of Annex 12, 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 cm^2 , does not exceed $1,725 \text{ cm}^2$ and the marking plates are rectangular.

Class 5 devices shall incorporate a minimum of 9 standard areas as described in para. 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 $40 \text{ mm} \pm 1 \text{ mm}$.

Annex 5

- 3.4. The slope of the oblique stripes of the chevron band shall be $45^{\circ} \pm 5^{\circ}$. The width of the stripes shall be $100 \text{ mm} \pm 2.5 \text{ mm}$.

Prescribed shapes, patterns and dimensional features are illustrated in figures 1 and 2 of Annex 12 to this Regulation.

Class 5 retro-reflective materials shall consist of red and white diagonal stripes each 100 mm wide sloping outwards and downwards at 45° . The basic standard area is a square of 141 mm in length subdivided diagonally into a white half and red half, which represents one standard area.

Prescribed shapes, patterns and dimensional features of Class 5 devices are illustrated in figure 3 of Annex 12 to this Regulation.

- 3.5. Rear marking plates or Class 5 devices supplied in sets shall form matching pairs.

Annex 6**COLORIMETRIC SPECIFICATIONS**

1. 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.
2. Yellow, red or white retro-reflective material
- 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 according to paragraph 2.31. of Regulation No. 48.

Table 1

Chromaticity co-ordinates x and y

Colour		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	Luminance factor β
Yellow	x	0.545	0.487	0.427	0.465	≥ 0.16
	y	0.454	0.423	0.483	0.534	
Red	x	0.690	0.595	0.569	0.655	≥ 0.03
	y	0.310	0.315	0.341	0.345	

2.1.1. Luminance factor for:

- (a) Yellow colour shall be ≥ 0.16 .
- (b) Red colour shall be ≥ 0.03 .
- (c) White colour shall be ≥ 0.25 .

- 2.2. 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 according to paragraph 2.30. of Regulation No. 48.

Table 2

Chromaticity co-ordinates x and y

Colour		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Yellow	x	0.585	0.610	0.520	0.505
	y	0.385	0.390	0.480	0.465
Red	x	0.720	0.735	0.665	0.643
	y	0.258	0.265	0.335	0.335

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.

3. Red fluorescent material

- 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 according to paragraph 2.32. of Regulation No. 48.

Table 3

Colour	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>Luminance factor</u>
Red x	0.690	0.595	0.569	0.655	≥ 0.30
y	0.310	0.315	0.341	0.345	

- 3.1.1. "Luminance factor for red colour shall be ≥ 0.30.

4. Compliance with the colorimetric specification shall be verified by a visual comparison test.

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.

Annex 7**PHOTOMETRIC SPECIFICATIONS****1. Photometric properties**

- 1.1. 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 metre 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.

Table 1

Coefficient of retro-reflection R'
[cd.m⁻².lx⁻¹]

Observation angle α [°]	Entrance angle β [°]				
20'	β_1	0°	0°	0°	0°
	β_2	5°	30°	40°	60°
Coefficient R' [cd.m ⁻² .lx ⁻¹]	Colour: Yellow	300	180	75	10

Table 2

Coefficient of retro-reflection R'
[cd.m⁻².lx⁻¹]

Observation angle α [°]	Entrance angle β [°]				
20'	β_1	0°	0°	0°	0°
	β_2	5°	30°	40°	60°
Coefficient R' [cd.m ⁻² .lx ⁻¹]	Colour: Yellow	300	180	75	10
	Red	10	7	4	-

- 1.2. The subtended angle at the sample shall not be larger than 80'.

1.3. Luminance factor

The luminance factor β shall be at least as indicated in table 3.

Table 3

Coefficient of retro-reflection R' [cd.m ⁻² .lx ⁻¹]					
Observation angle α [°]	Entrance angle β [°]				
20'	β_1	0°	0°	0°	0°
	β_2	5°	30°	40°	60°
Coefficient R' [cd.m ⁻² .lx ⁻¹]	Colour: White	450	200	90	16
	Red	120	30	10	2

"

Table 4

Luminance factor β

Colour	Luminance factor β
Red	≥ 0.03
Yellow	≥ 0.16

Annex 8

RESISTANCE TO EXTERNAL AGENTS

1. Resistance to weathering
 - 1.1. Procedure - For each test, two specimens of a sample unit (see paragraph 2.1.2. of this Regulation) 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 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.
 - 1.2. Visual appearance - No area of the exposed specimen shall show any evidence of cracking, scaling, pitting, blistering, delamination, distortion, chalking, staining or corrosion.

There shall be no shrinkage in excess of 0.5 per cent in any linear direction and no evidence of adhesion failure such as edge lifting from the substrate.
 - 1.3. Colour fastness – The colours of the exposed specimen shall still meet the requirements specified in Annex 6.
 - 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 7.
 - 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 7, table 1.
 - 1.4.3. The specimen shall then be subjected to simulated rainfall as described in paragraph 7.7. of EN 13422(2004) (Vertical road signs. Portable deformable warning devices and delineators. Portable road traffic signs. Cones and cylinders) and its coefficient of retro-reflection under this condition shall be not less than 90 per cent of the value obtained when measured in dry condition, as explained in paragraph 1.4.2. above.

It is possible to use nozzles other than those described in paragraph 7.7. of EN 13422(2004) provided that the same performance (e.g. water distribution on the surface of the test sample) of the simulated rainfall is achieved.
2. Resistance to corrosion (ISO Standard 3768)
 - 2.1. A specimen of the sample unit shall be subjected to the action of a saline mist for 48 hours comprising two periods of exposure of 24 hours each, separated by an interval of 2 hours during which the specimen is allowed to dry.

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

2.2. Immediately after completion of the test, the sample shall show no sign of corrosion liable to impair the efficiency of the 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 7, at an entrance angle of 5° and an observation angle of $20'$, shall be not less than the value in Annex 7, table 1. 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. Bonding strength (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.

5. Resistance to water

A section of a sample unit not less than 300 mm long shall be immersed in distilled water at a temperature of $23 \pm 5^{\circ}\text{C}$ 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.

6. Resistance to impact (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 $23 \pm 2^{\circ}\text{C}$, the material shall show no cracking or separation from the substrate at a distance of more than 5 mm from the impacted area.

7. Resistance to cleaning

7.1. Manual cleaning

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

7.2. Power washing

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

- (a) Water/wash solution pressure 8 ± 0.2 MPa;
- (b) Water/wash solution temperature $60^{\circ} - 5^{\circ}\text{C}$;
- (c) Water/wash solution flow rate 7 ± 1 l/min;
- (d) The tip of the cleaning wand to be positioned at distance of 600 ± 20 mm away from the retro-reflective surface;
- (e) Cleaning wand to be held at no greater angle than 45 degrees from perpendicular to the retro-reflective surface;
- (f) 40 degree nozzle creating wide fan pattern.

Annex 9**RESISTANCE TO HEAT**

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

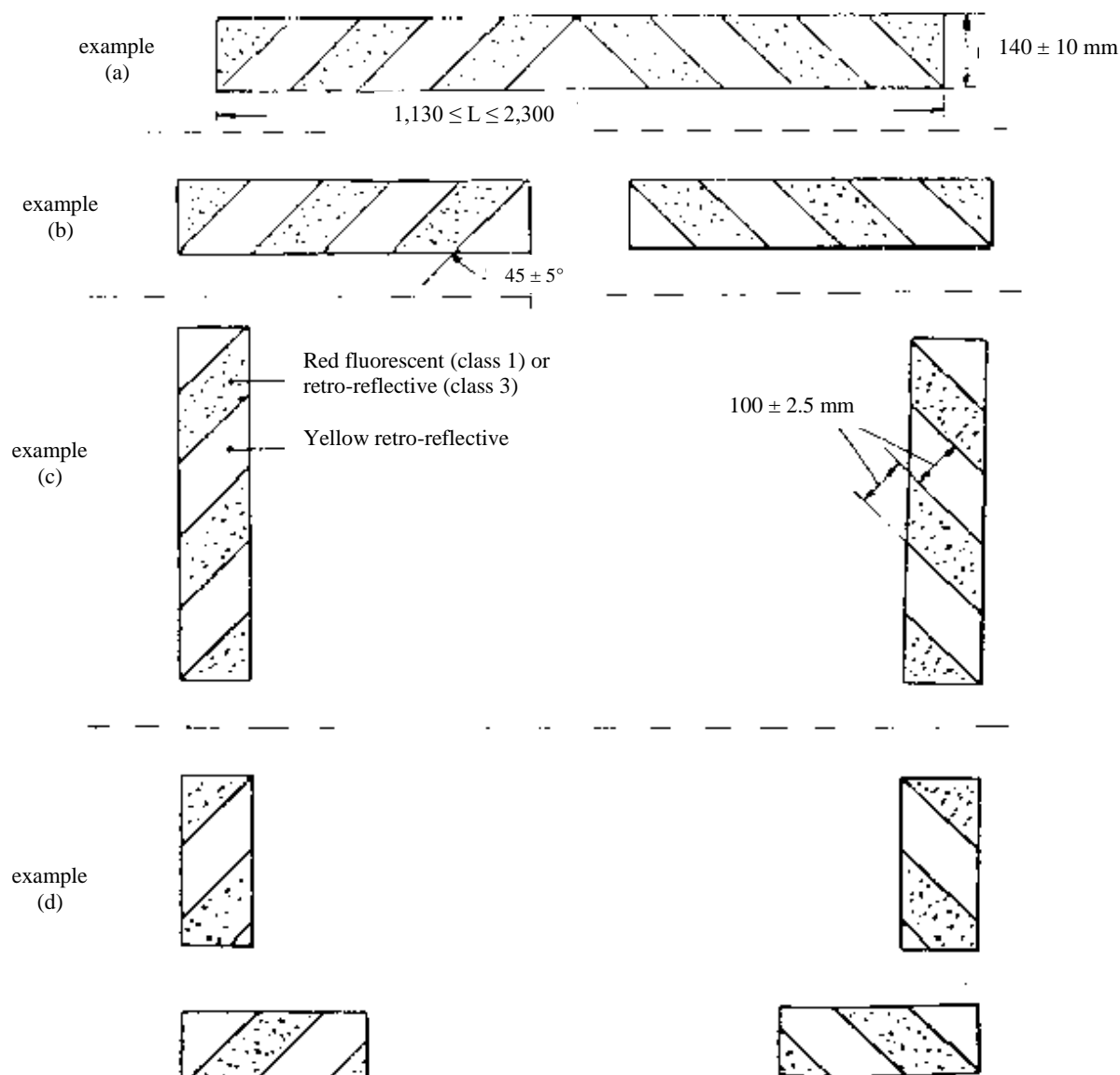
Annex 10**RIGIDITY OF THE PLATES**

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 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 11**STABILITY IN TIME OF THE OPTICAL PROPERTIES 1/
OF REAR MARKING PLATES**

1. The authority which granted approval shall have the right to check the stability in time of the optical properties of a type of rear marking plate in service.
2. The Competent Authorities of countries other than the country in which approval was granted may carry out similar checks in their territory. If a type of rear marking plate in use exhibits a systematic defect, the said authorities shall transmit to the authority which granted approval, with a request for its opinion, any components removed for examination.
3. In the absence of other criteria, the concept of "systematic defect" of a type of rear marking plate in use shall be interpreted in conformity with the intention of paragraph 6.1. of this Regulation.

1/ Despite the importance of tests to check the stability in time of the optical properties of rear marking plates it is in the present state of the art not yet possible to assess this stability by laboratory tests of limited duration.

Annex 12**REAR MARKING PLATES (CLASS 1 AND CLASS 3)****Figure 1**

REAR MARKING PLATES (CLASS 2 AND CLASS 4)

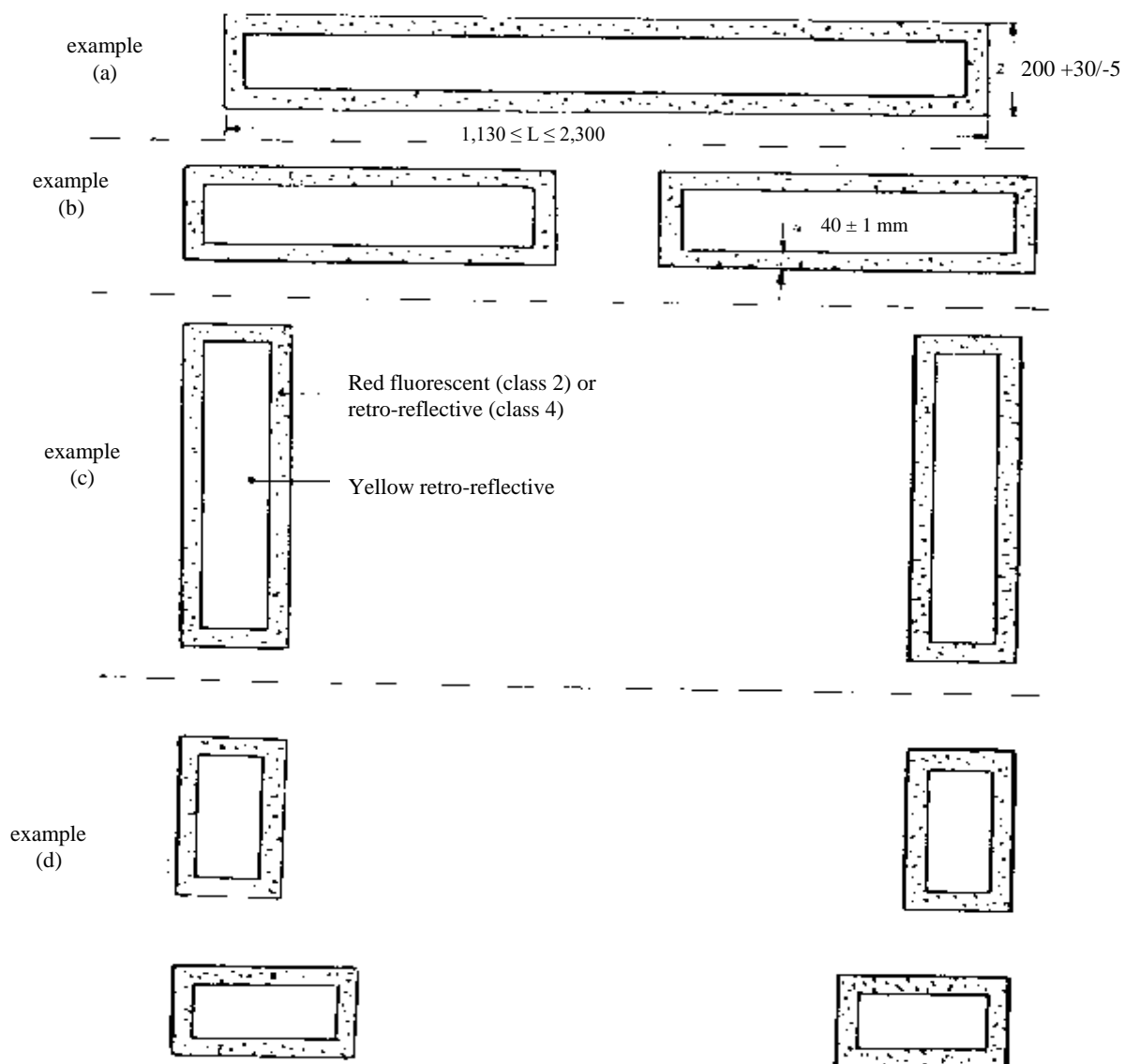


Figure 2

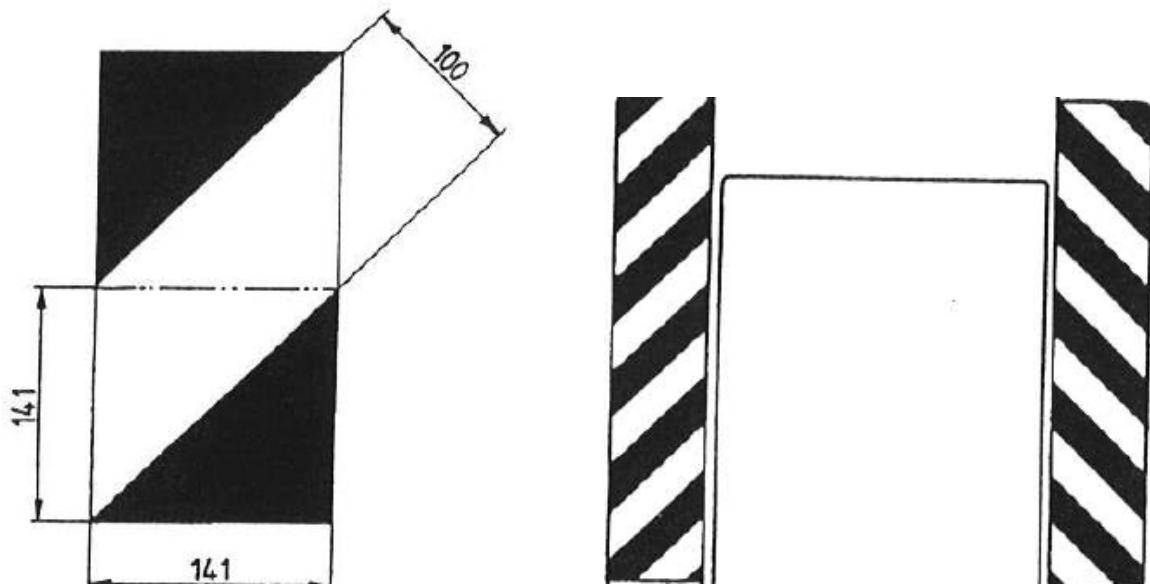
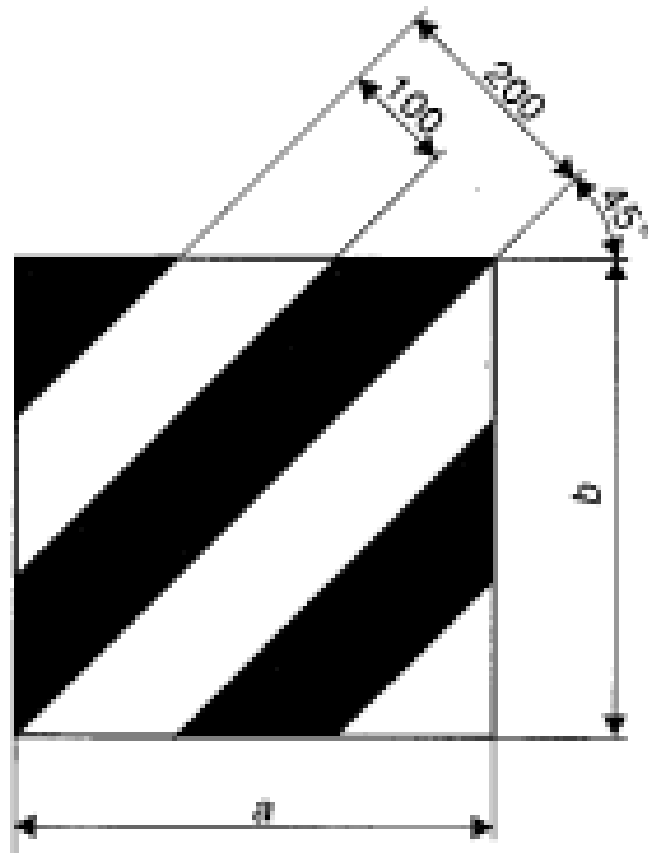
Rear marking plates (Class 5)**Figure 3a**

Figure 3b.
Example for a plate design



Annex 13

MINIMUM REQUIREMENTS FOR CONFORMITY OF PRODUCTION CONTROL PROCEDURES

1. GENERAL

- 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 Regulation.
- 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 per cent from the values prescribed in this Regulation.
- 1.3. The chromaticity coordinates shall be complied with.

2. MINIMUM REQUIREMENTS FOR VERIFICATION OF CONFORMITY BY THE MANUFACTURER

For each type of rear marking plate 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 Regulation.

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.

2.1. Nature of tests

Tests of conformity in this Regulation shall cover the photometric and colorimetric characteristics and the test of weather resistance of these characteristics.

2.2. Methods used in tests

- 2.2.1. Tests shall generally be carried out in accordance with the methods set out in this Regulation.
- 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 Regulation.
- 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 Regulation, particularly for the purpose of administrative verification and sampling.

2.3. Nature of sampling

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. Measured and recorded photometric characteristics

The sampled rear marking plate shall be subjected to photometric measurements at the points and chromaticity coordinates provided for in the Regulation.

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 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 9.1. of this Regulation.

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 14 (first sampling) would be 0.95.

Annex 14

MINIMUM REQUIREMENTS FOR SAMPLING BY AN INSPECTOR

1. GENERAL

- 1.1. The conformity requirements shall be considered satisfied from a mechanical and a geometric standpoint, in accordance with the requirements of this Regulation, if any, if the differences do not exceed inevitable manufacturing deviations.
- 1.2. 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 per cent from the values prescribed in this Regulation.
 - 1.2.2. Rear marking plates with apparent defects are disregarded.
- 1.3. The chromaticity coordinates shall be complied with.

2. First sampling

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.

- 2.1. The conformity of mass-produced rear marking plates shall not be contested if the deviation of any specimen of samples A and B (all four plates) is not more than 20 per cent
In the case, that the deviation of both plates of sample A is not more than 0 per cent the measurement can be closed.
- 2.2. The conformity of mass-produced rear marking plates shall be contested if the deviation of at least one specimen of sample A or B is more than 20 per cent.

The manufacturer shall be requested to bring his production in line with the requirements (alignment) and a repeated sampling according to paragraph 3. below shall be carried out within two months' time after the notification. The samples A and B shall be retained by the Technical Service until the entire Conformity of Production process is finished.

3. First repeated sampling

A sample of four rear marking plates is selected at random from stock manufactured after alignment.

The first sample of two is marked C, the second sample of two is marked D.

Annex 14

3.1. The conformity of mass-produced rear marking plates shall not be contested if the deviation of any specimen of samples C and D (all four plates) is not more than 20 per cent.
In the case, that the deviation of both plates of sample C is not more than 0 per cent, the measurement can be closed.

3.2. The conformity of mass-produced rear marking plates shall be contested if the deviation of at least:

3.2.1. One specimen of sample C or D is more than 20 per cent but the deviation of all specimen of these samples is not more than 30 per cent.

The manufacturer shall be requested again to bring his production in line with the requirements (alignment).

A second repeated sampling according to paragraph 4. below shall be carried out within two months' time after the notification. The samples C and D shall be retained by the Technical Service until the entire Conformity of Production process is finished.

3.2.2. One specimen of sample C or D is more than 30 per cent.

In this case the approval shall be withdrawn and paragraph 5. below shall be applied.

4. Second repeated sampling

A sample of four rear marking plates is selected at random from stock manufactured after alignment.

The first sample of two is marked E, the second sample of two is marked F.

4.1. The conformity of mass-produced rear marking plates shall not be contested if the deviation of any specimen of samples E and F (all four plates) is not more than 20 per cent.

In the case, that the deviation of both plates of sample E is not more than 0 per cent, the measurement can be closed.

4.2. The conformity of mass-produced rear marking plates shall be contested if the deviation of at least one specimen of sample E or F is more than 20 per cent.

In this case the approval shall be withdrawn and paragraph 5. below shall be applied.

5. Approval withdrawn

Approval shall be withdrawn according to paragraph 10. of this Regulation.

6. Resistance test

Annex 14

Specimens of one of the rear marking plates of sample A, after sampling procedure in Paragraph 2. of this Annex, shall be tested according to the procedures described in Annexes 8 and 9 to this Regulation.

The rear marking plate shall be considered acceptable if the tests were passed.

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.

Annex 15

GUIDELINES FOR INSTALLATION OF REAR MARKING PLATES ON HEAVY AND LONG VEHICLES

1. It is recommended to the Governments to apply on vehicles specified in paragraph 2. of this annex "Rear marking plates for heavy and long vehicles" conforming to this Regulation and the specific requirements relating to its scope in accordance with the guidelines given in this annex.

2. Scope

The main purpose of these guidelines is to establish requirements for installation, arrangement, position and geometric visibility of rear marking plates on heavy and long vehicles as well as on special utility vehicles and trailers. It increases the visibility and permits an easy identification of these vehicles.

- 2.1. Heavy motor vehicles

The installation of rear marking plates for heavy motor vehicles according to the provisions of this annex is required for vehicles of categories N₂ with a maximum mass exceeding 7.5 tonnes and N₃ with the exception of tractors for semi-trailers, and for articulated buses of classes II and III.

The rear marking plates may also be installed on special utility vehicles of categories other than above.

- 2.2. Long vehicles

The installation of rear marking plates for long vehicles, according to the provisions of this annex, is required for the following vehicles:

Categories O₁ to O₃ - trailers / semi-trailers exceeding 8 m in length (including the drawbar)

All vehicles of category O₄.

3. Number

One, two, or four.

4. Arrangement

Every rear marking shall be fitted such that the lower edge is horizontal. Every part of a rear marking shall lie within 5° of a transverse vertical plane at right angles to the longitudinal axis of the vehicle and shall face to the rear. The set of marking plates shall be arranged symmetrically with respect to the median longitudinal plane of the vehicle.

The rear marking plates shall be type approved and meet the requirements of this Regulation with the following classification:

(a) For heavy vehicles:

- Class 1 - alternate, oblique stripes of red fluorescent and yellow retro-reflective materials;
- Class 3 - alternate, oblique stripes of red retro-reflective and yellow retro-reflective materials.

(b) For long vehicles:

- Class 2 - yellow retro-reflective centre with a red fluorescent border;
- Class 4 - yellow retro-reflective centre with a red retro-reflective border.

(c) For special utility vehicles or trailers:

- Class 5 - red and white retro-reflective alternative stripes.

5. Position

In width: No individual specifications

In height: Above the ground, not less than 250 mm (lower edge), nor more than 2,100 mm (upper edge).

6. Geometric visibility

Horizontal angle: 30° inwards and outwards

Vertical angle: 15° above and below the horizontal

Orientation: rearwards.
