

First draft for
Regulation 3

to demonstrate the
application of the
HRD

17. October 2014

Regulation No. 3

Uniform provisions concerning the approval of retro-reflecting devices for power-driven vehicles and their trailers

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1. Scope

This Regulation applies to retro-reflecting devices¹ for vehicles of categories L, M, N, O, and T².

2. Definitions³

For the purpose of this Regulation:

The definitions including the definition of type etc. given in the Horizontal Reference Document (HRD) shall apply to this Regulation;

3. Application for approval

3.1. The applicant shall follow instructions stated in paragraph 3. of the HRD.

3.2. The drawings required by paragraph 3. of the HRD shall also identify the illuminating surface of the device.

4. Markings

4.1. The applicant shall follow instructions stated in paragraph 4. of the HRD.

4.1.1. In addition to paragraph 4.1. above, the word "TOP" inscribed horizontally on the highest part of the illuminating surface, if such an indication is necessary to determine without ambiguity the angle or angles of rotation prescribed by the manufacturer.

5. Approval

5.1. General

The applicant shall follow instructions stated in paragraph 5. of the HRD.

5.1.1. In addition, if the approval granted in respect of a retro-reflecting device is extended to other such devices differing only in colour, the two samples in any other colour submitted in conformity with paragraph 3.1.4. of this Regulation

¹ Also called "retro-reflector(s)".

² As defined in Annex 7 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), (document TRANS/WP.29/78/Rev.2, para.2.

³ The definitions of the technical terms (excluding the ones in Regulation No. 48) are those adopted by the International Commission on Illumination (CIE).

shall be required to meet only the colorimetric specifications, the other tests no longer being required. This paragraph is not applicable to devices of Class IVA.

5.2. Composition of the approval mark

5.2.1. The applicant shall follow instructions stated in paragraph 5.. of the HRD.

5.2.2. The approval mark has also to include following additional group of symbols IA, IB, IIIA, IIIB or IVA showing the class of the approved retro-reflecting device.

5.3. Arrangement of the approval mark

Follow the corresponding instructions in paragraph 5.3. and Annex 1 of the HRD.

Annex 3, to this Regulation and in addition Annex 1 of the HRD gives examples specific to this regulation of arrangements of approval marks for grouped, combined or reciprocally incorporated lamps with all the above-mentioned additional symbols.

6. General specifications

6.1. Follow instructions in paragraph 6.**and 9** of the HRD and in addition:

6.1.1. Retro-reflecting optical units may not be replaceable.

6.1.2.. For devices of Class IVA their means of fixation shall be such that they allow a stable and durable connection between the device and the vehicle.

7. Special specifications (tests)

7.1. Retro-reflecting devices must also satisfy the conditions as to dimensions and shape, and the colorimetric, photometric, physical and mechanical requirements set forth in Annexes 5 to 11 and 13 to this Regulation. The test procedures are described in Annex 4 (Classes IA, IIIA), Annex 14 (Class IVA) and Annex 16 (Classes IB, IIIB).

7.2. Depending on the nature of the materials of which the retro-reflecting devices and, in particular, their optical units, are made, the competent authorities may authorize laboratories to omit certain unnecessary tests, subject to the express reservation that such omission must be mentioned under "Remarks" on the form notifying approval.

8. Conformity of production

Devices approved in accordance with this Regulation and the referred HDR shall be so manufactured as to conform to the type approved and to meet the requirements set forth by this Regulation and the Horizontal Reference Document as described in paragraph 11 of the HRD.

9. Penalties for non-conformity of production

See paragraph 12. of the HDR.

10. Production definitively discontinued

See paragraph 13. of the HDR.

11. Names and addresses of Technical Services responsible for conducting approval tests, and of Type Approval Authorities

See paragraph 14. of the HDR.

12. Transitional provisions

The Contracting Parties applying this Regulation:

- 12.1. Shall continue to recognize approvals issued for the former Classes I, II and III in respect of the fitting of retro-reflecting devices intended as replacement for vehicles in use;
- 12.2. May issue approvals for Classes I and II on the basis of the original version of this Regulation (document E/ECE/324-E/ECE/TRANS/505/Add.2 of 23 September 1964) provided that the devices are intended as replacements for fitting to vehicles in use and that it would not be technically feasible for the devices in question to satisfy the photometric requirements for Class IA;
- 12.3. May prohibit the fitting of retro-reflecting devices which do not meet the requirements of this Regulation:
 - 12.3.1. On vehicles for which type approval or individual approval was issued on or after 20 March 1984.
 - 12.3.2. On vehicles first brought into use on or after 20 March 1985.

Annex 1

Retro-reflecting devices

Symbols and units are described **in Annex 7 to the Horizontal Reference Document.**

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 definitively discontinued

of a type of retro-reflecting device pursuant to Regulation No. 3.

Approval No. Extension No.

1. Trade name or mark of the device:
2. Manufacturer's name for the type of device:
3. Manufacturer's name and address:
4. If applicable, name and address of the 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. Concise description:
In isolation/part of an assembly of devices:²
- Colour of light emitted: white/red/amber:²
- Installation as an integral part of a lamp which is integrated into the body of a vehicle: yes/no²
- Geometric conditions of installation and relating variations, if any:

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

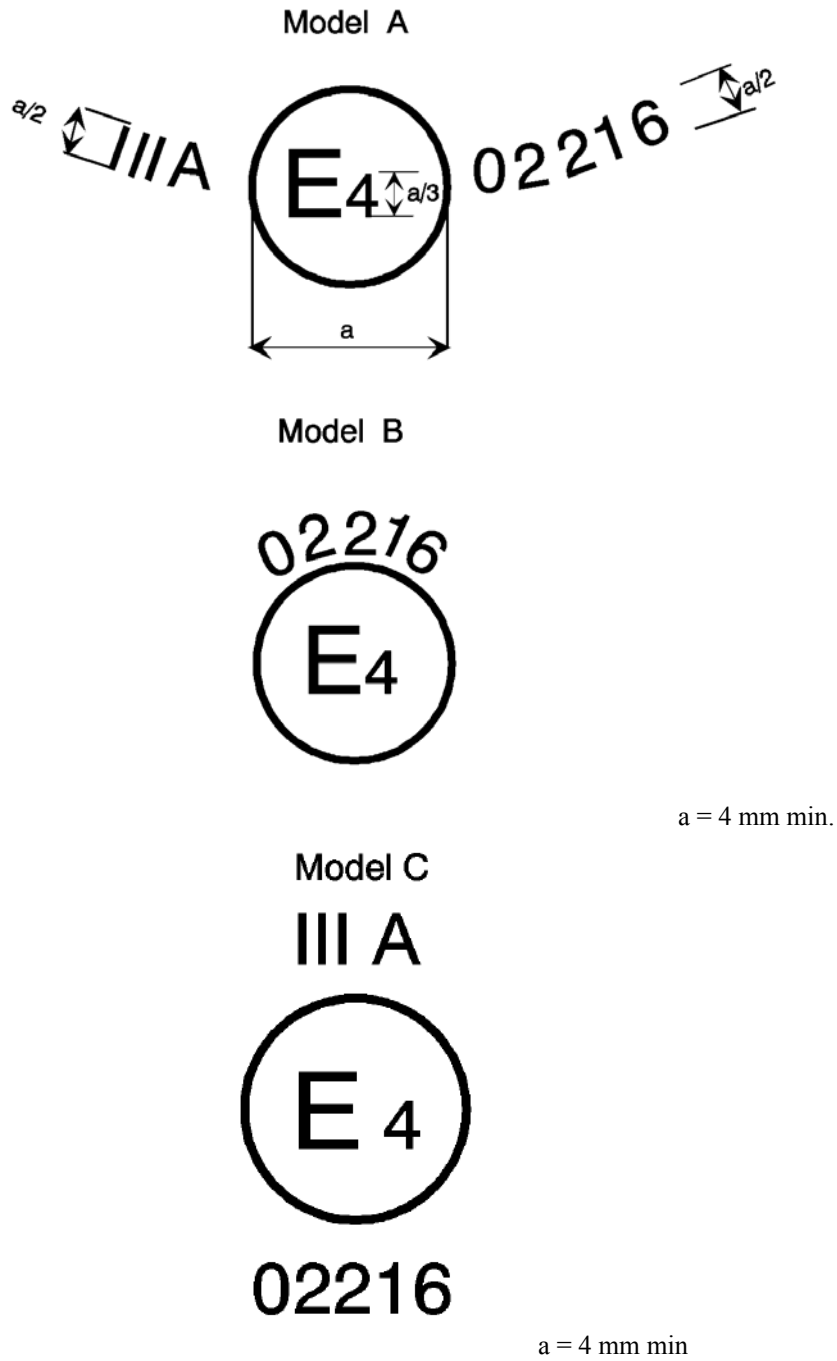
² Strike out what does not apply.

- 10. Position of the approval mark:
- 11. Reason(s) for extension (if applicable):
- 12. Approval granted/refused/extended/withdrawn:²
- 13. Place:
- 14. Date:
- 15. Signature:
- 16. The following documents, bearing the approval number shown above,
are available on request:
.....
.....
.....

Annex 3

Examples of approval marks

Figure 1
Marking for single lamps



Note: The above approval number must be placed close to, but in any position in relation to, the circle surrounding the letter "E". The digits constituting the approval number must face the same way as the "E". The group of symbols indicating the class must be diametrically opposite the approval number. The Type Approval Authorities shall avoid using approval numbers IA, IB, IIIA, IIIB and IVA which might be confused with the class symbols IA, IB, IIIA, IIIB and IVA.

These sketches show various possible arrangements and are given as examples only.

The above approval mark affixed to a retro-reflecting device shows that the type of device concerned has been approved in the Netherlands (E 4) under approval number 02216. The approval number shows that approval was granted in accordance with the requirements of the Regulation as modified by the 02 series of amendments.

Annex 4

Test procedure - Class IA and Class IIIA

1. The applicant shall submit for approval ten samples which shall be tested in the chronological order indicated in Annex 12.
2. After verification of the general specifications (paragraph 6. of the Regulation) and the specifications of shape and dimensions (Annex 5), the ten samples shall be subjected to the heat resistance test described in Annex 10 and at least one hour after this test examined as to their colorimetric characteristics and CIL (Annex 7) for an angle of divergence of 20' and an illumination angle $V = H = 0^\circ$ or if necessary, in the position defined in Annex 7, paragraphs 4. and 4.1. The two retro-reflecting devices giving the minimum and maximum values shall then be fully tested as shown in Annex 7. These two samples shall be kept by the laboratories for any further checks which may be found necessary. The other eight samples shall be divided into four groups of two:
 - First group: The two samples shall be subjected successively to the water penetration test (Annex 8, paragraph 1.1.) and then, if this test is satisfactory, to the tests for resistance to fuels and lubricants (Annex 8, paragraphs 3. and 4.).
 - Second group: The two samples shall, if necessary, be subjected to the corrosion test (Annex 8, paragraph 2.), and then to the abrasive-strength test of the rear face of the retro-reflecting device (Annex 8, paragraph 5.).
 - Third group: The two samples shall be subjected to the test for stability in time of the optical properties of retro-reflecting device (Annex 9).
 - Fourth group: The two samples shall be subjected to the colour-fastness test (Annex 11).
3. After undergoing the tests referred to in the above paragraph, the retro-reflecting devices in each group must have:
 - 3.1. A colour which satisfies the conditions laid down in Annex 6. This shall be verified by a qualitative method and, in case of doubt, confirmed by a quantitative method.
 - 3.2. A CIL which satisfies the conditions laid down in Annex 7. The verification shall be performed only for an angle of divergence of 20' and an illumination angle of $V = H = 0^\circ$ or, if necessary, in the position specified in Annex 7, paragraphs 4. and 4.1.

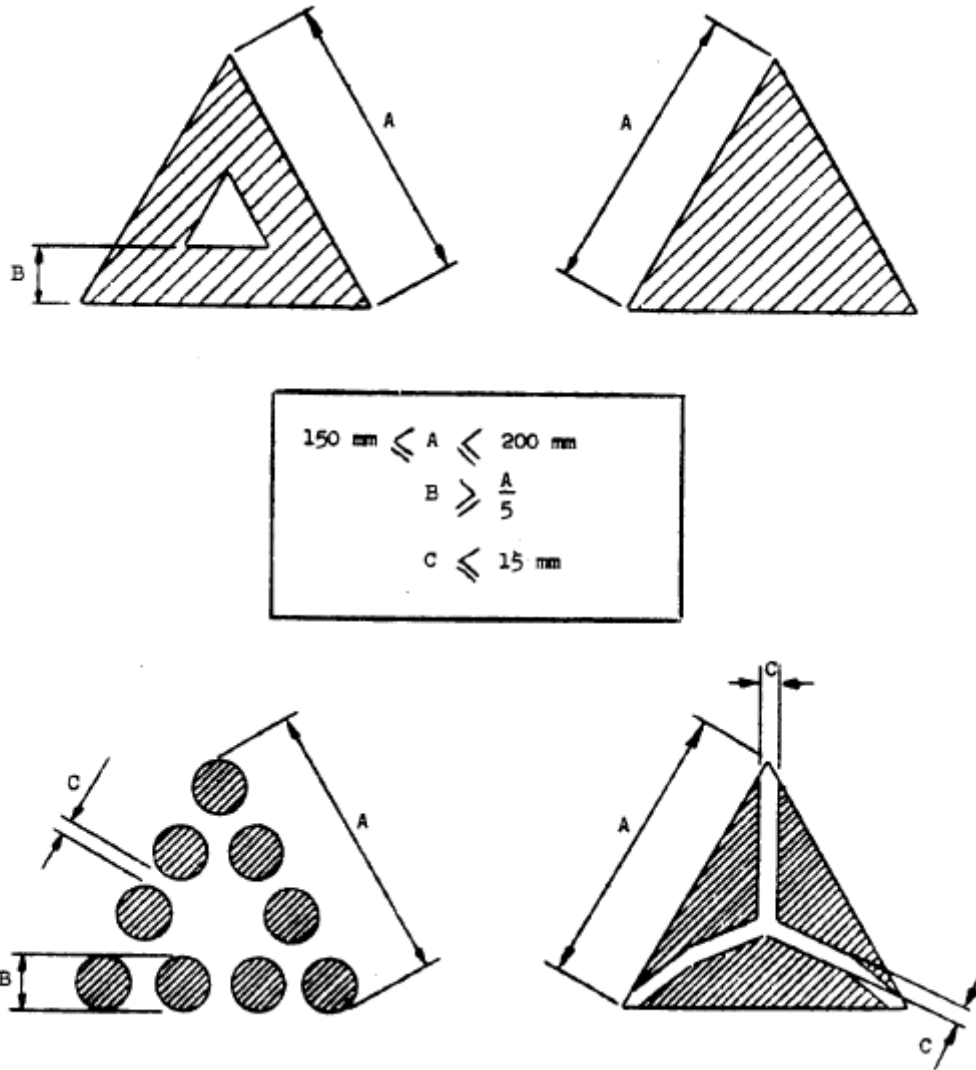
Annex 5

Specifications of shape and dimensions

1. Shape and dimensions of retro-reflecting devices in Class IA or IB
 - 1.1. The shape of the illuminating surfaces shall not be easily confused with a triangle at normal observation distances.
2. Shape and dimensions of retro-reflecting devices in Classes IIIA and IIIB (see appendix to this annex)
 - 2.1. The illuminating surfaces of retro-reflecting devices in Classes IIIA and IIIB must have the shape of an equilateral triangle. If the word "TOP" is inscribed in one corner, the apex of that corner must be directed upwards.
 - 2.2. The illuminating surface may or may not have at its centre a triangular, non-retro-reflecting area, with sides parallel to those of the outer triangle.
 - 2.3. The illuminating surface may or may not be continuous. In any case, the shortest distance between two adjacent retro-reflecting optical units must not exceed 15 mm.
 - 2.4. The illuminating surface of a retro-reflecting device shall be considered to be continuous if the edges of the illuminating surfaces of adjacent separate optical units are parallel and if the said optical units are evenly distributed over the whole solid surface of the triangle.
 - 2.5. If the illuminated surface is not continuous, the number of separate retro-reflecting optical units including the corner units shall not be less than four on each side of the triangle.
 - 2.5.1. The separate retro-reflecting optical units shall not be replaceable unless they consist of approved retro-reflecting devices in Class IA.
 - 2.6. The outside edges of the illuminating surfaces of triangular retro-reflecting devices in Classes IIIA and IIIB shall be between 150 and 200 mm long. In the case of devices of hollow-triangle type, the width of the sides, measured at right angles to the latter, shall be equal to at least 20 per cent of the effective length between the extremities of the illuminating surface.
3. Shape and dimensions of retro-reflecting devices in Class IVA
 - 3.1. The shape of the illuminating surfaces shall not be easily confused with a triangle at normal observation distances.
 - 3.2. The light emitting surface of the retro-reflecting device must be at least 25 cm².
4. Compliance with the above specifications shall be verified by visual inspection.

Annex 5 - Appendix

Retro-reflectors for trailers - Classes IIIA and IIIB



Note: These sketches are for illustration purposes only.

Annex 6

Colorimetric specifications

1. These specifications shall apply only to clear, red or amber retro-reflecting devices.
 - 1.1. Retro-reflecting devices may consist of a combined retro-reflecting optical unit and filter, which must be so designed that they cannot be separated under normal conditions of use.
 - 1.2. The colouring of retro-reflecting optical units and filters by means of paint or varnish is not permitted.
 2. When the retro-reflecting device is illuminated by CIE standard illuminant A, with an angle of divergence of 1/3 degrees and an illumination angle of $V = H = 0$ degree, or, if this produces a colourless surface reflection, an angle $V = +/- 5$ degrees, $H = 0$ degree, the trichromatic coordinates of the reflected luminous flux must be within the limits according to **relevant subparagraph 2 of Annex 4 of the HRD**.
3. Clear retro-reflecting devices must not produce a selective reflection, that is to say, the trichromatic coordinates "x" and "y" of the standard illuminant "A" used to illuminate the retro-reflecting device must not undergo a change of more than 0.01 after reflection by the retro-reflecting device.

Annex 7

Photometric specifications

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

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

2. For photometric measurements, only the illuminating surface defined by the planes contiguous to the outermost parts of the optical system of the retro-reflecting device as indicated by the manufacturer and contained within a circle of 200 mm diameter for Class IA or IB shall be considered, and the illuminating surface itself shall be limited to 100 cm² though the surfaces of the retro-reflecting optical units need not necessarily attain this area. The manufacturer shall specify the perimeter of the area to be used. In the case of Class IIIA, Class IIIB and Class IVA, the whole of the illuminating surfaces shall be considered without limitation as to size.

3. CIL values

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

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

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

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

$$(V = \pm 10^\circ, H = 0^\circ)$$

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

- 3.1.2. CIL values for amber retro-reflecting devices in Class IA or IB must be at least equal to those in the table of paragraph 3.1.1. above multiplied by the coefficient 2.5.
- 3.1.3. CIL values for colourless retro-reflecting devices in Class IA or IB must be at least equal to those in the table of paragraph 3.1.1. above multiplied by the coefficient 4.

- 3.2. However, in the case where a retro-reflecting device of Class IA, Class IB, Class IIIA or Class IIIB is intended to be installed with its H plane at a mounting height less than 750 mm above the ground, the CIL values are verified only up to an angle of 5° downwards.
- 3.3. For devices of Class IVA the CIL values must be at least equal to those in the table below, expressed in millicandelas per lux, for the angles of divergence and illumination shown.

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

- 3.4. However, in the case where a retro-reflecting device of Class IVA is intended to be installed with its H plane at a mounting height less than 750 mm above the ground, the CIL values are verified only up to an angle of 5° downwards.
4. When the CIL of a retro-reflecting device is measured for an angle β of $V = H = 0^\circ$, it shall be ascertained whether any mirror effect is produced by slightly turning the device. If there is any such effect, a reading shall be taken with an angle β of $V = \pm 5^\circ$, $H = 0^\circ$. The position adopted shall be that corresponding to the minimum CIL for one of these positions.
- 4.1. With an illumination angle β of $V = H = 0^\circ$, or the angle specified in paragraph 4. above, and an angle of divergence of 20', retro-reflecting devices which are not marked "TOP" shall be rotated about their axes of reference to the position of minimum CIL, which must conform to the value specified in paragraph 3. above. When the CIL is measured for the other angles of illumination and divergence, the retro-reflecting device shall be placed in the position corresponding to this value of ϵ . If the specified values are not attained, the device may be rotated about its axis of reference $\pm 5^\circ$ from that position.
- 4.2. With an illumination angle β of $V = H = 0^\circ$, or the angle specified in paragraph 4. above, and an angle of divergence of 20', retro-reflecting devices marked "TOP" shall be rotated about their axes $\pm 5^\circ$. The CIL must not fall below the prescribed value in any position assumed by the device during this rotation.
- 4.3. If for the direction $V = H = 0^\circ$, and for $\epsilon = 0^\circ$ the CIL exceeds the specified value by 50 per cent or more, all measurements for all angles of illumination and divergence shall be made for $\epsilon = 0^\circ$.

Annex 8

Resistance to external agents

1. Resistance to water and dirt penetration
 - 1.1. Water submersion test
 - 1.1.1. Retro-reflecting devices whether part of a lamp or not, shall be stripped of all removable parts and immersed for 10 minutes in water at a temperature of 50 ± 5 °C, the highest point of the upper part of the illuminating surface being 20 mm below the surface of the water. This test shall be repeated after turning the retro-reflecting device through 180°, so that the illuminating surface is at the bottom and the rear face is covered by about 20 mm of water. These optical units shall then be immediately immersed in the same conditions in water at a temperature of 25 ± 5 °C.
 - 1.1.2. No water shall penetrate to the reflecting surface of the retro-reflecting optical unit. If visual inspection clearly reveals the presence of water, the device shall not be considered to have passed the test.
 - 1.1.3. If visual inspection does not reveal the presence of water or in case of doubt, the CIL shall be measured by the method described in Annex 4, paragraph 3.2., or Annex 14, paragraph 4.2., the retro-reflecting device being first lightly shaken to remove excess water from the outside.
 - 1.2. Alternative test procedure for Classes IB and IIIB devices

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

 - 1.2.1. Moisture test

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

 - 1.2.1.1. Water spray test equipment

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

 - 1.2.1.1.1. Cabinet

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

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

- 1.2.1.1.3. Precipitation rate

The precipitation rate of the water spray at the device shall be 2.5 (+1.6/-0) mm/min as measured with a vertical cylindrical collector centred on the vertical axis of the rotating test platform. The height of the collector shall be 100 mm and the inside diameter shall be a minimum of 140 mm.
- 1.2.1.2. Water spray test procedure

A sample device mounted on a test fixture, with initial CIL measured and recorded shall be subjected to a water spray as follows:

 - 1.2.1.2.1. Device openings

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

The device shall be rotated about its vertical axis at a rate of $4.0 \pm 0.5 \text{ min}^{-1}$.
 - 1.2.1.2.3. If the retro-reflector is reciprocally incorporated or grouped with signalling or lighting functions, these functions shall be operated at design voltage according to a cycle of 5 min ON (in flashing mode, where appropriate), 55 min OFF.
 - 1.2.1.2.4. Test duration

The water spray test shall last 12 hours (12 cycles of 5/55 min).
 - 1.2.1.2.5. Drain period

The rotation and the water spray shall be turned OFF and the device allowed to drain for 1 hour with the cabinet door closed.
 - 1.2.1.2.6. Sample evaluation

Upon completion of the drain period. The interior of the device shall be observed for moisture accumulation. No standing pool of water shall be allowed to be formed, or which can be formed by tapping or tilting the device. The CIL shall be measured according to the method specified in Annex 4 paragraph 3.2. after having dried the exterior of the device with a dry cotton cloth.
- 1.2.2. Dust exposure test

This test evaluates the ability of the sample device to resist dust penetration which could significantly affect the photometric output of the retro-reflector.

 - 1.2.2.1. Dust exposure test equipment

The following equipment shall be used to test for dust exposure:

 - 1.2.2.1.1. Dust exposure test chamber

The interior of the test chamber shall be cubical in shape in size 0.9 to 1.5 m per side. The bottom may be "hopper shaped" to aid in collecting the dust. The internal chamber volume, not including a "hopper shaped" bottom shall be 2 m³ maximum and shall be charged with 3 to 5 kg of the test dust. The chamber shall have the capability of agitating the test dust by means of compressed air or blower fans in such a way that the dust is diffused throughout the chamber.

- 1.2.2.1.2. The dust
The test dust used shall be fine powdered cement in accordance with standard ASTM C 150-84.*
- 1.2.2.2. Dust exposure test procedure
A sample device, mounted on a test fixture, with the initial CIL measured and recorded, shall be exposed to dust as follows:
- 1.2.2.2.1. Device openings
All drain holes and other openings shall remain open. Drain wicks, when used, shall be tested in the device.
- 1.2.2.2.2. Dust exposure
The mounted device shall be placed in the dust chamber no closer than 150 mm from a wall. Devices with a length exceeding 600 mm shall be horizontally centred in the test chamber. The test dust shall be agitated as completely as possible by compressed air or blower(s) at intervals of 15 min for a period of 2 to 15 s for the duration of 5 hours. The dust shall be allowed to settle between the agitation periods.
- 1.2.2.2.3. Measured sample evaluation
Upon completion of the dust exposure test, the exterior of the device shall be cleaned and dried with a dry cotton cloth and the CIL measured according to the method specified in Annex 4, paragraph 3.2.
2. Resistance to corrosion
- 2.1. Retro-reflecting devices must be so designed that they retain the prescribed photometric and colorimetric characteristics despite the humidity and corrosive influences to which they are normally exposed. The resistance of the front surface to tarnishing and of the protection of the rear face to deterioration shall be checked, particularly when an essential metal component seems liable to be attacked.
- 2.2. The retro-reflecting device, or the lamp if the device is combined with a light, shall be stripped of all removable parts and subjected to the action of a saline mist for a period of 50 hours, comprising two periods of exposure of 24 hours each, separated by an interval of two hours during which the sample is allowed to dry.
- 2.3. The saline mist shall be produced by atomizing, at a temperature of $35\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, a saline solution obtained by dissolving 20 ± 2 parts by weight of sodium chloride in 80 parts of distilled water containing not more than 0.02 per cent of impurities.
- 2.4. Immediately after completion of the test, the sample must not show signs of excessive corrosion liable to impair the efficiency of the device.

* American Society for Testing and Materials

3. Resistance to fuels
The outer surface of the retro-reflecting device and, in particular, of the illuminating surface, shall be lightly wiped with a cotton cloth soaked in a mixture of 70 vol. per cent of n-heptane and 30 vol. per cent of toluol. After about five minutes, the surface shall be inspected visually. It must not show any apparent surface changes, except that slight surface cracks will not be objected to.
4. Resistance to lubricating oils
The outer surface of the retro-reflecting device and, in particular, the illuminating surface, shall be lightly wiped with a cotton cloth soaked in a detergent lubricating oil. After about 5 minutes, the surface shall be cleaned. The CIL shall then be measured (Annex 4, paragraph 3.2. or Annex 14, paragraph 4.2.).
5. Resistance of the accessible rear face of mirror-backed retro-reflecting devices
 - 5.1. After having brushed the rear face of the retro-reflecting device with a hard nylon brush, a cotton cloth soaked in the mixture, defined in paragraph 3. Above shall be applied to the said rear face for one minute. The cotton cloth is then removed and the retro-reflecting device left to dry.
 - 5.2. As soon as evaporation is completed, an abrasion test shall be made by brushing the rear face with the same nylon brush as before.
 - 5.3. The CIL shall then be measured (Annex 4, paragraph 3.2. or Annex 14, paragraph 4.2.) after the whole surface of the mirror-backed rear face has been covered with Indian ink.

Annex 9

Stability in time of the optical properties¹ of retro-reflecting devices

1. The Type Approval Authority which granted approval shall have the right to check the stability in time of the optical properties of a type of retro-reflecting device 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 retro-reflector in use exhibits a systematic defect, the said authorities shall transmit any components removed for examination to the Type Approval Authority which granted approval, with a request for its opinion.
3. In the absence of other criteria, the concept of "systematic defect" of a type of retro-reflector 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 retro-reflecting devices, it is in the present state of the art not yet possible to assess this stability by laboratory tests of limited duration.

Annex 10

Resistance to heat

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

Annex 11

Colour-fastness¹

1. The Type Approval Authority which granted approval shall have the right to check the colour-fastness of a type of retro-reflecting device 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 retro-reflector in use exhibits a systematic defect, the said authorities shall transmit any components removed for examination to the Type Approval Authority which granted approval, with a request for its opinion.
3. In the absence of other criteria, the concept "systematic defect" of a type of retro-reflector in use shall be interpreted in conformity with the intention of paragraph 9.1. of this Regulation.

¹ Despite the importance of tests to check the colour-fastness of retro-reflecting devices, it is in the present state of the art not yet possible to assess colour-fastness by laboratory tests of limited duration.

Annex 12

Chronological order of tests

Number of annex	Number of paragraph	Tests	Samples											
			a	b	c	d	e	f	g	h	i	j		
-	6.*	General specifications: visual inspection	x	x	x	x	x	x	x	x	x	x	x	x
5	-	Shapes and dimensions: visual inspection	x	x	x	x	x	x	x	x	x	x	x	x
10	-	Heat: 48 h at 65° ± 2°C	x	x	x	x	x	x	x	x	x	x	x	x
		Visual inspection for distortion	x	x	x	x	x	x	x	x	x	x	x	x
6	-	Colorimetry: visual inspection	x	x	x	x	x	x	x	x	x	x	x	x
		Trichromatic coordinates in case of doubt		x										
7	-	Photometry: limited to 20' and V = H = 0°	x	x	x	x	x	x	x	x	x	x	x	x
7	3.	Complete photometry			x	x								
8	1.	Water: 10 min. in normal position								x	x			
		10 min. in inverted position								x	x			
		visual inspection								x	x			
4	3.1.	Colorimetry: visual inspection								x	x			
		Trichromatic coordinates in case of doubt								x	x			
4	3.2.	Photometry: limited to 20' and V = H = 0°								x	x			
8	3.	Motor fuels: 5 min.								x	x			
		visual inspection								x	x			
8	4.	Oils: 5 min.								x	x			
		visual inspection								x	x			
4	3.1.	Colorimetry: visual inspection												
		Trichromatic coordinates in case of doubt								x	x			
4	3.2.	Photometry: limited to 20' and V = H = 0°								x	x			
8	2.	Corrosion: 24 hours						x	x					
		2 hours interval						x	x					
		24 hours						x	x					
		visual inspection						x	x					
8	5.	Rear face: 1 min.						x	x					
		visual inspection						x	x					
4	3.1.	Colorimetry: visual inspection						x	x					
		Trichromatic coordinates in case of doubt						x	x					
4	3.2.	Photometry: limited to 20' and V = H = 0°						x	x					
9	-	Stability in time												
4	3.1.	Colorimetry: Visual inspection or trichromatic coordinates												
4	3.2.	Photometry: limited to 20' and V = H = 0°												
11	-	Colour-fastness												
4	3.1.	Colorimetry: Visual inspection or trichromatic coordinates												
4	3.2.	Photometry: limited to 20' and V = H = 0°												
4	2.	Deposit of samples with authority			x	x								

* of the Regulation.

Annex 13

Resistance to impact - Class IVA

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

Annex 14

Test procedure - Class IVA

1. The applicant shall submit for approval ten samples which shall be tested in the chronological order indicated in Annex 15.
2. After verification of the specifications in paragraphs 6.1. to 6.5. of this Regulation and the specifications of shape and dimensions (Annex 5), the ten samples shall be subjected to the heat resistance test (Annex 10) and one hour minimum after this test examined as to their colorimetric characteristics and CIL (Annex 7) for an angle of divergence of 20' and an illumination angle $V = H = 0^\circ$ or, if necessary, in the positions defined in Annex 7. The two retro-reflecting devices giving the minimum and maximum values shall then be fully tested as shown in Annex 7. These two samples shall be kept by the laboratories for any further checks which may be found necessary.
3. Four samples out of the remaining eight samples shall be selected at random and divided into two groups of two in each group.

First group:

The two samples shall be subjected successively to the water-penetration resistance test (Annex 8, paragraph 1.) and then, if this test is satisfactory, to the tests for resistance to fuels and lubricating oils (Annex 8, paragraphs 3. and 4.).

Second group:

The two samples shall, if relevant, be subjected to the corrosion test (Annex 8, paragraph 2.), and then to the abrasive-strength test of the rear face of the retro-reflecting device (Annex 8, paragraph 5.). These two samples shall also be subjected to the impact test (Annex 13).
4. After undergoing the tests referred to in the above paragraph, the retro-reflecting devices in each group must have:
 - 4.1. A colour which satisfies the conditions laid down in Annex 6. This shall be verified by a qualitative method and, in case of doubt, confirmed by a quantitative method;
 - 4.2. A CIL which satisfies the conditions laid down in Annex 7. Verification shall be performed only for an angle of divergence of 20' and an illumination angle of $V = H = 0^\circ$ or, if necessary, in the positions specified in Annex 7.
5. The four remaining samples can be utilized, if necessary, for any other purpose.

Annex 15

Chronological order of tests for Class IVA

Number of annex	Number of paragraph	Tests	Samples											
			a	b	c	d	e	f	g	h	i	j		
-	6.*	General specifications: visual inspection	x	x	x	x	x	x	x	x	x	x	x	x
5	-	Shape and dimensions: visual inspection	x	x	x	x	x	x	x	x	x	x	x	x
10	-	Heat: 48 h at 65 °C ± 20°C Visual inspection for distortion	x	x	x	x	x	x	x	x	x	x	x	x
6	-	Colorimetry: visual inspection Trichromatic coordinates in case of doubt	x	x	x	x	x	x	x	x	x	x	x	x
7	-	Photometry: limited to 20' and V = H = 0°	x	x	x	x	x	x	x	x	x	x	x	x
7	-	Complete photometry	x	x										
8	1.	Water: 10 min. in normal position 10 min. in inverted position visual inspection			x	x								
8	3.	Motor fuels: 5 min. visual inspection			x	x								
8	4.	Oils: 5 min. visual inspection			x	x								
6	-	Colorimetry: visual inspection Trichromatic coordinates in case of doubt			x	x								
7	-	Photometry: limited to 20' and V = H = 0°			x	x								
8	2.	Corrosion: 24 hours 2 hours' interval 24 hours visual inspection					x	x						
8	5.	Rear face: 1 min. visual inspection					x	x						
13	-	Impact visual inspection					x	x						
6	-	Colorimetry: visual inspection Trichromatic coordinates in case of doubt					x	x						
7	-	Photometry: limited to 20' and V = H = 0°					x	x						
14	2.	Deposit of samples with Authority	x	x										

* of the Regulation.

Annex 16

Test procedure for Classes IB and IIIB devices

Retro-reflecting devices of Classes IB and IIIB shall be tested according to the test procedures specified in Annex 4, following the chronological order of tests given in Annex 12, with the exception of the test according to Annex 8, paragraph 1., which for Classes IB and IIIB devices may be replaced by the test specified in Annex 8, paragraph 1.2.

Annex 17

Minimum requirements for conformity of production control procedures

The minimum requirements for conformity of production control procedures set forth in **Annex 2** to the HRD shall be complied with;

Annex 18

Minimum requirements for sampling by an inspector

The minimum requirements for sampling by an inspector set forth in **Annex 3** to the Horizontal Reference Document shall be complied with;
