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Acts whose titles are printed in light type are those relating to day-to-day management of agricultural matters, and are generally valid for a limited period.

The titles of all other acts are printed in bold type and preceded by an asterisk.

II

*(Non-legislative acts)***ACTS ADOPTED BY BODIES CREATED BY
INTERNATIONAL AGREEMENTS**

Only the original UN/ECE texts have legal effect under international public law. The status and date of entry into force of this Regulation should be checked in the latest version of the UN/ECE status document TRANS/WP.29/343, available at:
<http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29fdocsts.html>.

**Regulation No 72 of the Economic Commission for Europe of the United Nations (UN/ECE) —
Uniform provisions concerning the approval of motor cycle headlamps emitting an asymmetrical
passing beam and a driving beam and equipped with halogen lamps (HS₁ lamps)**

Incorporating all valid text up to:

01 series of amendments - Date of entry into force: 12 September 2001

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1. SCOPE

This Regulation applies to the approval of headlamps equipped with halogen filament lamps (HS₁) and incorporating lenses of glass or plastic material(*) which are provided for the equipment of motor cycles and vehicles treated as such.

2. DEFINITIONS

For the purpose of this Regulation,

- 2.1. "Lens" means that outermost component of the headlamp (unit) which transmits light through the illuminating surface;
- 2.2. "Coating" means any product or products applied in one or more layers to the outer face of a lens;
- 2.3. Headlamps of different "types" are headlamps which differ in such essential respects as:
- 2.3.1. The trade name or mark;
- 2.3.2. The characteristics of the optical systems;
- 2.3.3. The inclusion or elimination of components capable of altering the optical effects by reflection, refraction or absorption and/or deformation during operation. A change in the colour of the beams emitted by headlamps whose other characteristics are not changed does not constitute a change of headlamp type. The same approval number shall accordingly be assigned to such headlamps;
- 2.3.4. Suitability for right-hand or left-hand traffic or for both traffic systems;
- 2.3.5. The materials constituting the lenses and coating, if any.

3. APPLICATION FOR APPROVAL

- 3.1. The application for approval of a headlamp shall be submitted by the owner of the trade name or mark or by his duly accredited representative. The application shall specify:
- 3.1.1. Whether the headlamp is designed for both left-hand and right-hand traffic or for either left-hand or right-hand traffic only.

(*) Nothing in this Regulation shall prevent a Party to the Agreement applying this Regulation from prohibiting the combination of a headlamp incorporating a lens of plastic material approved under this Regulation with a mechanical headlamp-cleaning device (with wipers).

- 3.2. Any application for approval shall be accompanied by:
- 3.2.1. Drawings in triplicate in sufficient detail to permit identification of the type and representing a frontal view of the headlamp, with details of lens ribbing if any, and the cross-section; the drawings shall indicate the space reserved for the approval mark;
- 3.2.2. A brief technical description;
- 3.2.3. Two samples of the type of headlamp with colourless lenses;
- 3.2.3.1. For the testing of a coloured filter or coloured screen (or of a coloured lens): two samples.
- 3.2.4. for the test of plastic material of which the lenses are made:
- 3.2.4.1. thirteen lenses;
- 3.2.4.1.1. six of these lenses may be replaced by six samples of material at least 60 × 80 mm in size, having a flat or convex outer surface and a substantially flat area (radius of curvature not less than 300 mm) in the middle measuring at least 15 × 15 mm;
- 3.2.4.1.2. every such lens or sample of material shall be produced by the method to be used in mass production;
- 3.2.4.2. a reflector to which the lenses can be fitted in accordance with the manufacturer's instructions.
- 3.3. The materials making up the lenses and coatings, if any, shall be accompanied by the test report of the characteristics of these materials and coatings if they have already been tested.
- 3.4. 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 ⁽¹⁾
- 4.1. Headlamps submitted for approval shall bear the trade name or mark of the applicant; this mark must be clearly legible and be indelible.
- 4.2. They shall comprise, on the lens and on the main body ⁽²⁾, spaces of sufficient size for the approval mark and the additional symbols referred to in paragraph 5.4.2; these spaces shall be indicated on the drawings referred to in paragraph 3.2.1 above.
- 4.3. Headlamps designed to satisfy the requirements both of right-hand and of left-hand traffic shall bear markings indicating the two settings of the optical unit on the vehicle or of the lamp on the reflector; these markings shall consist of the letters "R/D" for the position for right-hand traffic and the letters "L/G" for the position for left-hand traffic.
5. APPROVAL
- 5.1. If all the samples of a type of headlamp which are submitted in accordance with paragraph 3.2.3 above meet the requirements of this Regulation, approval shall be granted.

⁽¹⁾ In the case of headlamps designed to meet the requirements of traffic moving on one side of the road only (either right or left), it is further recommended that the area which can be occulted to prevent discomfort to users in a country where traffic moves on the side of the road opposite to that of the country for which the headlamp was designed should be outlined indelibly on the front glass. This marking is not necessary, however, where the area is clearly apparent from the design.

⁽²⁾ If the lens cannot be detached from the main body of the headlamp, a space on the lens shall be sufficient.

- 5.2. An approval number shall be assigned to each type approved. Its first two digits (at present 00 for the Regulation in its original form) 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 number so assigned shall not be assigned by the same Contracting Party to another type of headlamp covered by this Regulation ⁽¹⁾ except in the case of an extension of approval to a headlamp differing only in the colour of the light emitted.
- 5.3. Notice of approval or of refusal or of extension or withdrawal of approval or production definitely discontinued of a headlamp type 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 1 to this Regulation.
- 5.4. There shall be placed on every headlamp conforming to a type approved under this Regulation, in the spaces referred to in paragraph 4.2 above, in addition to the mark prescribed in paragraph 4.1 above, an international approval mark ⁽²⁾ consisting of:
- 5.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval ⁽³⁾;
- 5.4.2. The approval number and the following additional symbol or symbols placed close to the circle:
- 5.4.2.1. On headlamps meeting left-hand traffic requirements only, a horizontal arrow pointing to the right of an observer facing the headlamp, i.e. to the side of the road on which traffic moves;
- 5.4.2.2. On headlamps designed to meet the requirements of both traffic systems by means of an appropriate adjustment of the setting of the optical unit or the lamp, a horizontal arrow with a head on each end, the heads pointing respectively to the left and to the right;
- 5.4.2.3. The letters "MBH" placed opposite to the approval number.
- 5.4.2.4. In every case the relevant operation mode used during the test procedure according to paragraph 1.1.1.1 of annex 5 and the allowed voltage(s) according to paragraph 1.1.1.2 of annex 5 shall be stipulated on the approval certificates and on the notice transmitted to the countries which are Contracting Parties to Agreement and which apply this Regulation.

In the corresponding cases the device shall be marked as follows:

On units meeting the requirements of this Regulation which are so designed that the filament of the passing beam shall not be lit simultaneously with that of any other lighting function with which it may be reciprocally incorporated:

an oblique stroke (/) shall be placed behind the passing lamp symbol in the approval mark.

- 5.4.2.5. On headlamps incorporating a lens of plastic material, the group of letters "PL" shall be affixed near the symbols prescribed in paragraphs 5.4.2.1 to 5.4.2.4 above;

⁽¹⁾ A change in the colour of the beams emitted by headlamps whose other characteristics are not changed does not constitute a change of headlamp type. The same approval number shall accordingly be assigned to such headlamps (see paragraph 2.3).

⁽²⁾ If different types of headlamps have an identical lens, the lens may bear the several approval marks of these type of headlamps, on condition that the main body of the headlamp, even if it cannot be separated from the lens, is also provided with the space referred to in paragraph 4.2 above and bears the approval mark of the type of headlamp. If different types of headlamps have an identical main body, it may bear the several approval marks for these types of headlamps.

⁽³⁾ The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.2/Amend.1.

5.5. The marks and symbols referred to in paragraph 5.4 above shall be clearly legible and be indelible.

5.6. Annex 3 to this Regulation gives examples of arrangements of approval marks and additional symbols referred to above.

6. GENERAL SPECIFICATIONS

6.1. Each sample of a type of headlamp shall conform to the specifications set forth in this paragraph and in paragraphs 7 to 9 below.

6.2. Headlamps shall be so designed and constructed that, in normal use, in spite of the vibrations to which they may then be subjected, their satisfactory operation continues to be ensured and they retain the characteristics prescribed by this Regulation.

6.2.1. Headlamps shall be fitted with a device enabling them to be so adjusted on the vehicle as to comply with the rules applicable to them. Such a device need not be fitted on components in which the reflector and the diffusing lens cannot be separated, provided the use of such components is confined to vehicles on which the headlamps setting can be adjusted by other means.

Where a headlamp providing a driving beam and a headlamp providing a passing beam, each equipped with its own lamp, are assembled to form a composite unit the adjusting device shall enable each optical system individually to be duly adjusted.

6.2.2. However, these provisions shall not apply to headlamp assemblies whose reflectors are indivisible. For this type of assembly the requirements of paragraph 7.3 of the present Regulation shall apply. Where more than one light source is used to provide the main beam, the combined functions shall be used to determine the maximum value of the illumination ($E_{\max}$).

6.3. The components by which the filament lamp is fixed to the reflector shall be so made that, even in darkness, the filament lamp can be fixed in no position but the correct one.

6.4. The correct position of the lens in relation to the optical system shall be unequivocally marked and be blocked against rotation in service.

6.5. Headlamps designed to satisfy the requirements both of right-hand and of left-hand traffic may be adapted for traffic on a given side of the road either by an appropriate initial setting when fitted on the vehicle or by selective setting by the user. Such initial or selective setting may consist, for example, of fixing either the optical unit at a given angle on the vehicle or the lamp at a given angle in relation to the optical unit. In all cases, only two different and clearly distinct settings, one for right-hand and one for left-hand traffic, shall be possible, and the design shall preclude inadvertent shifting from one setting to the other or setting in an intermediate position. Where two different setting positions are provided for the lamp, the components for attaching the lamp to the reflector must be so designed and made that, in each of its two settings, the lamp will be held in position with the precision required for headlamps designed for traffic on only one side of the road. Conformity with the requirements of this paragraph shall be verified by visual inspection and, where necessary, by a test fitting.

6.6. Complementary tests shall be done according to the requirements of annex 5 to ensure that in use there is no excessive change in photometric performance.

6.7. If the lens of the headlamp is of plastic material, tests shall be done according to the requirements of annex 6.

7. REQUIREMENTS FOR ILLUMINATION

7.1. General provisions

7.1.1. Headlamps shall be so made that with suitable HS₁ lamps they give adequate illumination without dazzle when emitting the passing beam, and good illumination when emitting the driving beam.

7.1.2. The illumination produced by the headlamp shall be determined by means of a vertical screen set up 25 m forward of the headlamp as shown in annex 4 to this Regulation.

7.1.3. The headlamps shall be checked by means of an uncoloured standard (reference) lamp designed for a rated voltage of 12 V. In the case of headlamps which may be fitted with selective-yellow filters ⁽¹⁾ such filters shall be replaced by geometrically identical uncoloured filters with a transmission factor of at least 80 per cent. During the checking of the headlamp the voltage at the terminals of the lamp must be regulated so as to obtain the following characteristics:

	Consumption in watts	Light flux in lumens
passing filament	approx. 35	450
driving filament	approx. 35	700

The headlamp shall be considered acceptable if it meets the requirements of this paragraph 7 with at least one standard (reference) lamp, which may be submitted with the headlamp.

7.1.4. The dimensions determining the position of the filaments inside the HS₁ standard filament lamp are shown in Regulation No 37.

7.1.5. The bulb of the standard filament lamp must be of such shape and optical quality that it causes a minimum of reflection and refraction adversely affecting the light distribution.

7.2. Provisions concerning passing beams

7.2.1. The passing beam must produce a sufficiently sharp "cut-off" to permit satisfactory adjustment with its aid. The "cut-off" must be a horizontal straight line on the side opposite to the direction of the traffic for which the headlamp is intended; on the other side, it must not extend beyond either the broken line HV H₁ H₄ formed by a straight line HV H₁ making a 45° angle with the horizontal and the straight line H₁ H₄, 1 per cent above the straight line hh or the straight line HV H₃, inclined at an angle of 15° above the horizontal (see annex 4). A cut-off extending beyond both line HV H₂ and line H₂ H₄ and resulting from a combination of the two above possibilities shall in no circumstances be permitted.

7.2.2. The headlamp shall be so aimed that:

7.2.2.1. In the case of headlamps designed to meet the requirements of right-hand traffic, the "cut-off" on the left half of the screen ⁽²⁾ is horizontal and, in the case of headlamps designed to meet the requirements of left-hand traffic, the "cut-off" on the right half of the screen is horizontal;

7.2.2.2. This horizontal part of the "cut-off" is situated on the screen 25 cm below the level of the horizontal plane passing through the focus of the headlamp (see annex 4);

⁽¹⁾ These filters shall consist of all the components, including the lens, intended to colour the light.

⁽²⁾ The test screen must be sufficiently wide to allow examination of the "cut off" over a range of at least 5° on either side of the line vv.

- 7.2.2.3. The "apex" of the "cut-off" is on line vv ⁽¹⁾.
- 7.2.3. When so aimed, the headlamp shall comply with the requirements set out in paragraphs 7.2.5 to 7.2.7 and 7.3.
- 7.2.4. Where a headlamp so directed does not meet the requirements set out in paragraphs 7.2.5 to 7.2.7 and 7.3 its alignment may be changed provided that the axis of the beam is not displaced laterally by more than 1° (= 44 cm) to the right or left ⁽²⁾. To facilitate alignment by means of the "cut-off", the headlamp may be partially occulted in order to sharpen the "cut-off".
- 7.2.5. The illumination produced on the screen by the passing beam shall meet the following requirements:

Point on measuring screen				Required Illumination in lux
Headlamps for right-hand traffic		Headlamps for left-hand traffic		
Point B	50 L	Point B	50 R	≤ 0,3
Point	75 R	Point	75 L	≥ 6
Point	50 R	Point	50 L	≥ 6
Point	25 L	Point	25 R	≥ 1,5
Point	25 R	Point	25 L	≥ 1,5
Any point in zone III				≤ 0,7
Any point in zone IV				≥ 2
Any point in zone I				≤ 20

- 7.2.6. There shall be no lateral variations detrimental to good visibility in any of the zones I, II, III and IV.
- 7.2.7. Headlamps designed to meet the requirements of both right-hand and left-hand traffic must, in each of the two setting positions of the optical unit or of the lamp, meet the requirements set forth above for the corresponding direction of traffic.
- 7.3. Provisions concerning driving beams
- 7.3.1. Measurements of the illumination produced on the screen by the driving beam shall be taken with the same headlamp alignment as for measurements under paragraphs 7.2.5 to 7.2.7 above.
- 7.3.2. The illumination produced on the screen by the driving beam shall meet the following requirements:
- 7.3.2.1. The point of intersection HV of lines hh and vv shall be situated within the isolux 90 per cent of maximum illumination. The maximum value ($E_{m,ax}$) shall not be less than 32 lux. The maximum value shall not exceed 240 lux.
- 7.3.2.2. Starting from point HV, horizontally to the right and left, the illumination shall be not less than 16 lux up to a distance of 1,125 m and not less than 4 lux up to a distance of 2,25 m.
- 7.4. The screen illumination values mentioned in paragraphs 7.2.5 to 7.2.7 and 7.3 above shall be measured by means of a photo-receptor, the effective area of which shall be contained within a square of 65 mm side.

⁽¹⁾ If the beam does not have a cut off with a clear "apex", the lateral adjustment shall be effected in the manner which best satisfies the requirements for illumination at points 75 R and 50 R for right hand traffic and for points 75 L and 50 L for left hand traffic.

⁽²⁾ The limit of realignment of 1° towards the right or left is not incompatible with upward or downward vertical realignment. The latter is limited only by the requirements of paragraph 7.3. However, the horizontal part of the "cut off" should not extend beyond the line hh.

8. PROVISIONS CONCERNING COLOURED LENSES AND FILTERS

- 8.1. Approval may be obtained for headlamps emitting either colourless or selective-yellow lights with an uncoloured lamp. Expressed in CIE trichromatic co-ordinates, the corresponding colorimetric characteristics for yellow lenses or filters are as follows:

Selective-yellow filter (screen or lens)

Limit towards red $y \Rightarrow 0,138 + 0,58 x$

Limit towards green $y \leq 1,29 x - 0,1$

Limit towards white $y \Rightarrow -x + 0,966$

Limit towards spectral value $y \leq -x + 0,992$

which can also be expressed as follows:

dominant wave-length $575 - 585 \text{ nm}$

purity factor $0,90 - 0,98$

The transmission factor must be $\geq 0,78$

The transmission factor shall be determined by using a light source with a colour temperature of $2\,856 \text{ °K}^{(1)}$.

- 8.2. The filter must be part of the headlamp, and must be attached to it in such a way that the user cannot remove it either inadvertently or, with ordinary tools, intentionally.

9. STANDARD (REFERENCE) HEADLAMP ⁽²⁾

A headlamp shall be deemed to be a standard (reference) headlamp if it:

- 9.1. Satisfies the above-mentioned requirements for approval;
- 9.2. Has an effective diameter of not less than 160 mm;
- 9.3. Provides, with a standard (reference) lamp, at the various points and in the various zones referred to in paragraph 7.2.5, illumination equal to:
- 9.3.1. Not more than 90 per cent of the maximum limits and
- 9.3.2. Not less than 120 per cent of the minimum limits, prescribed in the table in paragraph 7.2.5.

10. OBSERVATION CONCERNING COLOUR

Since any approval under this Regulation is granted, pursuant to paragraph 8.1 above, for a type of headlamp emitting either colourless light or selective-yellow light, article 3 of the Agreement to which the regulation is annexed shall not prevent the Contracting Parties from prohibiting headlamps emitting a beam of uncoloured or selective-yellow light on vehicles registered by them.

11. CONFORMITY OF PRODUCTION

Every headlamp bearing an approval mark as prescribed under this Regulation shall conform to the approved type and meet the photometric and colorimetric requirements set forth above. Compliance with these provisions shall be verified in accordance with annex 2 and paragraph 3 of annex 5 to this Regulation and if applicable paragraph 3 of annex 6 to this Regulation.

⁽¹⁾ Corresponding to illuminant A of the International Commission on Illumination (CIE).

⁽²⁾ Different values may be accepted provisionally. In the absence of definitive specifications, the use of an approved headlamp is recommended.

12. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

12.1. The approval granted in respect of a headlamp type pursuant to this Regulation may be withdrawn if the requirements set forth above are not met or if a headlamp bearing the approval mark does not conform to the type approved.

12.2. 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 1 to this Regulation.

13. MODIFICATION OF HEADLAMP TYPE AND EXTENSION OF APPROVAL

13.1. Every modification of the headlamp type shall be notified to the administrative department which granted the type approval. The department may then either:

13.1.1. Consider that the modifications made are unlikely to have appreciable adverse effects and that in any case the type of headlamp complies with the requirements; or

13.1.2. Require a further test report from the technical service responsible for conducting the tests.

13.2. 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.

13.3. The competent authority issuing the extension of approval shall assign a series number for such an extension and inform thereof the other Contracting Parties applying this Regulation by means of a communication form conforming to the model in annex 1 to this Regulation.

14. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a headlamp 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 1 to this Regulation.

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

The 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.

16. TRANSITIONAL PROVISIONS

16.1. As from six months after the official date of entry into force of Regulation No 112, Contracting Parties applying this Regulation shall cease to grant ECE approvals according to this Regulation.

16.2. Contracting Parties applying this Regulation shall not refuse to grant extensions of approval to the 01 series of amendments or the original version of this Regulation.

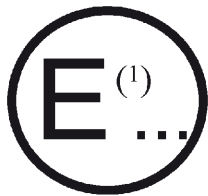
16.3. Approvals granted under this Regulation before the date of entry into force of Regulation No 112 and all extensions of approvals, including those to the original version of this Regulation granted subsequently, shall remain valid indefinitely.

- 16.4. Contracting Parties applying this Regulation shall continue to issue approvals for headlamps on the basis of the 01 series of amendments or the original version of this Regulation, provided that the headlamps are intended as replacements for fitting to vehicles in use.
- 16.5. As from the official date of entry into force of Regulation No 112, no Contracting Party applying this Regulation shall prohibit the fitting on a new vehicle type of a headlamp approved under Regulation No 112.
- 16.6. Contracting Parties applying this Regulation shall continue to allow fitting on a vehicle type or vehicle of a headlamp approved to this Regulation.
- 16.7. Contracting Parties applying this Regulation shall continue to allow fitting or use on a vehicle in use of a headlamp approved to this Regulation in its original version, provided that the headlamp is intended for replacement.
-

ANNEX 1

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration

.....

.....

.....

Concerning ⁽²⁾: APPROVAL GRANTED
 APPROVAL EXTENDED
 APPROVAL REFUSED
 APPROVAL WITHDRAWN
 PRODUCTION DEFINITELY DISCONTINUED

of a type of motor cycle headlamp, pursuant to Regulation No 72

Approval No Extension No

1. Headlamp submitted for approval as type ⁽³⁾
2. The passing lamp filament may/may not ⁽²⁾ be lit simultaneously with the driving lamp filament and/or another reciprocally incorporated headlamp.
3. Headlamp emitting, with a colourless lamp: a colourless beam, a selective yellow beam ⁽²⁾
4. Trade name or mark
5. Manufacturer's name and address
6. If applicable, name and address of manufacturer's representative
7. Submitted for approval on
8. Technical service responsible for conducting approval tests
9. Date of report issued by that service
10. Number of report issued by that service
11. Approval granted/refused/extended/withdrawn ⁽²⁾
12. Maximum illumination (in lux) of the driving beam at 25 m from the headlamp (average for two headlamps)
13. Place
14. Date
15. Signature
16. The attached drawing No ... shows the headlamp.

⁽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.

⁽³⁾ Indicate the appropriate marking selected from the list below:

MBH,	MBH,	MBH,	MBH/,	MBH/,	MBH/
→	↔	↔	→	↔	↔
MBH PL,	MBH PL,	MBH PL,	MBH/PL,	MBH/PL,	MBH/PL
→	↔	↔	→	↔	↔

ANNEX 2

**VERIFICATION OF CONFORMITY OF PRODUCTION OF HEADLAMPS
EQUIPPED WITH HS₁ LAMPS**

1. Headlamps bearing an approval mark shall conform to the approved type.
2. The requirement of conformity shall be deemed satisfied from a mechanical and geometrical standpoint if the discrepancies do not exceed inevitable manufacturing errors.
3. As regards photometric performance, the conformity of headlamps of the series will not be contested ⁽¹⁾ if, during photometric tests of any headlamp, selected at random and equipped with a standard (reference) lamp;
 - 3.1. None of the values measured deviates unfavourably by more than 20 per cent from the prescribed value (for values B 50 R or L and zone III, the maximum unfavourable deviation may be 0,2 lux (B 50 R or L), or 0,3 lux (zone III);
 - 3.2. or if
 - 3.2.1. for the passing beam, the prescribed values are met at HV (with a tolerance of 0,2 lux) and at least one point of the area delimited on the measuring screen (at 25 m) by a circle 15 cm in radius around points B 50 R or L (with a tolerance of 0,1 lux), 75 R or L, 50 R or L, 25 R or L, and in the entire area of zone IV which is not more than 22,5 cm above line 25 R and 25 L;
 - 3.2.2. and if, for the driving beam, HV being situated within the isolux 0,75 Emax, a tolerance of 20 per cent is observed for the photometric values.
4. If the results of the tests described in paragraph 3 above do not satisfy the requirements, the tests for the headlamp in question shall be repeated with another standard (reference) lamp.

⁽¹⁾ It is recommended that the authorities of the country of manufacture should refer to the results of any statistical checks made by the manufacturer rather than undertake the checks mentioned in paragraph 3.

ANNEX 3

ARRANGEMENTS OF APPROVAL MARKS

(see paragraph 5 of this Regulation)

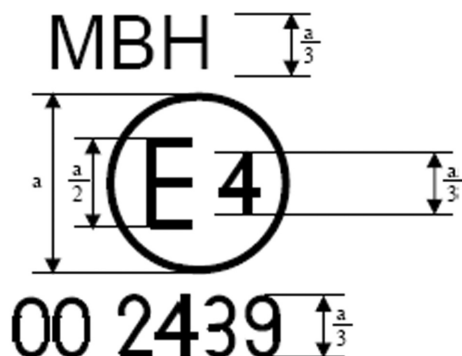
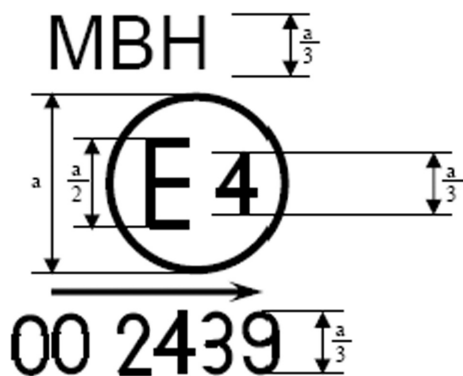


Figure 1

a = 12 mm min.

The headlamp bearing the above approval mark is a headlamp meeting the requirements of this Regulation and is designed for right-hand traffic only.



a = 12 mm min.

Figure 2

The headlamp bearing the above approval mark is a headlamp meeting the requirements of this Regulation and is designed: For left-hand traffic only.



Figure 3

For both traffic systems by means of an appropriate adjustment of the setting of the optical unit or the lamp on the vehicle.

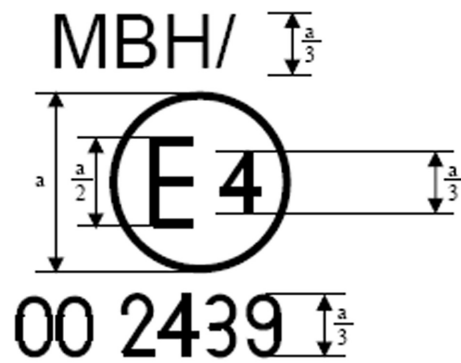


Figure 4

The headlamp bearing the above approval mark is a headlamp meeting the requirements of this Regulation and is so designed that the filament of the passing lamp shall not be lit together simultaneously with the driving beam and/or another reciprocally incorporated lighting function.

Note: The above headlamps bearing the above approval marks have been approved in the Netherlands (E/4) under No 002439. The approval number indicates that the approval was granted in accordance with the requirements of this Regulation in its original form.

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



Figure 5

The headlamp bearing the above approval mark is a headlamp incorporating a lens of plastic material and meeting the requirements of this Regulation.

It is so designed that the filament of the passing beam can be lit together simultaneously with the driving beam and/or another reciprocally incorporated lighting function.

ANNEX 5

TESTS FOR STABILITY OF PHOTOMETRIC PERFORMANCE OF HEADLAMPS IN OPERATION

TESTS ON COMPLETE HEADLAMPS

Once the photometric values have been measured according to the prescriptions of this Regulation, in points for $E_{\max}$ for driving beam and HV, 50 R, B 50 L for passing beam (or HV, 50 L, B 50 R for headlamps designed for left-hand traffic) a complete headlamp sample shall be tested for stability of photometric performance in operation. "Complete headlamp" shall be understood to mean the complete lamp itself including those surrounding body parts and lamps which could influence its thermal dissipation.

1. TEST FOR STABILITY OF PHOTOMETRIC PERFORMANCE

The tests shall be carried out in a dry and still atmosphere at an ambient temperature of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, the complete headlamps being mounted on a base representative of the correct installation on the vehicle.

1.1. Clean headlamp

The headlamp shall be operated for 12 hours as described in subparagraph 1.1.1 and checked as prescribed in subparagraph 1.1.2.

1.1.1. Test procedure

The headlamp shall be operated for a period according to the specified time, so that:

1.1.1.1. (a) In the case where only one lighting function (driving or passing beam) is to be approved, the corresponding filament is lit for the prescribed time ⁽¹⁾,

(b) In the case of a reciprocally incorporated passing lamp and driving lamp (dual filament lamp or two filament lamps):

If the applicant declares that the headlamp is to be used with a single filament lit ⁽²⁾ at a time, the test shall be carried out in accordance with this condition, activating each specified function successively for half the time specified in paragraph 1.1;

In all other cases, the headlamp shall be subjected to the following cycle until the time specified is reached:

15 minutes, passing-beam filament lit

5 minutes, all filaments lit.

(c) In the case of grouped lighting functions all the individual functions shall be lit simultaneously for the time specified for individual lighting functions (a) also taking into account the use of reciprocally incorporated lighting functions, (b) according to the manufacturer's specifications.

1.1.1.2. Test voltage

The voltage shall be adjusted so as to supply 90 per cent of the maximum wattage specified for filament lamps category HS₁ in Regulation No 37.

1.1.2. Test results

1.1.2.1. Visual inspection

Once the headlamp has been stabilized to the ambient temperature, the headlamp lens and the external lens, if any, shall be cleaned with a clean, damp cotton cloth. It shall then be inspected visually; no distortion, deformation, cracking or change in colour of either the headlamp lens or the external lens, if any, shall be noticeable.

⁽¹⁾ When the tested headlamp is grouped and/or reciprocally incorporated with signalling lamps, the latter shall be lit for the duration of the test. In the case of a direction indicator lamp, it shall be lit in flashing operation mode with an on/off time ratio of approximately one to one.

⁽²⁾ Should two or more lamp filaments be simultaneously lit when headlamp flashing is used, this shall not be considered as being normal use of the filaments simultaneously.

1.1.2.2. Photometric test

To comply with the requirements of this Regulation, the photometric values shall be verified in the following points:

Passing beam:

50 R - B 50 L - HV for headlamps designed for right-hand traffic,

50 L - B 50 R - HV for headlamps designed for left-hand traffic.

Driving beam:

Point of $E_{\max}$

Another aiming may be carried out to allow for any deformation of the headlamp base due to heat (the change of the position of the cut-off line is covered in paragraph 2 of this annex).

A 10 % discrepancy between the photometric characteristics and the values measured prior to the test is permissible including the tolerances of the photometric procedure.

1.2 Dirty headlamp

After being tested as specified in subparagraph 1.1 above, the headlamp shall be operated for one hour as described in subparagraph 1.1.1, after being prepared as prescribed in subparagraph 1.2.1, and checked as prescribed in subparagraph 1.1.2.

1.2.1. Preparation of the headlamp

1.2.1.1. Test mixture

1.2.1.1.1. For headlamp with the outside lens in glass:

The mixture of water and a polluting agent to be applied to the headlamp shall be composed of:

9 parts by weight of silica sand with a particle size of 0-100 μm ,

1 part by weight of vegetal carbon dust (beechwood) with a particle size of 0-100 μm ,

0,2 part by weight of NaCMC ⁽¹⁾, and

an appropriate quantity of distilled water, with a conductivity of $\leq 1 \text{ mS/m}$.

The mixture must not be more than 14 days old.

1.2.1.1.2. For headlamp with outside lens in plastic material:

The mixture of water and polluting agent to be applied to the headlamp shall be composed of:

9 parts by weight of silica sand with a particle size of 0-100 μm ,

1 part by weight of vegetal carbon dust (beechwood) with a particle size of 0-100 μm ,

0,2 part by weight of NaCMC,

13 parts by weight of distilled water with a conductivity of $\leq 1 \text{ mS/m}$, and

2 ± 1 parts by weight of surface-actant ⁽²⁾.

The mixture must not be more than 14 days old.

⁽¹⁾ NaCMC represents the sodium salt of carboxymethylcellulose, customarily referred to as CMC. The NaCMC used in the dirt mixture shall have a degree of substitution (DS) of 0,6-0,7 and a viscosity of 200-300 cP for a 2 % solution at 20 °C.

⁽²⁾ The tolerance on quantity is due to the necessity of obtaining a dirt that correctly spreads out on all the plastic lens.

1.2.1.2. Application of the test mixture to the headlamp

The test mixture shall be uniformly applied to the entire light emitting surface of the headlamp and then left to dry. This procedure shall be repeated until the illumination value has dropped to 15-20 per cent of the values measured for each following point under the conditions described in this annex:

Point of $E_{\max}$ in driving beam, photometric distribution for a driving/passing lamp,

Point of $E_{\max}$ in driving beam, photometric distribution for a driving lamp only,

50 R and 50 V ⁽¹⁾ for a passing lamp only, designed for right-hand traffic,

50 L and 50 V for a passing lamp only, designed for left-hand traffic.

1.2.1.3. Measuring equipment

The measuring equipment shall be equivalent to that used during headlamp approval tests. A standard (reference) filament lamp shall be used for the photometric verification.

2. TEST FOR CHANGE IN VERTICAL POSITION OF THE CUT-OFF LINE UNDER THE INFLUENCE OF HEAT

This test consists of verifying that the vertical drift of the cut-off line under the influence of heat does not exceed a specified value for an operating passing lamp.

The headlamp tested in accordance with paragraph 1, shall be subjected to the test described in 2.1, without being removed from or readjusted in relation to its test fixture.

2.1. Test

The test shall be carried out in a dry and still atmosphere at an ambient temperature of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

Using a mass production filament lamp which has been aged for at least one hour the headlamp shall be operated on passing beam without being dismounted from or readjusted in relation to its test fixture. (For the purpose of this test, the voltage shall be adjusted as specified in paragraph 1.1.1.2) The position of the cut-off line in its horizontal part (between vv and the vertical line passing through point B 50 L for right-hand traffic or B 50 R for left-hand traffic) shall be verified 3 minutes (r_3) and 60 minutes (r_{60}) respectively after operation.

The measurement of the variation in the cut-off line position as described above shall be carried out by any method giving acceptable accuracy and reproducible results.

2.2. Test results

2.2.1 The result in milliradians (mrad) shall be considered as acceptable for a passing lamp, only when the absolute value $\Delta r_1 = |r_3 - r_{60}|$ recorded on the headlamp is not more than 1,0 mrad ($\Delta r_1 \leq 1,0$ mrad).

2.2.2 However, if this value is more than 1,0 mrad but not more than 1,5 mrad ($1,0 \text{ mrad} < \Delta r_1 \leq 1,5 \text{ mrad}$) a second headlamp shall be tested as described in paragraph 2.1 after being subjected three consecutive times to the cycle as described below, in order to stabilize the position of mechanical parts of the headlamp on a base representative of the correct installation on the vehicle:

Operation of the passing lamp for one hour (the voltage shall be adjusted as specified in paragraph 1.1.1.2),

Period of rest for one hour.

The headlamp type shall be considered as acceptable if the mean value of the absolute values Δr_1 measured on the first sample and Δr_{II} measured on the second sample is not more than 1,0 mrad

$$\frac{\Delta r_1 + \Delta r_{II}}{2} \leq 1,0 \text{ mrad}$$

⁽¹⁾ 50 V is situated 375 mm below HV on the vertical line v-v on the screen at 25 m distance.

3. CONFORMITY OF PRODUCTION

One of the sampled headlamps shall be tested according to the procedure described in paragraph 2.1 after being subjected three consecutive times to the cycle described in paragraph 2.2.2. The headlamp shall be considered as acceptable if Δr does not exceed 1,5 mrad.

If this value exceeds 1,5 mrad but is not more than 2,0 mrad, a second headlamp shall be subjected to the test after which the mean of the absolute values recorded on both samples shall not exceed 1,5 rad.

ANNEX 6

REQUIREMENTS FOR LAMPS INCORPORATING LENSES OF PLASTIC MATERIAL — TESTING OF LENS OR MATERIAL SAMPLES AND OF COMPLETE LAMPS**1. GENERAL SPECIFICATIONS**

- 1.1. The samples supplied pursuant to paragraph 3.2.4 of this Regulation shall satisfy the specifications indicated in paragraphs 2.1 to 2.5 below.
- 1.2. The two samples of complete lamps supplied pursuant to paragraph 3.2.3 of this Regulation and incorporating lenses of plastic material shall, with regard to the lens material, satisfy the specifications indicated in paragraph 2.6 below.
- 1.3. The samples of lenses of plastic material or samples of material shall be subjected, with the reflector to which they are intended to be fitted (where applicable), to approval tests in the chronological order indicated in table A reproduced in appendix 1 to this annex.
- 1.4. However, if the lamp manufacturer can prove that the product has already passed the tests prescribed in paragraphs 2.1-2.5 below, or the equivalent tests pursuant to another Regulation, those tests need not be repeated; only the tests prescribed in appendix 1, table B, shall be mandatory.

2. TESTS**2.1. Resistance to temperature changes****2.1.1. Tests**

Three new samples (lenses) shall be subjected to five cycles of temperature and humidity (RH = relative humidity) change in accordance with the following programme:

- 3 hours at $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and 85-95 % RH;
- 1 hour at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and 60-75 % RH;
- 15 hours at $-30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$;
- 1 hour at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and 60-75 % RH;
- 3 hours at $80\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$;
- 1 hour at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and 60-75 % RH;

Before this test, the samples shall be kept at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and 60-75 % RH for at least four hours.

Note: The periods of one hour at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ shall include the periods of transition from one temperature to another which are needed in order to avoid thermal shock effects.

2.1.2. Photometric measurements**2.1.2.1. Method**

Photometric measurements shall be carried out on the samples before and after the test.

These measurements shall be made using a standard lamp, at the following points:

B 50 L and 50 R for the passing beam of a passing lamp or a passing/driving lamp (B 50 R and 50 L in the case of headlamps intended for left-hand traffic);

E_{max} for the driving beam of a driving lamp or a passing/driving lamp.

2.1.2.2. Results

The variation between the photometric values measured on each sample before and after the test shall not exceed 10 % including the tolerances of the photometric procedure.

2.2. Resistance to atmospheric and chemical agents

2.2.1. Resistance to atmospheric agents

Three new samples (lenses or samples of material) shall be exposed to radiation from a source having a spectral energy distribution similar to that of a black body at a temperature between 5 500 K and 6 000 K. Appropriate filters shall be placed between the source and the samples so as to reduce as far as possible radiations with wave lengths smaller than 295 nm and greater than 2 500 nm. The samples shall be exposed to an energetic illumination of $1\,200\text{ W/m}^2 \pm 200\text{ W/m}^2$ for a period such that the luminous energy that they receive is equal to $4\,500\text{ MJ/m}^2 \pm 200\text{ MJ/m}^2$. Within the enclosure, the temperature measured on the black panel placed on a level with the samples shall be $50\text{ °C} \pm 5\text{ °C}$. In order to ensure a regular exposure, the samples shall revolve around the source of radiation at a speed between 1 and 5 min.

The samples shall be sprayed with distilled water of conductivity lower than 1 mS/m at a temperature of $23\text{ °C} \pm 5\text{ °C}$, in accordance with the following cycle:

spraying: 5 minutes;
drying: 25 minutes.

2.2.2. Resistance to chemical agents

After the test described in paragraph 2.2.1 above and the measurement described in paragraph 2.2.3.1 below have been carried out, the outer face of the said three samples shall be treated as described in paragraph 2.2.2.2 with the mixture defined in paragraph 2.2.2.1 below.

2.2.2.1. Test mixture

The test mixture shall be composed of 61,5 % n-heptane, 12,5 % toluene, 7,5 % ethyl tetrachloride, 12,5 % trichloroethylene and 6 % xylene (volume per cent).

2.2.2.2. Application of the test mixture

Soak a piece of cotton cloth (as per ISO 105) until saturation with the mixture defined in paragraph 2.2.2.1 above and, within 10 seconds, apply it for 10 minutes to the outer face of the sample at a pressure of 50 N/cm^2 , corresponding to an effort of 100 N applied on a test surface of $14 \times 14\text{ mm}$.

During this 10-minute period, the cloth pad shall be soaked again with the mixture so that the composition of the liquid applied is continuously identical with that of the test mixture prescribed.

During the period of application, it is permissible to compensate the pressure applied to the sample in order to prevent it from causing cracks.

2.2.2.3. Cleaning

At the end of the application of the test mixture, the samples shall be dried in the open air and then washed with the solution described in paragraph 2.3. (Resistance to detergents) at $23\text{ °C} \pm 5\text{ °C}$.

Afterwards the samples shall be carefully rinsed with distilled water containing not more than 0,2 % impurities at $23\text{ °C} \pm 5\text{ °C}$ and then wiped off with a soft cloth.

2.2.3. Results

2.2.3.1. After the test of resistance to atmospheric agents, the outer face of the samples shall be free from cracks, scratches, chipping and deformation, and the mean variation in transmission

$$\Delta t = \frac{T_2 - T_3}{T_2}, \text{ measured on the three samples according to the}$$

procedure described in appendix 2 to this annex shall not exceed 0,020

$$(\Delta t_m \leq 0,020).$$

2.2.3.2. After the test of resistance to chemical agents, the samples shall not bear any traces of chemical staining likely to cause a variation of flux diffusion, whose mean variation

$$\Delta d = \frac{T_5 - T_4}{T_2}, \text{ measured on the three samples according to the}$$

procedure described in appendix 2 to this annex shall not exceed 0,020

$$(\Delta d_m \leq 0,020).$$

2.3. Resistance to detergents and hydrocarbons

2.3.1. Resistance to detergents

The outer face of three samples (lenses or samples of material) shall be heated to $50\text{ °C} \pm 5\text{ °C}$ and then immersed for five minutes in a mixture maintained at $23\text{ °C} \pm 5\text{ °C}$ and composed of 99 parts distilled water containing not more than 0,02 % impurities and one part alkylaryl sulphonate.

At the end of the test, the samples shall be dried at $50\text{ °C} \pm 5\text{ °C}$. The surface of the samples shall be cleaned with a moist cloth.

2.3.2. Resistance to hydrocarbons

The outer face of these three samples shall then be lightly rubbed for one minute with a cotton cloth soaked in a mixture composed of 70 % n-heptane and 30 % toluene (volume per cent), and shall then be dried in the open air.

2.3.3. Results

After the above two tests have been performed successively, the mean value of the variation in transmission

$$\Delta t = \frac{T_2 - T_3}{T_2}, \text{ measured on the three samples according to the}$$

procedure described in appendix 2 to this annex shall not exceed 0,010

$$(\Delta t_m \leq 0,010).$$

2.4. Resistance to mechanical deterioration

2.4.1. Mechanical deterioration method

The outer face of the three new samples (lenses) shall be subjected to the uniform mechanical deterioration test by the method described in appendix 3 to this annex.

2.4.2. Results

After this test, the variations:

$$\text{in transmission: } \Delta t = \frac{T_2 - T_3}{T_2},$$

$$\text{and in diffusion: } \Delta d = \frac{T_5 - T_4}{T_2},$$

shall be measured according to the procedure described in appendix 2 in the area specified in paragraph 2.2.4 above. The mean value of the three samples shall be such that:

$$\Delta t_m \leq 0,100;$$

$$\Delta d_m \leq 0,050.$$

2.5. Test of adherence of coatings, if any

2.5.1. Preparation of the sample

A surface of 20 mm × 20 mm in area of the coating of a lens shall be cut with a razor blade or a needle into a grid of squares approximately 2 mm × 2 mm. The pressure on the blade or needle shall be sufficient to cut at least the coating.

2.5.2. Description of the test

Use an adhesive tape with a force of adhesion of 2 N/ (cm of width) ± 20 % measured under the standardized conditions specified in appendix 4 to this annex. This adhesive tape, which shall be at least 25 mm wide, shall be pressed for at least five minutes to the surface prepared as prescribed in paragraph 2.5.1.

Then the end of the adhesive tape shall be loaded in such a way that the force of adhesion to the surface considered is balanced by a force perpendicular to that surface. At this stage, the tape shall be torn off at a constant speed of 1,5 m/s ± 0,2 m/s.

2.5.3. Results

There shall be no appreciable impairment of the gridded area. Impairments at the intersections between squares or at the edges of the cuts shall be permitted, provided that the impaired area does not exceed 15 % of the gridded surface.

2.6. Tests of the complete lamp incorporating a lens of plastic material

2.6.1. Resistance to mechanical deterioration of the lens surface

2.6.1.1. Tests

The lens of lamp sample No 1 shall be subjected to the test described in paragraph 2.4.1. above.

2.6.1.2. Results

After the test, the results of photometric measurements carried out on the lamp in accordance with this Regulation shall not exceed by more than 30 % the maximum values prescribed at points B 50 L and HV and not be more than 10 % below the minimum values prescribed at point 75 R (in the case of headlamps intended for left-hand traffic, the points to be considered are B 50 R, HV and 75 L).

2.6.2. Test of adherence of coatings, if any

The lens of lamp sample No 2 shall be subjected to the test described in paragraph 2.5 above.

3. VERIFICATION OF THE CONFORMITY OF PRODUCTION

3.1. With regard to the materials used for the manufacture of lenses, the lamps of a series shall be recognized as complying with this Regulation if:

3.1.1. After the test for resistance to chemical agents and the test for resistance to detergents and hydrocarbons, the outer face of the samples exhibits no cracks, chipping or deformation visible to the naked eye (see paragraphs 2.2.2, 2.3.1 and 2.3.2);

3.1.2. After the test described in paragraph 2.6.1.1, the photometric values at the points of measurement considered in paragraph 2.6.1.2 are within the limits prescribed for conformity of production by this Regulation.

3.2. If the test results fail to satisfy the requirements, the tests shall be repeated on another sample of headlamps selected at random.

Appendix 1

Chronological order of approval tests

A. Tests on plastic materials (lenses or samples of material supplied pursuant to paragraph 3.2.4 of this Regulation)

Samples Tests	Lenses or samples of material						Lenses						
	1	2	3	4	5	6	7	8	9	10	11	12	13
1.1. Limited photometry (para. 2.1.2)										X	X	X	
1.1.1. Temperature change (para. 2.1.1)										X	X	X	
1.1.2. Limited photometry (para. 2.1.2)										X	X	X	
1.2.1. Transmission measurement	X	X	X	X	X	X	X	X	X				
1.2.2. Diffusion measurement	X	X	X				X	X	X				
1.3. Atmospheric agents (para. 2.2.1)	X	X	X										
1.3.1. Transmission measurement	X	X	X										
1.4. Chemicals agents (para. 2.2.2)	X	X	X										
1.4.1. Diffusion measurement	X	X	X										
1.5. Detergents (para. 2.3.1)				X	X	X							
1.6. Hydrocarbons (para. 2.3.2)				X	X	X							
1.6.1. Transmission measurement				X	X	X							
1.7. Deterioration (para. 2.4.1)							X	X	X				
1.7.1. Transmission measurement							X	X	X				
1.7.2. Diffusion measurement							X	X	X				
1.8. Adherence (para. 2.5)													X

B. Tests on complete lamps (supplied pursuant to paragraph 3.2.3 of this Regulation)

Tests	Complete lamp	
	Sample No	
	1	2
2.1. Deterioration (para. 2.6.1.1)	X	
2.2. Photometry (para. 2.6.1.2)	X	
2.3. Adherence (para. 2.6.2)		X

Appendix 2

Method of measurement of the diffusion and transmission of light**1. EQUIPMENT** (see figure)

The beam of a collimator K with a half divergence $\beta/2 = 17,4 \times 10^{-4}$ rd is limited by a diaphragm D_T with an opening of 6 mm against which the sample stand is placed.

A convergent achromatic lens L_2 , corrected for spherical aberrations, links the diaphragm D_T with the receiver R; the diameter of the lens L_2 shall be such that it does not diaphragm the light diffused by the sample in a cone with a half top angle of $\beta/2 = 14^\circ$.

An annular diaphragm D_D with angles $\alpha/2 = 1^\circ$ and $\alpha_{\max}/2 = 12^\circ$ is placed in an image focal plane of the lens L_2 .

The non-transparent central part of the diaphragm is necessary in order to eliminate the light arriving directly from the light source. It shall be possible to remove the central part of the diaphragm from the light beam in such a manner that it returns exactly to its original position.

The distance $L_2 D_T$ and the focal length F_2 ⁽¹⁾ of the lens L_2 shall be so chosen that the image of D_T completely covers the receiver R.

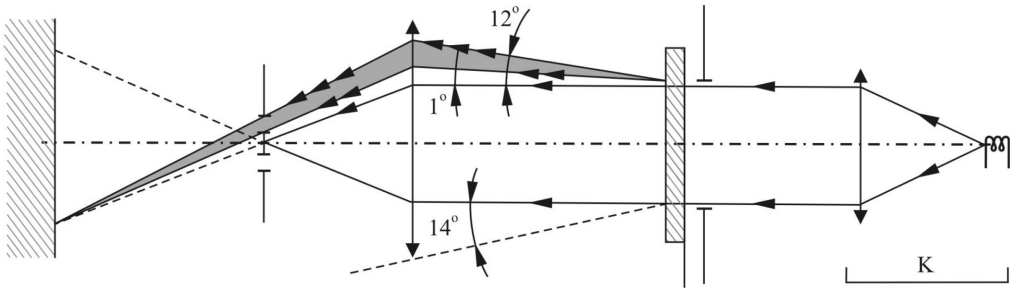
When the initial incident flux is referred to 1,000 units, the absolute precision of each reading shall be better than 1 unit.

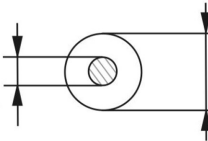
2. MEASUREMENTS

The following readings shall be taken:

Reading	With sample	With central part of D_D	Quantity represented
T_1	no	no	Incident flux in initial reading
T_2	yes (before test)	no	Flux transmitted by the new material in a field of 24 °C
T_3	yes (after test)	no	Flux transmitted by the tested material in a field of 24 °C
T_4	yes (before test)	yes	Flux diffused by the new material
T_5	yes (after test)	yes	Flux diffused by the tested material

⁽¹⁾ For L_2 it is recommended to use a focal distance of about 80 mm.



$$D_{D_0} = 0,0349 F_2$$

$$D_{D_{max}} = 0,425 F_2$$



*Appendix 3***Spray testing method****1. TEST EQUIPMENT****1.1. Spray gun**

The spray gun used shall be equipped with a nozzle 1,3 mm in diameter allowing a liquid flow rate of $0,24 \pm 0,02$ l/minute at an operating pressure of 6.0 bars $-0, +0,5$ bar.

Under these operation conditions the fan pattern obtained shall be 170 mm $\pm$ 50 mm in diameter on the surface exposed to deterioration, at a distance of 380 mm $\pm$ 10 mm from the nozzle.

1.2. Test mixture

The test mixture shall be composed of:

Silica sand of hardness 7 on the Mohs scale, with a grain size between 0 and 0,2 mm and an almost normal distribution, with an angular factor of 1,8 to 2;

Water of hardness not exceeding 205 g/m³ for a mixture comprising 25 g of sand per litre of water.

2. TEST

The outer surface of the lamp lenses shall be subjected once or more than once to the action of the sand jet produced as described above. The jet shall be sprayed almost perpendicular to the surface to be tested.

The deterioration shall be checked by means of one or more samples of glass placed as a reference near the lenses to be tested. The mixture shall be sprayed until the variation in the diffusion of light on the sample or samples measured by the method described in appendix 2, is such that:

$$\Delta d = \frac{T_5 - T_4}{T_2} = 0,0250 \pm 0,0025$$

Several reference samples may be used to check that the whole surface to be tested has deteriorated homogeneously.

*Appendix 4***Adhesive tape adherence test****1. PURPOSE**

This method allows to determine under standard conditions the linear force of adhesion of an adhesive tape to a glass plate.

2. PRINCIPLE

Measurement of the force necessary to unstick an adhesive tape from a glass plate at an angle of 90°.

3. SPECIFIED ATMOSPHERIC CONDITIONS

The ambient conditions shall be at 23 °C ± 5 °C and 65 ± 5 % relative humidity (RH).

4. TEST PIECES

Before the test, the sample roll of adhesive tape shall be conditioned for 24 hours in the specified atmosphere (see para. 3 above). Five test pieces each 400 mm long shall be tested from each roll.

These test pieces shall be taken from the roll after the first three turns were discarded.

5. PROCEDURE

The test shall be under the ambient conditions specified in paragraph 3.

Take the five test pieces while unrolling the tape radially at a speed of approximately 300 mm/s, then apply them within 15 seconds in the following manner:

Apply the tape to the glass plate progressively with a slight lengthwise rubbing movement of the finger, without excessive pressure, in such a manner as to leave no air bubble between the tape and the glass plate.

Leave the assembly in the specified atmospheric conditions for 10 minutes.

Unstick about 25 mm of the test piece from the plate in a plane perpendicular to the axis of the test piece.

Fix the plate and fold back the free end of the tape at 90°. Apply force in such a manner that the separation line between the tape and the plate is perpendicular to this force and perpendicular to the plate.

Pull to unstick at a speed of 300 mm/s ± 30 mm/s and record the force required.

6. RESULTS

The five values obtained shall be arranged in order and the median value taken as the result of the measurement. This value shall be expressed in Newtons per centimetre of width of the tape.

Only the original UN/ECE texts have legal effect under international public law. The status and date of entry into force of this Regulation should be checked in the latest version of the UN/ECE status document TRANS/WP.29/343, available at:
<http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29docstts.html>.

**Regulation No 104 of the Economic Commission for Europe of the United Nations (UN/ECE)
— Uniform provisions concerning the approval of retro-reflective markings for vehicles of
category M, N and O**

Incorporating all valid text up to:

Supplement 7 to the original version of the Regulation - Date of entry into force: 26 July 2012

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12. Names and addresses of Technical Services responsible for conducting approval tests and of Administrative Departments

ANNEXES

- Annex 1 — The CIE co-ordinate system; Goniometer mechanism embodying the CIE angular system
- Annex 2 — Communication concerning the approval or extension or refusal or withdrawal of approval or production definitely discontinued of retro-reflective markings of heavy and long vehicles and their trailers pursuant to Regulation No 104
- Annex 3 — Arrangement of the approval mark
- Annex 4 — Test procedure
- Annex 5 — Specification of marking dimensions
- Annex 6 — Colorimetric specifications
- Annex 7 — Photometric specifications
- Annex 8 — Resistance to external agents

1. SCOPE

This Regulation applies to retro-reflective markings for vehicles of category M₂, M₃, N, O₂, O₃ and O₄ ⁽¹⁾.

2. DEFINITIONS

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

2.1.1. "Sample unit" means part or all of the retro-reflective material intended to be used to achieve the markings defined in paragraph 2.1.2.

2.1.2. "Distinctive markings, graphics" mean coloured markings, whose coefficient of retro-reflection is as defined in paragraphs 7.2.1 and 7.2.2 below.

2.1.3. 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. "Retro-reflection" means the reflection in which luminous flux 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 luminous flux.

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

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

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

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

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

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

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

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

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

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

⁽¹⁾ As defined in Annex 7 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), (document TRANS/WP.29/78/Rev.1/Amend.2 as last amended by Amend.4)

- 2.3.9. "First axis (symbol 1)" means an axis through the reference centre and perpendicular to the observation half-plane;
- 2.3.10. "First component of the entrance angle (symbol β_1)" means the angle from the illumination axis to the plane containing the reference axis and the first axis; range: $-180^\circ < \beta_1 < 180^\circ$;
- 2.3.11. "Second component of the entrance angle (symbol β_2)" means the angle from the plane containing the observation half-plane to the reference axis; range $-90^\circ < \beta_2 < 90^\circ$;
- 2.3.12. "Second axis (symbol 2)" means an axis through the reference centre and perpendicular to both the first axis and the reference axis. The positive direction of the second axis lies in the observation half-plane when $-90^\circ < \beta_1 < 90^\circ$ as shown in Annex 1, figure 1.

2.4. Definition of photometric terms

- 2.4.1. "Coefficient of retro-reflection (symbol R')" means the quotient of the coefficient of luminous intensity R of a plane retro-reflecting surface and its area A

$$\left(R' = \frac{R}{A} \right) \quad \text{The coefficient of retro-reflection } R' \text{ is expressed in candelas per m}^2 \text{ per lx (cd.m}^{-2}\text{.lx}^{-1}\text{)}$$

$$\left(R' = \frac{I}{E_{\perp} \cdot A} \right) \quad (\text{Luminance/Illumination});$$

- 2.4.2. "Angular diameter of the retro-reflector sample (symbol η_1)" means the angle subtended by the greatest dimension of the retro-reflective sample, either at the centre of the source of illumination or at the centre of the receiver ($\beta_1 = \beta_2 = 0^\circ$);
- 2.4.3. "Angular diameter of the receiver (symbol η_2)" means the angle subtended by the greatest dimension of the receiver as seen from the reference centre ($\beta_1 = \beta_2 = 0^\circ$);
- 2.4.4. "Luminance factor (symbol β)" means the ratio of the luminance of the body to the luminance of a perfect diffuser under identical conditions of illumination and observation;
- 2.4.5. "Colour of the reflected light of the device" The definitions of the colour of the reflected light are given in paragraphs 2.30 of Regulation No 48.

2.5. Description of Goniometer

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

2.6. Definition of "type"

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

- 2.6.1. the trade name or trade mark;
- 2.6.2. the characteristics of the retro-reflective material;
- 2.6.3. the parts affecting the properties of the retro-reflective materials or devices.

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a retro-reflective marking material shall be submitted by the holder of the trade name or trade 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 orientation in which the marking materials are to be fitted to a 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 retro-reflective marking materials;

3.1.3. Samples of the retro-reflective marking materials, as specified in Annex 4;

4. TRADE NAMES AND OTHER MARKS

4.1. Every marking material submitted for approval shall bear:

4.1.1. The trade name or trade mark of the applicant;

4.1.2. An orientation mark "TOP" which must be inscribed on any marking material whose retro-reflective system is not omnirotational at least:

(a) on strips in a 0,5 m distance,

(b) on areas within $100 \times 100 \text{ mm}^2$.

4.2. The marks shall be clearly legible on the outside of the marking material and shall be indelible.

5. APPROVAL

5.1. If the retro-reflective marking material submitted for approval in accordance with paragraph 4 above meets the requirements of this Regulation, approval for this type of marking material shall be granted.

5.2. An approval number shall be assigned to each type approved. Its first two digits (at present 00 for the Regulation in its original form) 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 may not assign the same number to another type of retro-reflective marking material.

5.3. Notice of approval or refusal or extension of approval of a type of marking material under this Regulation shall be communicated to the Parties to the 1958 Agreement which apply this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

5.4. Every marking material conforming to a type approved under this Regulation shall bear, in addition to the marks prescribed in paragraph 4.1, a clearly legible and indelible international approval mark consisting of:

5.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval⁽¹⁾.

⁽¹⁾ The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to Consolidated Resolution on the Construction of Vehicles (R.E.3), document TRANS/WP.29/78/Rev.2/Amend.1.

- 5.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number according to paragraph 5.2.
- 5.4.3. The following additional symbols indicating the class of material:
- 5.4.3.1. "C" for material for contour/strip marking;
- 5.4.3.2. "D" for material for distinctive markings/graphics intended for a limited area;
- 5.4.3.3. "E" for material for distinctive markings/graphics for extended area;
- 5.4.3.4. "D/E" for materials for distinctive markings or graphics as base or background in printing process for fully coloured logos and markings of class "E" in use which fulfil the requirements of class "D" materials.
- 5.5. The approval mark shall be visible and clearly legible on the outside of the marking material and shall be indelible and positioned at least once
- (a) at 0,5 m intervals on strips,
- (b) on areas within $100 \times 100 \text{ mm}^2$.
- 5.6. Annex 3 to this Regulation gives an example of the arrangement of the approval mark.
6. GENERAL SPECIFICATIONS
- 6.1. Retro-reflective marking materials shall be that way constructed that they function satisfactorily and will continue to do so in normal use. In addition, they shall not have any defect in design or manufacture that is detrimental to their efficient operation or to their maintenance in good condition.
- 6.2. Retro-reflective marking materials or parts thereof shall not be capable of being easily dismantled.
- 6.3. The means of attachment of the marking materials shall be durable and stable.
- 6.4. The outer surface of the retro-reflective marking materials shall be easy to be cleaned. The surface shall therefore not be rough and any protuberances they may exhibit shall not prevent easy cleaning.
7. SPECIAL SPECIFICATIONS
- 7.1. Retro-reflective marking materials shall also satisfy the conditions as to shape and dimensions, and the colorimetric, photometric, physical and mechanical requirements set forth in Annexes 5 to 8 to this Regulation.
- 7.2. Advertising, consisting of retro-reflective logos, distinctive markings or letters/characters has to be decent.

It may consist of marking materials of class "D" if the total retro-reflective area is less than 2 m^2 ; if the total retro-reflective area is at least 2 m^2 class "E" shall be used ⁽¹⁾.

⁽¹⁾ Nothing in this Regulation shall preclude the national authorities to prohibit the use of retro-reflective advertising, logos, distinctive markings, letters/characters as defined in paragraph 2.1.2 of this Regulation.

- 7.2.1. For class "D" marking materials the maximum values of the coefficient of retro-reflection are less or equal to the value defined in Annex 7, table 2, and are intended to be used in distinctive markings, graphics.
- 7.2.2. For class "E" marking materials the maximum values of the coefficient of retro-reflection are less or equal to 33 per cent of the values defined in Annex 7, table 2.
- 7.2.3. White retro-reflective marking materials intended as base or background in printing processes for fully coloured logos and markings of class "E" in use, without unprinted blank areas, may fulfil the requirements in Annex 7, table 2, for class "D" materials and must be marked as class "D/E".
- 7.3. Depending on the nature of retro-reflective marking material, the competent authorities may authorize laboratories to omit certain unnecessary tests, provided that such omission is mentioned under "Remarks" on the form notifying approval.
8. MODIFICATIONS AND EXTENSION OF APPROVAL FOR RETRO-REFLECTIVE MARKING MATERIALS
- 8.1. Every modification of the retro-reflective marking material shall be notified to the administrative department which granted the type approval. The department may then:
- 8.1.1. either 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;
- 8.1.2. or 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 to each communication form drawn up for such an extension.
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. Any retro-reflective marking material approved to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set forth in paragraphs 6 and 7 above.
- 9.2. The conformity of production shall not be contested if the mean value of the photometric measurements of five specimens taken at random deviates unfavourably by not more than 20 per cent from the prescribed values given in Annex 7 of this Regulation.
- 9.3. The conformity of production shall not be contested, if the mean value of the colorimetric properties of five specimens taken at random meet the specifications of Annex 6 of this Regulation, to be judged by visual inspection.
- 9.4. 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 retro-reflective marking material pursuant to this Regulation may be withdrawn if the requirements set forth above are not met or if a retro-reflective marking material bearing the approval mark does not conform to the type approved.

10.2. 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.

11. PRODUCTION DEFINITELY DISCONTINUED

If the holder of an approval completely ceases to manufacture a retro-reflective marking material 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 the other parties applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

12. 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, or production definitely discontinued issued in other countries, are to be sent.

ANNEX 1

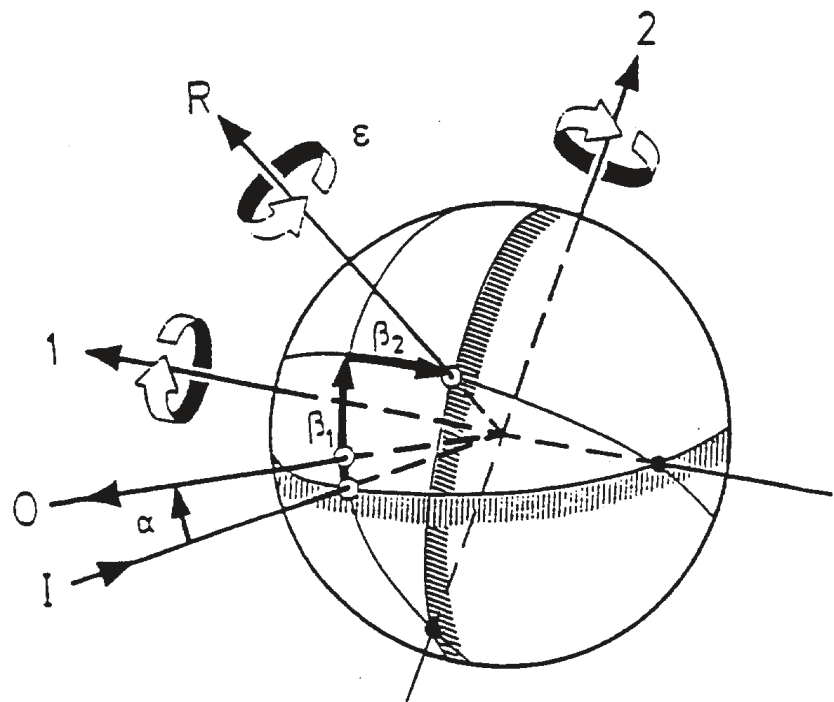


Figure 1

The CIE co-ordinate system

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

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

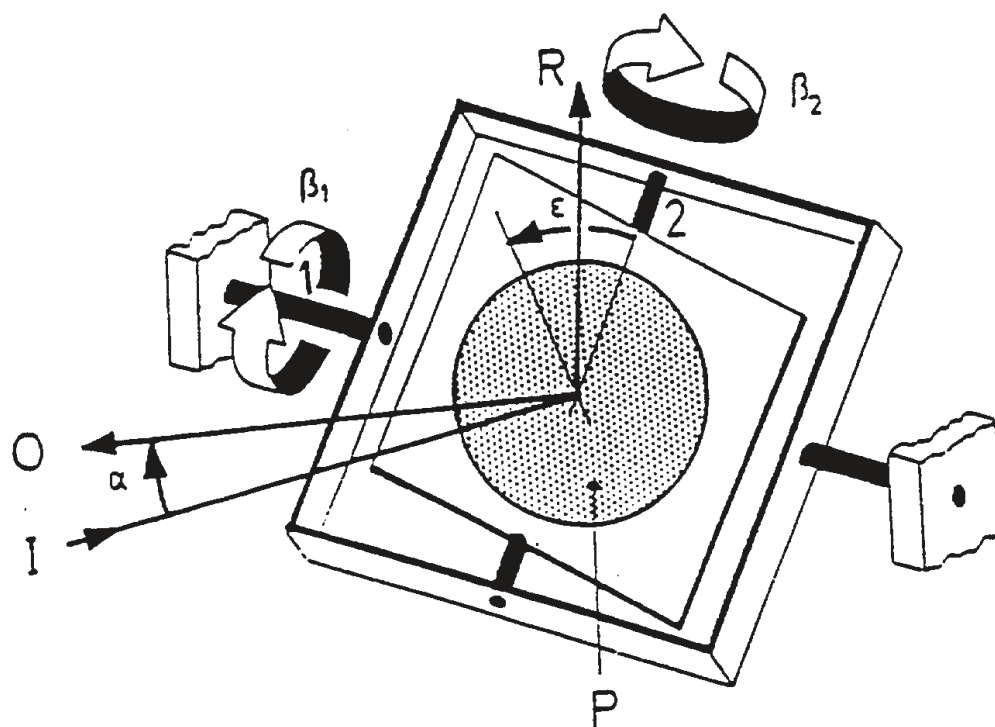


Figure 2

Goniometer mechanism embodying the CIE angular system

1: First Axis
2: Second Axis

I: Illumination Axis
O: Observation Axis
R: Reference Axis
P: Retro-reflective material

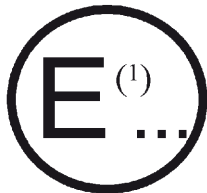
α : Observation angle
 β_1, β_2 : Entrance angles
 ϵ : Rotation angle

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

ANNEX 2

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration

.....

concerning ⁽²⁾: APPROVAL GRANTED
 APPROVAL EXTENDED
 APPROVAL REFUSED
 APPROVAL WITHDRAWN
 PRODUCTION DEFINITELY DISCONTINUED

of retro-reflective markings of heavy and long vehicles and their trailers, pursuant to Regulation No. 104

Approval No:

Extension No:

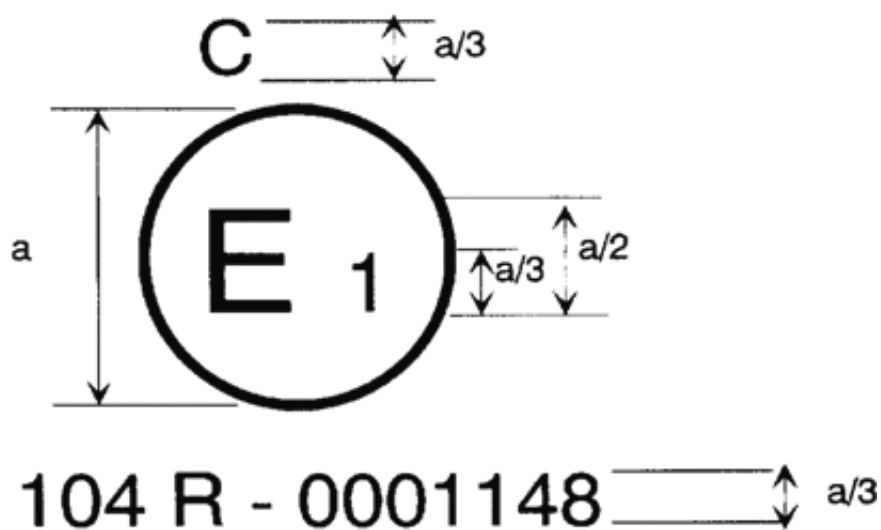
1. Trade name mark of the marking material:
2. Class of the marking material: C/D/E ⁽²⁾
3. Name and address of the manufacturer:
4. If applicable, name and address of manufacturer's representative:
5. Date on which the marking material was submitted for approval tests:
6. Technical service responsible for carrying out the approval test:
7. Date of test report issued by the technical service:
8. Number of test report issued by the technical service:
9. Remarks:
10. Approval granted/refused/extended/withdrawn ⁽²⁾
11. Reason(s) for the extension (if applicable):
12. Place:
13. Date:
14. Signature:
 Name:
15. Annexed is a list of documents making up the approval file, deposited with the Competent Authority which granted approval; a copy can be obtained on request.

⁽¹⁾ Distinguishing number of the country which has granted/extended/refused/withdrawn approval

⁽²⁾ Strike out what does not apply.

ANNEX 3

ARRANGEMENT OF THE APPROVAL MARK



$a = 12 \text{ mm min.}$

The retro-reflective marking material bearing the above approval mark has been approved in Germany (E1) under approval number 0001148. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No 104 in its original form. Symbol "C" indicates the class of the retro-reflective material which is intended for contour/strip marking. Symbol "D" shall indicate material for distinctive markings/graphics intended for a limited area and symbol "E" material for distinctive markings/graphics for extended area.

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. Five test samples representing either strips or planes of retro-reflective marking materials have to be submitted to the test laboratory. In the case of strips, at least a length of 3 meters shall be provided; in the case of planes, at least a surface of 500 mm × 500 mm shall be provided.
2. The test samples shall be representative of current production, manufactured in accordance with the recommendation of the manufacturer(s) of the retro-reflective marking materials ⁽¹⁾.
3. After verification of the general specifications (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 8 to this Regulation, prior to the tests described in Annexes 6 and 7.
4. The photometric and colorimetric measurements may be made on five samples. The mean values should be taken.
5. For other tests, samples which have not undergone any testing should be used.

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

ANNEX 5

SPECIFICATION OF MARKING DIMENSIONS

1. Side and rear marking with strips
 - 1.1. General

The markings shall be made of strips of retro-reflective material.
 - 1.2. Dimensions
 - 1.2.1. The width of a side and/or rear marking material shall be 50 mm + 10/- 0 mm.
 - 1.2.2. The minimum length of an element of a retro-reflective marking material shall be such that at least one approval mark is visible.

ANNEX 6

COLORIMETRIC SPECIFICATIONS

1. Retro-reflective marking materials (class C) shall be white, yellow or red. Retro-reflective distinctive markings and/or graphics (classes D and E) may be of any colour.
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 $= 20^\circ$, the colour of the material in new condition shall be within the limits according to paragraph 2.30 of Regulation No 48.

Chromaticity Co-ordinates

Colour		1	2	3	4
yellow	x [1]	0,585	0,610	0,520	0,505
	y [1]	0,385	0,390	0,480	0,465
white	x [1]	0,373	0,417	0,450	0,548
	y [1]	0,402	0,359	0,513	0,414
red	x [1]	0,720	0,735	0,665	0,643
	y [1]	0,258	0,265	0,335	0,335

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

ANNEX 7

PHOTOMETRIC SPECIFICATIONS

1. When illuminated with a CIE Standard illuminant A and measured as recommended by CIE publication No 54, 1982, the coefficient of retro-reflection R' in candelas per m^2 per lux ($cd/m^2/lux$) of the retro-reflective areas in new condition shall be at least as indicated in table 1 for yellow, white and red materials.

1.1. Minimum values for the coefficient of Retro-reflection

Photometric specifications for retro-reflective markings of Class C:

Table 1

Minimum values for the Coefficient of Retro-reflection R' [$cd.m^{-2}.lx^{-1}$]

Observation angle α [°]	Entrance Angle β [°]					
$\alpha = 0,33(20')$	β_1	0	0	0	0	0
	β_2	5	20	30	40	60
Colour						
Yellow		300	—	130	75	10
White		450	—	200	95	16
Red		120	60	30	10	—

1.2. Maximum values for the coefficient of retro-reflection

Photometric specifications for distinctive markings or graphics of class D:

Table 2

Maximum values for the Coefficient of Retro-reflection R' [$cd.m^{-2}.lx^{-1}$]

Observation angle α [°]	Entrance Angle β (°)				
$\alpha = 0,33^\circ (20')$	β_1	0	0	0	0
	β_2	5	30	40	60
Any colour		150	65	37	5

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

ANNEX 8

RESISTANCE TO EXTERNAL AGENTS

1. RESISTANCE TO WEATHERING

- 1.1. Procedure - For each test, two specimens of a sample unit (see paragraph 2.1.1 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. After the test, the specimen shall be washed in a dilute neutral detergent solution, dried and examined for conformity with the requirements specified in paragraphs 1.2 to 1.4.

1.2. Visual appearance

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

- 1.3. Colour fastness - The 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, measurements shall be made only at an observation angle of $\alpha = 20^\circ$ and an entrance angle of $\beta_2 = 5^\circ$ 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, tables 1 and 2.

2. RESISTANCE TO CORROSION

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

The saline mist shall be produced by atomizing at a temperature of $35 \pm 2^\circ \text{C}$ 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 marking.

- 2.2.1. The coefficient of retro-reflection R' of the retro-reflective areas, when measured after a recovery period of 48 hours as specified in paragraph 1 of Annex 7, at an entrance angle of $\beta_2 = 5^\circ$ and an observation angle of $\alpha = 20^\circ$, shall be not less than the value in Annex 7, table 1 or more than the value in table 2 respectively. Before measuring, the surface shall be cleaned to remove salt deposits from the saline mist.

3. RESISTANCE TO FUELS

A section of a sample unit not less than 300 mm long shall be immersed in a mixture of n-heptane and toluol, 70 per cent and 30 per cent by volume, for one minute.

After removal, the surface shall be wiped dry with a soft cloth and shall not show any visible change which would reduce its effective performance.

4. RESISTANCE TO HEAT

- 4.1. A section of a sample unit not less than 300 mm long shall be kept for 12 hours (in the case of moulded plastics reflectors this time shall be 48 hours) in a dry atmosphere at a temperature of $65 \pm 2^\circ \text{C}$ 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 $-20 \pm 2^\circ \text{C}$.

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

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

5. RESISTANCE TO CLEANING

5.1. Manual cleaning

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

5.2. Power washing

5.2.1. 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 $8 \pm 0,2$ 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.

6. STABILITY OF PHOTOMETRIC PROPERTIES

6.1. The approval granting authority has the right to test the optical properties stability of a retro-reflecting material in use (when used for marking or as distinctive markings/graphics).

6.2. The Administrative Departments of Contracting Parties, in which the approval was granted, may undertake the same tests. If "systematic failures in use" occur for a type of retro-reflective material, the tested material samples shall be transferred for appraisal to the authority which granted approval.

6.3. If other criteria are missing, the notation "systematic failures in use" for a type of retro-reflective material is to be established according to paragraph 6 of this Regulation.

7. RESISTANCE TO PENETRATION OF WATER

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

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

7.3. If visual inspection does not reveal the presence of water or in case of doubt, the coefficient of retro-reflection R' shall be measured in conformity with Annex 7, the sample unit being first lightly shaken to remove excess water from the outside.

8. BONDING STRENGTH (IN THE CASE OF ADHESIVE MATERIALS OF CLASS C)

8.1. The adhesion of retro-reflective materials shall be determined after 24 hours curing time by utilising a 90 degree peel on a tensile strength testing machine.

8.2. The retro-reflective materials shall not be easily removable without damaging the material.

8.3. The retro-reflective materials shall need a force of at least 10 N per 25 mm width at a constant speed of 300 mm per minute to be removed from their substrate.

9. FLEXING

9.1. For samples that are to be adhered to a flexible substrate, i.e. tarpaulin, the following shall apply:

9.1.1. A specimen of the sample unit that measures 50 mm by 300 mm shall be bent once lengthwise, around a 3,2 mm mandrel with adhesive contacting the mandrel for a period of 1 second. The test temperature shall be $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

Note: For ease of testing, spread talcum powder on the adhesive to prevent sticking to the mandrel.

9.1.2. After this test, specimen shall not have cracking of the surface and shall not show any visible change that would reduce its effective performance.

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