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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 */

(Revision 2, including the amendments entered into force on 16 October 1995)

Addendum 2: Regulation No. 3

Revision 2

Incorporating:
01 series of amendments - Date of entry into force: 20 March 1982
02 series of amendments - Date of entry into force: 1 July 1985
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UNIFORM PROVISIONS CONCERNING THE APPROVAL OF RETROREFLECTING DEVICES FOR POWER-DRIVEN VEHICLES AND THEIR TRAILERS

UNITED NATIONS

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*/ Former title of the Agreement:

Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958.

Regulation No. 3

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF RETROREFLECTING DEVICES FOR POWER-DRIVEN VEHICLES AND THEIR TRAILERS

Contents

Contents

1. SCOPE

This Regulation applies to retroreflecting devices 1/ used on road vehicles.

2. DEFINITIONS 2/

For the purpose of this Regulation,

2.1. The definitions given in Regulation No. 48 and its series of amendments in force at the time of application for type approval shall apply to this Regulation.

2.2. "Retroreflection" means the reflection in which light is reflected in directions close to the direction from which it came. This property is maintained over wide variations of the illumination angle.

2.3. "Retroreflecting optical unit" means a combination of optical components producing retroreflection.

2.4. "Retroreflecting device" 1/ means an assembly ready for use and comprising one or more retroreflecting optical units.

2.5. "Angle of divergence" means the angle between the straight lines connecting the centre of reference to the centre of the receiver and to the centre of the source of illumination.

2.6. "Illumination angle" means the angle between the axis of reference and the straight line connecting the centre of reference to the centre of the source of illumination.

2.7. "Angle of rotation" means the angle through which the retroreflecting device is rotated about its axis of reference starting from one given position.

2.8. "Angular diameter of the retroreflecting device" means the angle subtended by the greatest dimension of the visible area of the illuminating surface, either at the centre of the source of illumination or at the centre of the receiver.

2.9. "Illumination of the retroreflecting device" is the abbreviated expression used conventionally to designate the illumination measured in a plane perpendicular to the incident rays and passing through the centre of reference.

1/ Also called "retroreflector(s)".

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

2.10. "Coefficient of luminous intensity (CIL)" means the quotient of the luminous intensity reflected in the direction considered, divided by the illumination of the retroreflecting device for given angles of illumination, divergence and rotation.

2.11. The symbols and units used in this Regulation are given in annex 1 to this Regulation.

2.12. A type of "retroreflecting device" is defined by the models and descriptive literature submitted with the application for approval. Retroreflecting devices can be considered as belonging to the same type if they have one or more "retroreflecting optical units" which are identical with those of the standard model, or if not identical are symmetrical and suitable for mounting one on the left and one on the right side of the vehicle, and if their other parts differ from those of the standard model only in ways not affecting the properties to which this Regulation applies.

2.13. Retroreflecting devices are divided into three classes according to their photometric characteristics: Class I A, Class III A and Class IV A.

3. APPLICATION FOR APPROVAL

3.1. The application for approval 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, in sufficient detail to permit identification of the type, showing geometrically the position in which the retroreflecting device is to be fitted to the vehicle. The drawings must show the position intended for the approval number and class indicator 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 retroreflecting optical unit is made;

3.1.3. samples of the retroreflecting device of the colour specified by the manufacturer; the number of samples to be submitted is specified in annex 4;

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

3.1.5. In the case of devices of Class IV A: samples of the retroreflecting device and, if necessary, the means of fixation; the number of samples to be submitted is specified in annex 14 to this Regulation.

4. MARKINGS

4.1. Every retroreflecting device submitted for approval must bear:

4.1.1. the trade name or mark of the applicant;

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

4.2. A space of sufficient size to accommodate the approval mark shall be provided on every device. This space shall be shown on the drawings referred to in paragraph 3.1.1. above.

4.3. The markings must be applied on the illuminating surface, or on one of the illuminating surfaces, of the retroreflecting device and must be visible from the outside when the retroreflecting device is fitted on the vehicle.

4.4. The markings must be clearly legible and be indelible.

5. APPROVAL

5.1. If all the samples submitted meet the requirements of this Regulation, approval shall be granted.

5.2. If the approval granted in respect of a retroreflecting 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 shall be required to meet only the colorimetric specifications (annex 6), the other tests no longer being required. Paragraph 5.2. is not applicable to devices of Class IV A.

5.3. An approval number shall be assigned to each type approved. Its first two digits (at present 02, corresponding to the 02 series of amendments which entered into force on 1 July 1985) 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 same Contracting Party shall not assign the same number to another type of retroreflecting device covered by this Regulation except in the case of an extension of the approval to a device differing only in colour.

5.4. Notice of approval or of extension or refusal of approval of a type of retroreflecting device pursuant to 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.

5.5. There shall be affixed to every retroreflecting device conforming to a type approved under this Regulation, in the space referred to

in paragraph 4.2. above and in addition to the markings prescribed in paragraph 4.1.

5.5.1. an international approval mark consisting of:

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

5.5.1.2. an approval number;

5.5.1.3. a group of symbols "I A", "III A" or "IV A" showing the class in which the retroreflecting device was placed when approved.

5.6. When two or more lamps are part of the same unit of grouped, combined or reciprocally incorporated lamps (including a retroreflector), approval is granted only if each of these lamps satisfies the requirements of this Regulation or of another Regulation. Lamps not satisfying any one of those Regulations shall not be part of such a unit of grouped, combined or reciprocally incorporated lamps.

5.6.1. Where grouped, combined or reciprocally incorporated lamps comply with the requirements of several Regulations, a single international approval mark may be applied, consisting of a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted the approval, an approval number and, if necessary, the required arrow. This approval mark may be placed anywhere on the grouped, combined or reciprocally incorporated lamps provided that:

5.6.1.1. It is visible after their installation;

5.6.1.2. No part of the grouped, combined or reciprocally incorporated lamps that transmits light can be removed without at the same time removing the approval mark.

5.6.2. The identification symbol for each lamp appropriate to each Regulation under which approval has been granted, together with the corresponding series of amendments incorporating the most recent

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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 Yugoslavia, 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 (vacant), 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30-36 (vacant) and 37 for Turkey. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Recognition of Approval for Motor Vehicle Equipment and Parts, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

major technical amendments to the Regulation at the time of issue of the approval, shall be marked;

5.6.2.1. Either on the appropriate light-emitting surface,

5.6.2.2. Or in a group, in such a way that each lamp of the grouped, combined or reciprocally incorporated lamps may be clearly identified (see three possible examples shown in annex 3).

5.6.3. The size of the components of a single approval mark shall not be less than the minimum size required for the smallest of the individual marks by a Regulation under which approval has been granted.

5.6.4. An approval number shall be assigned to each type approved. The same Contracting Party may not assign the same number to another type of grouped, combined or reciprocally incorporated lamps covered by this Regulation.

5.7. The approval mark must be clearly legible and indelible.

5.8. Annex 3 to this Regulation gives examples of arrangements of approval marks for a single lamp (figure 1) and for grouped, combined or reciprocally incorporated lamps (figure 2) with all the additional symbols referred to above.

6. GENERAL SPECIFICATIONS

6.1. Retroreflecting devices must be so constructed that they function satisfactorily and will continue to do so in normal use. In addition, they must 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 retroreflecting devices must not be capable of being easily dismantled.

6.3. Retroreflecting optical units may not be replaceable.

6.4. The outer surface of retroreflecting devices must be easy to clean. Hence it must not be a rough surface; any protuberances it may exhibit must not prevent easy cleaning.

6.5. For devices of Class IV A 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. Retroreflecting 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 (Class I A and Class III A) and annex 14 (Class IV A).

7.2. Depending on the nature of the materials of which the retroreflecting 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

8.1. Every device bearing an approval mark as prescribed in this Regulation shall conform to the type approved.

8.2. Conformity with regard to mechanical and geometrical characteristics shall be considered sufficient if the divergencies are not greater than unavoidable manufacturing tolerances.

8.3. The conformity of production shall not be contested if all the photometric measurements of one specimen taken at random are equal to at least 80 per cent of the specification.

8.4. If the requirement in paragraph 8.3. is not met, a further sample consisting of five specimens shall be taken at random. The average of all like photometric measurements shall be at least equal to the specification and no individual measurement may be less than 50 per cent of the specification.

9. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

9.1. The approval granted for a type of retroreflecting device may be withdrawn if the requirements are not complied with or if a retroreflecting device bearing the approval mark does not conform to the type approved.

9.2 If a Contracting 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.

10. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of retroreflecting device 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 1958 Agreement applying this Regulation by means of a communication form conforming to the model in annex 2 to this Regulation.

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

The Contracting Parties to the Agreement applying 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.

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 retroreflecting devices intended as replacement for vehicles in use;

12.2. May issue approvals for Classes I and II on the basis of the original 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 I A;

12.3. May prohibit the fitting of retroreflecting 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

RETROREFLECTING DEVICE

Symbols and units

A = Area of the illuminating surface of the retroreflecting device (cm^2)

C = Centre of reference

NC = Axis of reference

Rr = Receiver, observer or measuring device

Cr = Centre of receiver

Ør = Diameter of receiver Rr if circular (cm)

Se = Source of illumination

Cs = Centre of source of illumination

Øs = Diameter of source of illumination (cm)

De = Distance from centre Cs to centre C (m)

D'e = Distance from centre Cr to centre C (m)

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

D = Observation distance from and from beyond which the illuminating surface appears to be continuous

α = Angle of divergence

β = Illumination angle. With respect to the line CsC which is always considered to be horizontal, this angle is prefixed by the signs - (left), + (right), + (up) or - (down), according to the position of the source Se in relation to the axis NC, as seen when looking towards the retroreflecting device. For any direction defined by two angles, vertical and horizontal, the vertical angle is always given first.

γ = Angular diameter of the measuring device Rr as seen from point C

δ = Angular diameter of the source Se as seen from point C

ε = Angle of rotation. This angle is positive when the rotation is clockwise as seen when looking towards the illuminating surface. If the retroreflecting device is marked "TOP", the position thus indicated is taken as the origin.

E = Illumination of the retroreflecting device (lux)

CIL = Coefficient of luminous intensity (millicandelas/lux)
Angles are expressed in degrees and minutes.

RETROREFLECTORS

Symbols

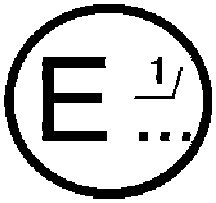
(OFFSET)

ELEVATION

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 retroreflecting 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/ .....

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: .....

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

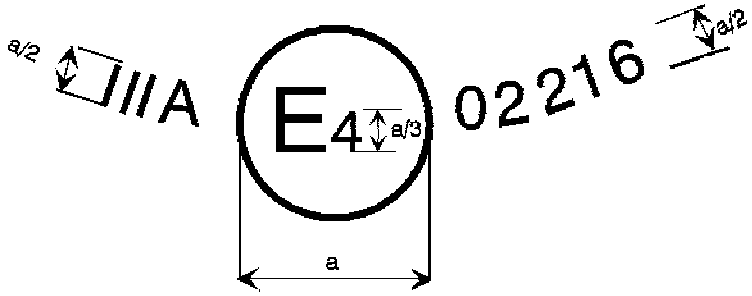
2/ Strike out what does not apply.

Annex 3

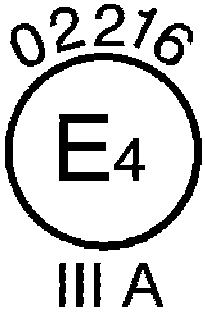
EXAMPLES OF APPROVAL MARKS

Figure 1
(Marking for single lamps)

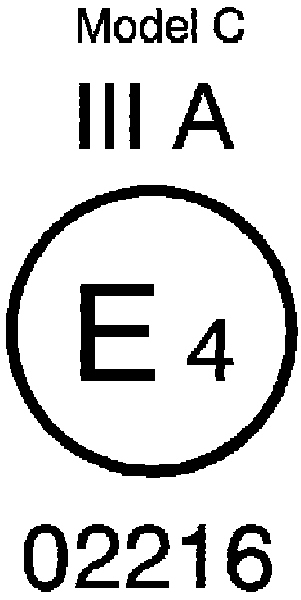
Model A



Model B



a = 4 mm min.



a = 4 mm min.

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 competent authorities shall avoid using approval numbers I A and III A which might be confused with the class symbols I A and III A.

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

The above approval mark affixed to a retroreflecting device shows that the type of device concerned has been approved in the Netherlands (E4) 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.

Figure 2

(Simplified marking for grouped, combined
or reciprocally incorporated lamps)

Model D

Model E

Model F

Note: The three examples of approval marks, models D, E and F represent three possible variants of the marking of a lighting device when two or more lamps are part of the same unit of grouped, combined or reciprocally incorporated lamps. This approval mark shows that the device was approved in the Netherlands (E4) under approval number 3333 and comprising:

A retroreflector of Class I A approved in accordance with the 02 series of amendments to Regulation No. 3;

A rear direction indicator of category 2a approved in accordance with Regulation No. 6 in its original form;

A red rear position lamp (R) approved in accordance with the 01 series of amendments to Regulation No. 7;

A rear fog lamp (F) approved in accordance with Regulation No. 38 in its original form;

A reversing lamp (AR) approved in accordance with Regulation No. 23 in its original form.

A stop lamp with two levels of illumination (S2) approved in accordance with the 01 series of amendments to Regulation No. 7.

Annex 4

TEST PROCEDURE - CLASS I A AND CLASS III A

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 to this Regulation and at least one hour after this test examined as to their colorimetric characteristics (annex 6) and CIL (annex 7) for an angle of divergence of 20′ and an illumination angle V = H = 0° or if necessary, in the position defined in annex 7, paragraphs 4 and 4.1. The two retroreflecting 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) 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 retroreflecting 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 retroreflecting 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 retroreflecting 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° 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 RETROREFLECTING DEVICES IN CLASS I A

1.1. The shape of the illuminating surfaces must be simple, and not easily confused at normal observation distances, with a letter, a digit or a triangle.

1.2. The preceding paragraph notwithstanding, a shape resembling the letters or digits of simple form O, I, U or 8 is permissible.

2. SHAPE AND DIMENSIONS OF RETROREFLECTING DEVICES IN CLASS III A (see appendix to this annex)

2.1. The illuminating surfaces of retroreflecting devices in Class III A must have the shape or 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-retroreflecting 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 retroreflecting optical units must not exceed 15 mm.

2.4. The illuminating surface of a retroreflecting 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 retroreflecting optical units including the corner units shall not be less than four on each side of the triangle.

2.5.1. The separate retroreflecting optical units shall not be replaceable unless they consist of approved retroreflecting devices in Class I A.

2.6. The outside edges of the illuminating surfaces of triangular retroreflecting devices in Class III A 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 RETROREFLECTING DEVICES IN CLASS IV A

3.1. The shape of the light emitting surfaces must be simple and not easily confused at normal observation distances with a letter, a digit or a triangle. However, a shape resembling the letters and digits of simple form, O, I, U and 8 is permissible.

3.2. The light emitting surface of the retroreflecting device must be at least 25 cm^2.

4. Compliance with the above specifications shall be verified by visual inspection.

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Annex 5 - Appendix

RETROREFLECTORS FOR TRAILERS - CLASS III A

(OFFSET)

Note: These sketches are for illustration purposes only.

Annex 6

COLORIMETRIC SPECIFICATIONS

1. These specifications shall apply only to clear, red or amber retroreflecting devices.

1.1. Retroreflecting devices may consist of a combined retroreflecting optical unit and filter, which must be so designed that they cannot be separated under normal conditions of use.

1.2. The colouring of retroreflecting optical units and filters by means of paint or varnish is not permitted.

2. When the retroreflecting device is illuminated by ICI standard illuminant A, with an angle of divergence of 1/3° and an illumination angle of V = H = 0°, or, if this produces a colourless surface reflection, an angle V = ± 5°, H = 0°, the trichromatic coordinates of the reflected luminous flux must be within the following limits:

Red:	limit towards yellow:	$y \leq 0.335$
	limit towards purple:	$z \leq 0.008$
Amber:	limit towards yellow:	$y \leq 0.429$
	limit towards red:	$y \geq 0.398$
	limit towards white:	$z \leq 0.007$

2.1. In the case of red and amber, compliance with the colorimetric specifications shall be verified by a visual comparison test.

2.2. If any doubt remains after this test, compliance with the colorimetric specifications shall be verified by determining the trichromatic coordinates of the most doubtful sample.

3. Clear retroreflecting 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 retroreflecting device must not undergo a change of more than 0.01 after reflection by the retroreflecting device.

3.1. This shall be verified by the visual comparison test indicated above, the control field being illuminated by a light source of which the trichromatic coordinates differ by 0.01 from that of standard illuminant A.

3.2. In case of doubt, the trichromatic coordinates for the most selective sample shall be determined.

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Annex 7

PHOTOMETRIC SPECIFICATIONS

1. When applying for approval, the applicant shall specify the axis of reference. This corresponds to the illumination angle V = H = 0° in the table of coefficients of luminous intensity (CIL).

2. For photometric measurements, only the illuminating surface contained within a circle of 200 mm diameter for Class I A shall be considered, and the illuminating surface itself shall be limited to 100 cm^2 though the surfaces of the retroreflecting 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 III A and Class IV A, the whole of the illuminating surfaces shall be considered without limitation as to size.

3. CIL values

3.1. Categories I A and III A

3.1.1. The CIL values for red retroreflecting 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 V Horizontal H	0° 0°	± 10° 0°	± 5° ± 20°
I A	20′ 1°30′		300 5	200 2.8	100 2.5
III A	20′ 1°30′		450 12	200 8	150 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 = ± 10°, H = 0°) (V = ± 5°, H = ± 20°).

3.1.2. CIL values for amber retroreflecting devices in Class I A 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 retroreflecting devices in Class I A must be at least equal to those in the table of paragraph 3.1.1. above multiplied by the coefficient 4.

3.2. For devices of Class IV A 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 V Horizontal H	0 0	± 10 0	0 ± 20	0 ± 30	0 ± 40	0 ± 50
White	20′ 1°30′		1,800 34	1,200 24	610 15	540 15	470 15	400 15
Amber	20′ 1°30′		1,125 21	750 15	380 10	335 10	290 10	250 10
Red	20′ 1°30′		450 9	300 6	150 4	135 4	115 4	100 4

4. When the CIL of a retroreflecting device is measured for an angle β of V = H = 0°, 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 = ± 5°, H = 0°. 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°, or the angle specified in paragraph 4 above, and an angle of divergence of 20′, retroreflecting 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 retroreflecting 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 ± 5° from that position.

4.2. With an illumination angle β of V = H = 0°, or the angle specified in paragraph 4 above, and an angle of divergence of 20′, retroreflecting devices marked "TOP" shall be rotated about their axes ± 5°. 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°, and for ε = 0° 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 ε = 0°.

Annex 8

RESISTANCE TO EXTERNAL AGENTS

1. RESISTANCE TO PENETRATION OF WATER

1.1. Retroreflecting 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 retroreflecting device through 180°C, 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.

1.2. No water must penetrate to the reflecting surface of the retroreflecting optical unit. If visual inspection clearly reveals the presence of water, the device shall not be considered to have passed the test.

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 retroreflecting device being first lightly shaken to remove excess water from the outside.

2. RESISTANCE TO CORROSION

2.1. Retroreflecting 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 retroreflecting 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° ± 2°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.

3. RESISTANCE TO FUELS

The outer surface of the retroreflecting 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 retroreflecting 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 RETROREFLECTING DEVICES

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

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Annex 9

STABILITY IN TIME OF THE OPTICAL PROPERTIES 1/
OF RETROREFLECTING DEVICES

1. The authority which granted approval shall have the right to check the stability in time of the optical properties of a type of retroreflecting 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 retroreflector in use exhibits a systematic defect, the said authorities shall transmit any components removed for examination to the 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 retroreflector 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 retroreflecting 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 retroreflecting device shall be kept for 48 consecutive hours in a dry atmosphere at a temperature of 65 ± 2°C.

2. After this test, no cracking or appreciable distortion of the retroreflecting device and, in particular, of its optical component must be visible.

Annex 11

COLOUR-FASTNESS 1/

1. The authority which granted approval shall have the right to check the colour-fastness of a type of retroreflecting 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 retroreflector in use exhibits a systematic defect, the said authorities shall transmit any components removed for examination to the 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 retroreflector 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 retroreflecting 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
5	–	Shapes and dimensions: visual inspection	x	x	x	x	x	x	x	x	x	x
10	–	Heat: 48 h at 65° ± 2°C Visual inspection for distortion	x x	x x	x x	x x	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
7	–	Photometry: limited to 20' and V = H = 0°	x	x	x	x	x	x	x	x	x	x
7	3	Complete photometry			x	x						
8	1	Water: 10 min. in normal position 10 min. in inverted position visual inspection							x x x	x x x		
4	3.1.	Colorimetry: visual inspection Trichromatic coordinates in case of doubt							x x	x x		
4	3.2.	Photometry: limited to 20' and V = H = 0°							x	x		
8	3	Motor fuels: 5 min. visual inspection							x x	x x		
8	4	Oils: 5 min. visual inspection							x x	x x		
4	3.1.	Colorimetry: visual inspection Trichromatic coordinates in case of doubt							 x	 x		

*/ of the Regulation.

Number of annex	Number of paragraph	TESTS	SAMPLES									
			a	b	c	d	e	f	g	h	i	j
4	3.2.	Photometry: limited to 20' and V = H = 0°							x	x		
8	2	Corrosion: 24 hours 2 hours interval 24 hours visual inspection					x x x x	x x x x				
8	5	Rear face: 1 min. visual inspection					x x	x x				
4	3.1.	Colorimetry: visual inspection Trichromatic coordinates in case of doubt					x x	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 administration			x	x						

Annex 13

RESISTANCE TO IMPACT - CLASS IV A

1. The retroreflecting 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 retroreflecting device is tested at room temperature with this method, the lens shall not crack.

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Annex 14

TEST PROCEDURE - CLASS IV A

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. 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 (annex 6) and CIL (annex 7) for an angle of divergence of 20′ and an illumination angle V = H = 0° or, if necessary, in the positions defined in annex 7. The two retroreflecting 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 retroreflecting 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 retroreflecting 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° 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 IV A

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
5	-	Shape and dimensions: visual inspection	x	x	x	x	x	x	x	x	x	x
10	-	Heat: 48 h at 65° ± 20°C Visual inspection for distortion	x x	x x	x x	x x	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
7	-	Photometry: limited to 20' and V = H = 0°	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 x	x x x						
8	3	Motor fuels: 5 min. visual inspection			x x	x x						
8	4	Oils: 5 min. visual inspection			x x	x x						
6	-	Colorimetry: visual inspection Trichromatic coordinates in case of doubt			x x	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 x x	x x x x				
8	5	Rear face: 1 min. visual inspection					x x	x x				

*/ of the Regulation.

Number of annex	Number of paragraph	TESTS	SAMPLES									
			a	b	c	d	e	f	g	h	i	j
13	-	Impact visual inspection					x x	x x				
6	-	Colorimetry: visual inspection Trichromatic coordinates in case of doubt					x x	x x				
7	-	Photometry: limited to 20' and V = H = 0°					x	x				
14	2	Deposit of samples with administration	x	x								