



## Economic and Social Council

Distr.: General  
18 December 2013

Original: English

---

### Economic Commission for Europe

#### Inland Transport Committee

#### World Forum for Harmonization of Vehicle Regulations

##### 162<sup>nd</sup> session

Geneva, 11-14 March 2014

Item 4.9.6 of the provisional agenda

**1958 Agreement – Consideration of draft amendments  
to existing Regulations submitted by GRE**

### **Proposal for the 04 series of amendments to Regulation No. 27 (Advance warning triangles)**

#### **Submitted by the Working Party on Lighting and Light-Signalling \***

The text reproduced below was adopted by the Working Party on Lighting and Light-Signalling (GRE) at its seventieth session (ECE/TRANS/WP.29/GRE/70, para. 34). It is based on ECE/TRANS/WP.29/GRE/2013/49 as amended by Annex VII to the report. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee AC.1 for consideration.

---

\* In accordance with the programme of work of the Inland Transport Committee for 2012–2016 (ECE/TRANS/224, para. 94 and ECE/TRANS/2012/12, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

*List of contents,*

*Insert a new reference to new paragraph 14., to read:*

"14. Transitional provisions"

*Insert a new reference to new Annex 9, to read:*

"9. Colour fastness to artificial light: Xenon-arc lamp test"

*Insert a new reference to new Annex 10, to read:*

"10. Description of the measurement geometry for measurement of the colour and the luminance factor of fluorescent retro-reflective materials"

*The text of the Regulation,*

*Insert new paragraphs 2.1.1. and 2.1.2., to read:*

"2.1.1. "advance-warning triangle of type 1" means advance-warning triangle comprised of a separate retro-reflecting device and separate fluorescent material;

2.1.2. "advance-warning triangle of type 2" means advance-warning triangle comprised of a single fluorescent retro-reflecting material."

*Paragraph 2.2.1., amend to read:*

"2.2.1. Trade name or mark:

(a) Advance-warning triangle bearing the same trade name or mark but produced by different manufacturers are considered as being of different types;

(b) Advance-warning triangle produced by the same manufacturer differing only by the trade name or mark may be considered to be of the same type."

*Paragraph 2.9., amend to read:*

"2.9. "Fluorescent retro-reflecting material" means a material with retro-reflecting properties which, when excited by daylight, exhibits the phenomenon of photo-luminescence ceasing rather shortly after excitation."

*Paragraph 3.5., amend to read:*

"3.5. Two samples of the fluorescent or fluorescent retro-reflecting material in which..."

*Add new paragraphs 3.6. to 3.6.2., to read;*

"3.6. In the case of a type of advance warning triangle differing only by the trade name or mark from a type that has already been approved it shall be sufficient to submit:

3.6.1. A declaration by the advance warning triangle manufacturer that the type submitted is identical (except in the trade name or mark) with and has been produced by the same manufacturer as, the type already approved, the latter being identified by its approval code;

3.6.2. Two samples bearing the new trade name or mark or equivalent documentation."

*Paragraph 5.2.*, amend to read:

"5.2. The approval number shall be assigned to each type approved. Its first two digits (at present 04 corresponding to the 04 series of amendments) shall indicate ..."

*Paragraph 6.1.*, amend to read:

"6.1. The advance-warning triangle ... concentric equilateral triangular contours. Alternatively, a fluorescent retro-reflecting material may be used (type 2)."

*Paragraph 7.1.1.2.*, amend to read:

"7.1.1.2 In the case of an advance-warning triangle of type 1, the retro reflecting units shall be arranged along the edge within a strip of an unvarying width which shall be between 25 mm and 50 mm. In the case of an advance-warning triangle of type 2 with fluorescent retro-reflecting material, the unvarying width shall be between 50 mm and 85 mm."

*Paragraph 7.1.1.5.*, amend to read:

"7.1.1.5. In the case of an advance-warning triangle of type 1, the fluorescent surface shall be continuous to the retro-reflecting units. It shall be arranged symmetrically along the three sides of the triangle. When in use, its surface area shall be not less than 315 cm<sup>2</sup>. However, an edging, continuous or not, not more than 5 mm wide, which need not necessarily be red-coloured, may be placed between the retro-reflecting surface and the fluorescent surface."

*Insert a new paragraph 7.1.3.*, to read:

"7.1.3. The fluorescent retro-reflecting material shall be coloured in the mass, either in the retro-reflective elements or as solid surface layer."

*Paragraph 7.2.1.2.*, amend to read:

"7.2.1.2. The testing of the colour for retro-reflecting device (Night-time colour) shall be carried out according to the method described in Annex 5, paragraph 2.1. and the trichromatic co-ordinates of the red reflected luminous flux shall be within the following limits:

<i>Point</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
<i>x</i>	0.712	0.735	0.589	0.625
<i>y</i>	0.258	0.265	0.376	0.375

"

*Paragraph 7.2.1.3.*, shall be deleted.

*Paragraph 7.2.2.2.*, amend to read (including the table):

"7.2.2.2. The testing of the colour of the fluorescent materials (Daytime Colour) of advance-warning triangle of type 1 or type 2 shall be carried out according to the method described in Annex 5, paragraph 2.2. and the colour of the material in new condition shall be within an area of which the corner points are determined by the following coordinates:

<i>Point</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
<i>x</i>	0.570	0.506	0.595	0.690
<i>y</i>	0.430	0.404	0.315	0.310

*Paragraph 7.2.2.3.*, amend to read:

"7.2.2.3. The testing of the luminance factor of the fluorescent materials shall be carried out according to the method described in Annex 5, paragraph 3.

The luminance factor including the luminance by reflection and fluorescence shall be:

- (a) For advance-warning triangle of type 1, not less than 30 per cent; and
- (b) For advance-warning triangle of type 2, not less than 25 per cent."

*Insert a new paragraph 7.2.3.*, to read:

"7.2.3. The largest measured trichromatic coordinate *y* value according to paragraph 7.2.1.2. (night time colour) shall be smaller or equal to the largest measured trichromatic coordinate *y* value according to paragraph 7.2.2.2. (day time colour)."

*Paragraph 7.3.1.*, amend to read:

"7.3.1. Retro-reflecting devices and fluorescent retro-reflecting material."

*Paragraph 7.3.1.1.*, amend to read:

"7.3.1.1. The values of the CIL of retro-reflecting optical units or the fluorescent retro-reflecting material shall be not less than those given in the table below, expressed in millicandelas per lux, for the angles of divergence and the illumination angle shown:

	<i>Illumination angles <math>\beta</math></i>			
<i>Vertical V (<math>\beta_1</math>)</i>	0°	±20°	0°	0°
<i>Horizontal H (<math>\beta_2</math>)</i>	0° or ± 5°	0°	± 30°	± 40°
<i>Angles of Divergence 20'</i>	8000	4000	1700	600
<i>Angles of Divergence 1°30'</i>	600	200	100	50

*Paragraphs 7.3.2. to 7.3.2.2.*, shall be deleted.

*Paragraph 10.1.*, amend to read:

"10.1. Advance-warning triangles approved under this Regulation shall be so manufactured as to conform to the type approved under this Regulation.

The compliance with the requirements set forth in paragraphs 6, 7 and 8 above shall be verified as follows:"

*Paragraph 10.2. (former)*, renumber as paragraph 10.1.1.

*Paragraph 10.3. (former)*, renumber as paragraph 10.1.2.

Paragraph 10.4. (former), renumber as paragraph 10.1.3.

Paragraph 10.5. (former), renumber as paragraph 10.2.

Insert a new paragraph 14., to read:

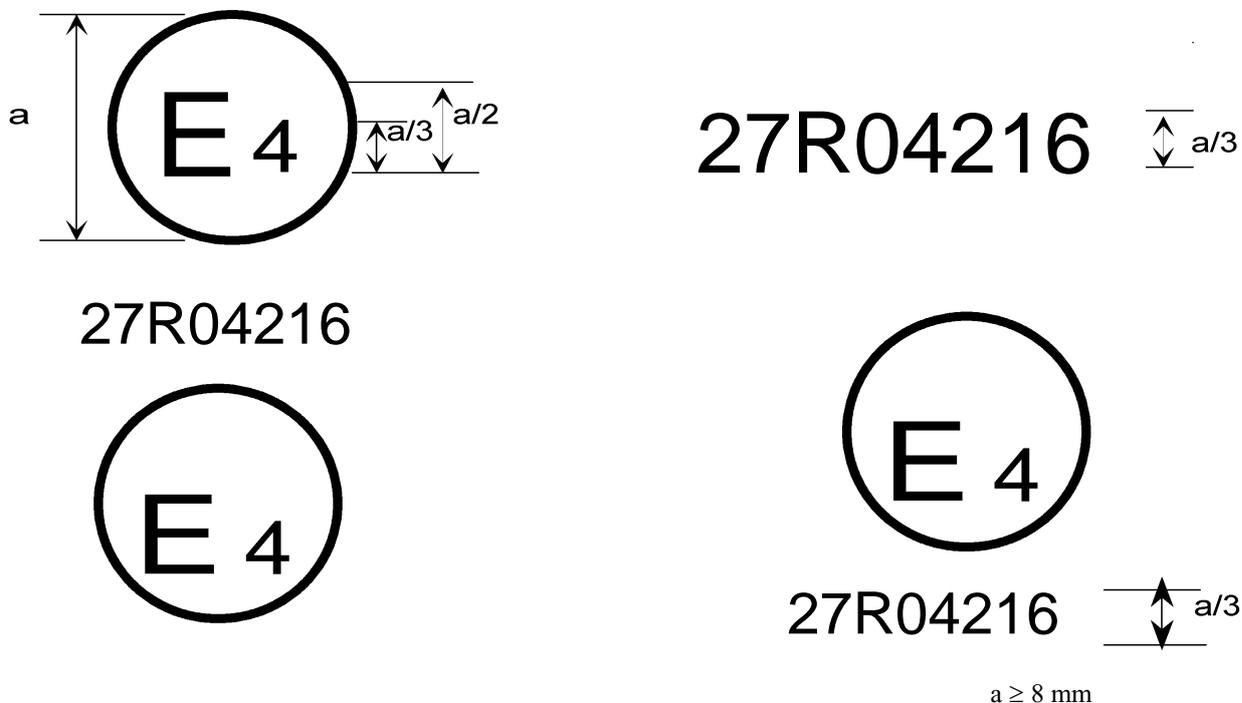
## "14. Transitional provisions

- 14.1. From the date of entry into force of the 04 series of amendments, no Contracting Party applying this Regulation shall refuse to grant approvals under this Regulation as amended by the 03 series of amendments.
- 14.2. As from 36 months after the date of entry into force of the 04 series of amendments, Contracting Parties applying this Regulation shall grant approvals only if the Advance Warning Triangle meets the requirements of this Regulation as amended by the 04 series of amendments.
- 14.3. Existing approvals for Advance Warning Triangles already granted under this Regulation before the date of entry into force of the 04 series of amendments shall remain valid indefinitely.
- 14.4. Contracting Parties applying this Regulation shall not refuse to grant extensions of approvals to the preceding series to this Regulation."

Annex 2, amend to read:

## "Annex 2

### Arrangements of the approval marks



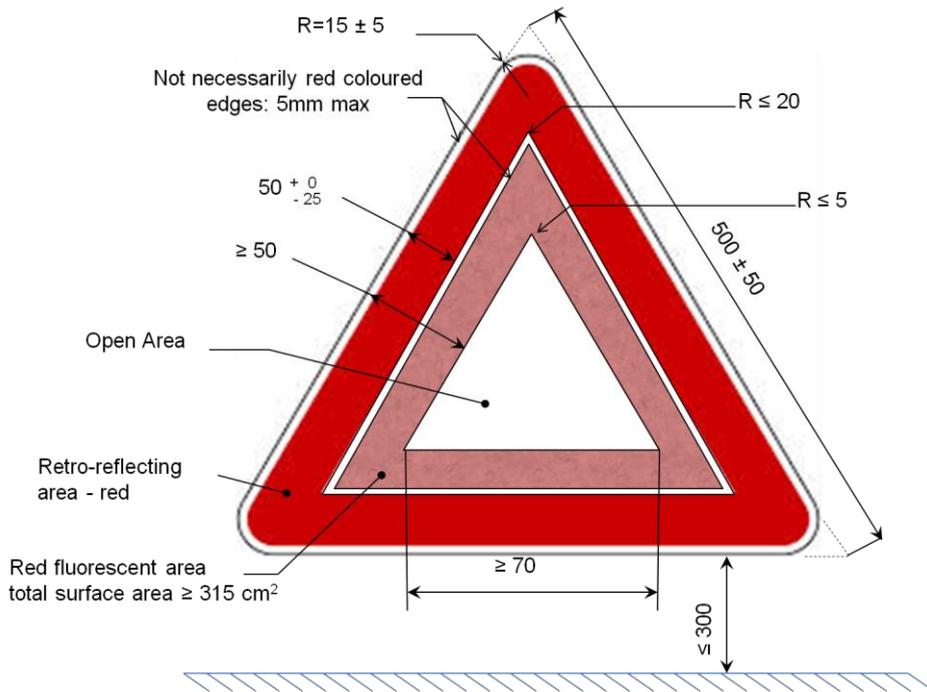
An advance-warning triangle bearing one of the approval marks shown above has been approved in the Netherlands (E4) under approval number 04216. The first two digits of the approval number indicate that the approval was granted according to the requirements of this Regulation as amended by the 04 series of amendments.

*Note:* The drawings show several possible embodiments and are given by way of example. The competent authorities shall avoid using Roman numerals for the approval, in order to prevent any confusion with other symbols."

*Annex 3, figure 1., amend to read:*

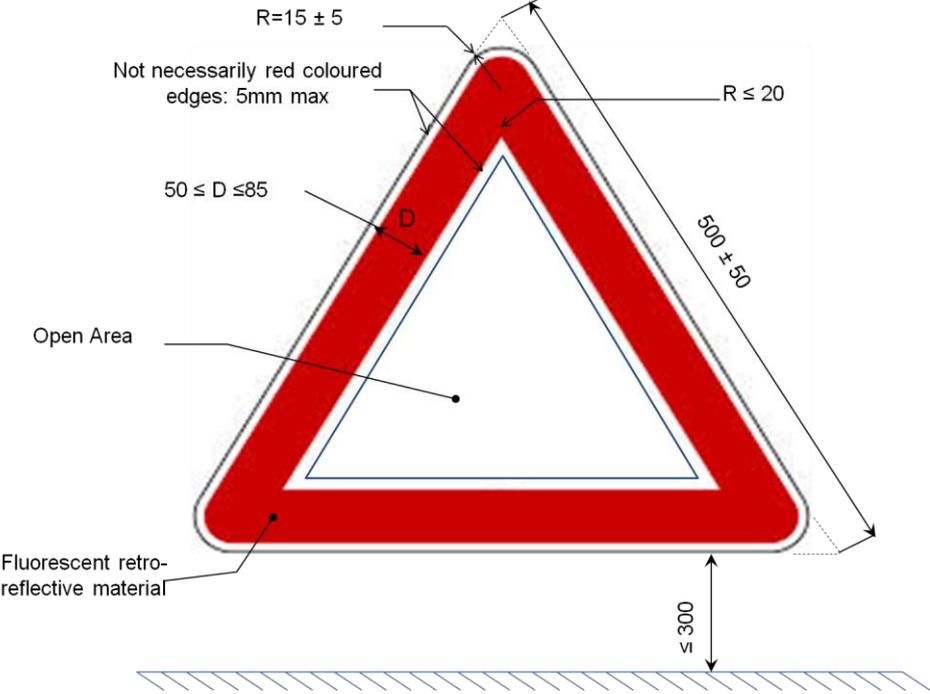
"Figure 1

**Shape and dimensions of the advance-warning triangle of type 1 and of the support**



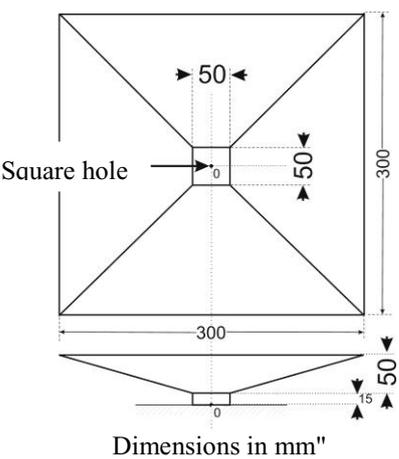
Insert a new Figure 2, to read

"Figure 2  
Shape and dimensions of the advance-warning triangle of type 2 and of the support



Annex 3, Figure 2 (former), renumber as Figure 3 and amend to read:

"Figure 3  
Test device for clearance to ground



*Annex 5,*

*Paragraph 1.4., shall be deleted*

*Paragraphs 1.5. to 1.5.2., renumber as paragraphs 1.4. to 1.4.2. and amend to read:*

- "1.4. The two samples with the smallest and the largest CIL value in the tests according to paragraph 1.3. above shall be subsequently subjected to the following tests:
- 1.4.1. Measurement of the values of the CIL in respect of the observation and illumination angles referred to in paragraphs 7.3.1.1. and 7.3.1.2. of this Regulation according to the method described in paragraph 4 below.
- 1.4.2. Testing of the colour of the retro-reflected light according to paragraph 2.1. below on the sample with the highest CIL concerned shall be examined."

*Paragraphs 1.5.3. to 1.8.3., renumber as paragraphs 1.4.3. to 1.7.3.*

*Paragraph 2.1. and 2.1.1., amend to read:*

- "2.1. Colour of retro-reflecting devices
- 2.1.1. The colour of the retro- reflecting devices to be tested when illuminated by the CIE standard illuminant A with an angle of divergence of  $1/3^\circ$  and an illumination angle  $V = H = 0^\circ$ , or, if this produces a colourless surface reflection, an angle  $V = \pm 5^\circ$ ,  $H = 0^\circ$  shall be applied."

*Paragraph 2.1.2., shall be deleted.*

*Paragraph 2.2 and 2.2.1., amend to read:*

- "2.2. Colour of the fluorescent material
- "2.2.1. Colour of the fluorescent material for the advance-warning triangle of type 1
- For testing the colour of the fluorescent material, the material shall be illuminated by the CIE Standard Illuminant D65 (ISO 11664-2:2007(E)/CIE S 014-2/E:2006) and measured with a spectrophotometer in accordance with the provisions of Publication CIE 15:2004, Recommendations on Colorimetry - Second Edition, either illuminated polychromatically or with a monochromator providing stepwise the CIE Standard Illuminant D 65 (ISO 11664-2:2007(E)/CIE S 014-2/E:2006) at an angle  $45^\circ$  to the normal and viewed along the normal (geometry 45/0). In the latter case, the stepwise resolution  $\Delta\lambda$  shall be not larger than 10nm. Alternatively similar "Illuminants" are allowed, if verified that the colorimetric measuring procedure is of the same sufficient accuracy, meaning that the quality of the simulation of D65 shall be assessed by the method described in ISO 23603:2005(E)/CIE S 012/E:2004. The spectral distribution of the illuminant shall be in category BC (CIELAB) or better.
- The Illumination shall be carried out at an angle  $45^\circ$  to the normal and viewed along the normal (geometry 45/0)."

*Paragraph 2.2.2., shall be deleted.*

*Insert a new paragraph 2.2.2. to read:*

- "2.2.2. Colour of the fluorescent material for the advance-warning triangle of type 2
- For testing the colour of the fluorescent material, the material shall be illuminated by the CIE Standard Illuminant D65 (ISO 11664-2:2007(E)/CIE S 014-2/E:2006) and measured with a spectrophotometer in accordance with

the provisions of publication CIE 15:2004, Recommendations on Colorimetry - second edition, either illuminated polychromatically or with a monochromator providing stepwise the CIE Standard Illuminant D 65 (ISO 11664-2:2007(E)/CIE S 014-2/E:2006). In the latter case, the stepwise resolution  $\Delta\lambda$  shall be not larger than 10nm. Alternatively similar "Illuminants" are allowed, if verified that the colorimetric measuring procedure is of the same sufficient accuracy, meaning that the quality of the simulation of D65 shall be assessed by the method described in ISO 23603:2005(E)/CIE S 012/E:2004. The spectral distribution of the illuminant shall be in category BC (CIELAB) or better. The illumination shall be carried out circumferential at an angle 45° to the normal and viewed along the normal (annular geometry 45/0) (circumferential/normal geometry), as described in Annex 10 to this Regulation."

*Paragraph 3.1. to 3.1.2., amend to read:*

- "3.1. For the determination of the luminance factor the sample shall be tested for advance-warning triangle of
- (a) type 1 with the same method as described in paragraph 2.2.1 of this annex and
  - (b) type 2 with the same method as described in paragraph 2.2.2. of this annex...
- 3.1.2. When the colour of the fluorescent material has been colorimetrically determined in compliance with paragraph 2. 2. ~~4~~ above, from the ratio of the tristimulus value Y the sample and the tristimulus value of the perfect diffuser  $Y_0$ ; in this case it is:

$$\beta = \frac{Y}{Y_0} "$$

*Paragraphs 10. to 10.5., amend to read:*

- "10. Test of stability against wind
- 10.1. The advance-warning triangle shall be set up in a wind tunnel, on a base measuring about 1.50 m by 1.20 m with a surface formed of abrasive material of the type P36 corresponding to the FEPA<sup>1</sup> specification 43-1-2006. This surface shall be characterised by its geometric roughness,  $HS = 0.5 \text{ mm} \pm 0.05 \text{ mm}$ , which shall be defined and determined by the so-called "sandy beach" method according to Annex 4 of this Regulation.
- To avoid a laminar boundary layer of the incident flow over the surface of the base, this base shall have a splitter plate and shall be set up in such a way, that the flow is completely around the plate.
- 10.2. For the air flow the following conditions shall apply:
- (a) The air stream shall reach a dynamic pressure of 180 Pa; and shall have a flow field which shall be homogeneous and free of turbulence;
  - (b) The dimension of the flow field shall be such, that horizontally to each corner and vertical to the top of the advance-warning triangle a

<sup>1</sup> FEPA: Federation of European Producers of Abrasives, 20 Avenue Reille, 75014 Paris, France.

clearance of at least 150mm to the border line of this flow field shall exist;

- (c) The air stream (flow field) shall be parallel to the supporting surface, in a direction which seems to be most unfavourable for the stability;
  - (d) In the case of a closed wind tunnel, the area of the advance-warning triangle shall be not larger than 5 per cent of the area cross-section of the closed wind tunnel.
- 10.3. When set up in this manner, the advance-warning triangle shall be subjected for 3 minutes to this open air stream.
- 10.4. The advance-warning triangle shall neither overturn nor shift. Slight shifting of the points of contact with the road surface by not more than 5 cm, however, shall be allowed.
- 10.5. The retro-reflecting triangular part of the device shall not rotate through more than 10° round a horizontal axis or a vertical axis from its initial position. The rotation around the horizontal axis or the vertical axis shall be determined by the aid of a virtual plane at the initial position of the retro-reflecting triangular part of the device, which is orthogonal to the base and orthogonal to the air stream."

*Paragraph 11.*, amend to read:

- "11. Test of resistance of the retro-reflecting device or fluorescent retro-reflecting material."

*Paragraph 11.1.2.*, amend to read:

- "11.1.2. After this ...  
... the test. Water or water vapour penetration into the edges of fluorescent retro-reflecting materials shall not be deemed to indicate failure."

*Paragraph 11.2.*, amend to read:

- "11.2. Test of resistance of the accessible reverse side of the mirror-backed retro-reflecting device  
  
The reverse side of the ... more than 40 per cent of the values recorded before the test. This test is not applicable for fluorescent retro-reflecting material."

*Paragraph 12.*, amend to read:

- "12 Test of the weather-resistance of the luminance factor and of the colour of the fluorescent (advance-warning triangle of type 1) and fluorescent retro-reflecting (advance-warning triangle of type 2) materials.
- 12.1. One of the samples of the fluorescent material submitted according to paragraph 3.5 of this Regulation shall be subjected to a temperature and irradiation test described in Annex 9 to this Regulation until the contrast No. 4 of the grey scale has been reached for the reference sample No. 5 or the light exposure equivalents for blue wool light fastness references sample No. 5 to fade to the grey scale 4 for exposure by a Xenon-arc lamp has been reached.
- 12.2. After this test, the colour co-ordinates of the fluorescent material shall comply with colour specification in paragraph 7. 2. 2. 2. of this Regulation. The luminance factor (see paragraph 3 above) shall comply with paragraph

7.2.2.3 above and shall not have increased by more than 5 per cent compared with the value ascertained according to paragraph 1. 8. 2. above

- 12.3. The sample shall not exhibit any visible damage such as cracks, scaling or peeling of the fluorescent or of the fluorescent retro-reflecting material.
- 12.4. If the fluorescent material is an adhesive film which had already successfully passed the above-mentioned tests in a previous approval test, the test need not be repeated; a corresponding note shall be entered under item 12 ("Remarks") in the communication concerning approval ( annex 1 of this Regulation)."

*Annex 6, the title, amend to read:*

## "Annex 6

### **Method for Measurement of the CIL of retro-reflecting devices and fluorescent retro-reflecting materials"**

*Insert a new Annex 9, to read:*

## "Annex 9

### **Colour fastness to artificial light Xenon-arc lamp test**

1. Scope
 

This annex specifies a method intended for determining the resistance of the colour of test samples of all kinds and in all forms to the action of an artificial light source representative of natural daylight (D65).
2. Principle
 

A specimen of the test samples to be tested is exposed to artificial light under prescribed conditions, along with a blue wool reference as specified.
3. Reference materials
 

The colour fastness ratings mentioned in this annex are obtained by comparison unexposed with exposed specified blue wool references for verification of the radiation dose as a required maximum contrast in this Regulation.

  - 3.1. Blue wool references developed and produced in Europe are identified by the numerical designation 1 to 8. These references are blue wool cloths dyed with the dyes listed in table 1. For the test procedure of this Regulation described by this annex only the blue wool references 5 and 7 will be applied as described in Table 1 below.

Table 1  
**Dyes for blue wool references 5 and 7**

<i>Reference</i>	<i>Dye (Colour Index designation)<sup>1</sup></i>
5	CI Acid Blue 47
7	CI Solubilised Vat Blue 5

<sup>1</sup> The Colour Index (third edition) is published by The Society of Dyers and Colourists, P.O. Box 244, Perkin House, 82 Grattan Road, Bradford BD1 2JB, UK, and by The American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709-2215, USA.

4. Grey scale
- The grey scale for determining changes in colour of test samples in colour fastness tests. A precise colorimetric specification of the scale is given in Appendix 1 to this annex.
- 4.1. The use of the scale is described in paragraph 2 of Appendix 1 to this annex.
5. Xenon-arc lamp apparatus
- The apparatus shall be either an air-cooled or water-cooled Xenon-arc weathering device capable of exposing samples in accordance with EN ISO 4892-2.
- 5.1. The exposure conditions shall comply with the specifications in the Table 2 below.

Table 2  
**Artificial weathering test parameters**

<i>Exposure parameters</i>	<i>Air-cooled lamp</i>	<i>Water-cooled lamp</i>
Light/dark/water spray cycle	Continuous light without water spray	Continuous light without water spray
Black standard temperature during light only periods	(47 ± 3) °C using a black standard thermometer	(47 ± 3) °C using a black standard thermometer
Relative humidity	Approximately 40 %	Approximately 40 %
Filters	Window glass filters Specifications see paragraph 5.2. below	Window glass filters Specifications see paragraph 5.2. below
<i>Irradiance (W/m<sup>2</sup>) controlled at:</i>		
Over 300nm to 400nm range	42±2	42±2
Over 300nm to 800nm range	550	630

*Note 1:* Water used for the specimen spray should contain no more than 1 ppm silica. Higher levels of silica can produce spotting on samples and variability in results. Water of the required purity can be obtained by distillation or by a combination of deionization and reverse osmosis.

*Note 2:* While irradiance levels should be set at the above levels, variations in filter ages and transmissivity, and in calibration variations, will generally mean that irradiance error will be in the order of ± 10 per cent.

## 5.2 Light source

The light source shall consist of a xenon arc lamp of correlated colour temperature 5500 K to 6500 K, the size of which will depend on the type of apparatus used. The xenon-arc lamp shall use filters that provide a reasonable simulation of solar radiation filtered by typical window glass. Table 3 gives the relative spectral irradiance requirements for the filtered xenon-arc. It is the responsibility of the supplier of the exposure device to provide necessary certification that the filters that they supply for use in the exposure tests described in this standard meets the requirements of Table 3.

Table 3  
**Relative spectral irradiance requirements for window glass filters<sup>a, b, c, d, e</sup> used for the Xenon-arc devices used in this standard.**

<i>Spectral Bandpass Wavelength <math>\lambda</math> in nm</i>	<i>Minimum %<sup>c</sup></i>	<i>CIE No.85, Table 4 plus window glass %<sup>d, e</sup></i>	<i>Maximum %<sup>e</sup></i>
1 < 300			0.29
300 $\leq \lambda \leq$ 320	0.1	$\leq 1$	2.8
320 < $\lambda \leq$ 360	23.8	33.1	35.5
360 < $\lambda \leq$ 400	62.4	66.0	76.2

<sup>a</sup> Data in Table 3 is the irradiance in the given bandpass expressed as a percentage of the total irradiance from 290 nm to 400 nm. To determine whether a specific filter or set of filters for a xenon-arc meets the requirements of Table 3, the spectral irradiance from 250 nm to 400 nm must be measured. The total irradiance in each wavelength bandpass is then summed and divided by the total irradiance from 290 nm to 400 nm.

<sup>b</sup> The minimum and maximum data in Table 3 are based on more than 30 spectral irradiance measurements for water and air cooled xenon-arcs with window glass filters of various lots and ages. Spectral irradiance data is for filters and xenon-burners within the ageing recommendations of the device manufacturer. As more spectral irradiance data become available, minor changes in the limits are possible. The minimum and maximum data are at least the three sigma limits from the mean for all measurements.

<sup>c</sup> The minimum and maximum columns will not necessarily sum to 100 per cent because they represent the minimum and maximum for the data used. For any individual spectral irradiance, the calculated percentage for the bandpasses in Table 3 will sum to 100 per cent. For any individual xenon-arc lamp with window glass filters, the calculated percentage in each bandpass must fall within the minimum and maximum limits of Table 2. Test results can be expected to differ between exposures using xenon-arc devices in which the spectral irradiance differ by as much as that allowed by the tolerances. Contact the manufacturer of the xenon-arc devices for specific spectral irradiance data for the xenon-arc and filters used.

<sup>d</sup> The data from Table 4 in CIE No. 85 [1] plus window glass was determined by multiplying the CIE No. 85, Table 4 data by the spectral transmittance of 3 mm thick window glass (see ISO 11341 [2]). These data are target values for xenon-arc with window glass filters.

<sup>e</sup> For the CIE 85 Table 4 plus window glass, the UV irradiance from 300 nm to 400 nm is typically about 9 per cent and the visible irradiance (400 nm to 800 nm) is typically about 91 per cent when expressed as a percentage of the total irradiance from 300 nm to 800 nm. The percentages of UV and visible irradiances on samples exposed in xenon arc devices may vary due to the number and reflectance properties of specimens being exposed.

- 5.3. Light exposure equivalents for blue wool light fastness references for exposure by a Xenon-arc lamp

Table 4

**Blue wool reference**

<i>Blue wool reference</i>		<i>420nm</i>	<i>300 nm–400 nm</i>
No.		kJ/m <sup>2</sup>	kJ/m <sup>2</sup>
5	L6	340	13824
7	L8	1360	55296
For colour change of step 4 on the grey scale			

6. Procedure (blue wool references)
- 6.1 Place the test samples mounted on the holders in the apparatus and expose them continuously to weathering following the method described below.
- 6.2 At the same time expose the blue wool references mounted on card-board, cover one-third of each.
- 6.3 Only one side of the test samples shall be exposed to weathering and light.
- 6.4 While the specimens are drying, the air in the test chamber shall not be moistened.
- Note:* The actual conditions of the weathering test depend on the kind of test apparatus used.
- 6.5 Before mounting the tested specimens for assessment, dry them in air at a temperature not exceeding 60°C.
- 6.6 Trim and mount the exposed blue wool reference so that they measure at least 15 mm x 30 mm, one on each side of a portion of the original which has been trimmed to the same size and shape as the specimens.
- 6.7 Unexposed samples of original fabric identical to those being tested are required as references for comparison with the specimens during weathering.

## Annex 9 - Appendix 1

### Definition of the Grey Scale

This section describes the grey scale for determining changes in colour of test samples in colour fastness tests, and its use. A precise colorimetric specification of the scale is given as a permanent record against which newly prepared working standards and standards that may have changed can be compared.

1. The essential, or 5-step, scale consists of five pairs of non-glossy grey colour chips (or swatches of grey cloth), which illustrate the perceived colour differences corresponding to fastness ratings 5, 4, 3, 2 and 1. This essential scale may be augmented by the provision of similar chips or swatches illustrating the perceived colour differences corresponding to the half-step fastness ratings 4-5, 3-4, 2-3 and 1-2, such scales being termed 9-step scales. The first member of each pair is neutral grey in colour and the second member of the pair illustrating fastness rating 5 is identical with the first

member. The second members of the remaining pairs are increasingly lighter in colour so that each pair illustrates increasing contrasts or perceived colour differences which are defined colorimetrically. The full colorimetric specification is given below:

- 1.1. The chips or swatches shall be neutral grey in colour and shall be measured with a spectrophotometer with the specular component included. The colorimetric data shall be calculated using CIE standard colorimetric system for Illuminant D65;
- 1.2. The Y tristimulus value of the first member of each pair shall be  $12 \pm 1$ ;
- 1.3. The second member of each pair shall be such that the colour difference between it and the adjacent first member is as follows.

Table 1  
**CIELab difference in relation to the Fastness grade**

<i>Fastness grade</i>	<i>CIELab difference</i>	<i>Tolerance</i>
5	0	0.2
(4-5)	0.8	$\pm 0.2$
4	1.7	$\pm 0.3$
(3-4)	2.5	$\pm 0.35$
3	3,4	$\pm 0.4$
(2-3)	4.8	$\pm 0.5$
2	6.8	$\pm 0.6$
(1-2)	9.6	$\pm 0.7$
1	13.6	$\pm 1.0$

*Note 1:* Bracketed values apply only to the 9-step scale.

*Note 2:* Use of the scale:

Place a piece of the original blue reference and the exposed specimen of it side by side in the same plane and oriented in the same direction. Place the grey scale nearby in the same plane. The surrounding field should be neutral grey colour approximately midway between that illustrating grade 1 and that illustrating grade 2 of the grey scale for assessing change in colour (this is approximately Munsell N5). Illuminate the surfaces with north sky light in the Northern hemisphere, south sky light in the Southern hemisphere, or an equivalent source with an illumination of 600 lx or more. The light should be incident upon the surfaces at approximately 45°, and the direction of viewing approximately perpendicular to the plane of the surfaces. Compare the visual difference between original and exposed blue standard with the differences represented by the grey scale.

If the 5-step scale is used, the fairness rating of the specimen is that number of the grey scale which has a perceived colour difference equal in magnitude to the perceived colour difference between the original and the treated specimens; if the latter is judged to be nearer the imaginary contrast lying midway between two adjacent pairs than it is to either, the specimen is given an intermediate assessment, for example 4-5 or 2-3. A rating of 5 is given only when there is no perceived difference between the tested specimen and the original material.

If the 9-step scale is used, the fastness rating of the specimen is that number of the grey scale which has a perceived colour difference nearest in magnitude to the perceived colour difference between the original and the tested specimens. A rating of 5 is given only when there is no perceived difference between the tested specimen and the original material.

Insert a new Annex 10, to read:

## "Annex 10

### **Description of the measurement geometry for measurement of the colour and the luminance factor of fluorescent retro-reflective materials**

Micro-prismatic materials show the phenomenon of 'flares' or 'sparkles' (Note 1), which might influence the measured results unless special precautions are taken. A reference method, using the wider apertures of the CIE 45°a:0° (or 0°:45°a) geometry is introduced in paragraph 12. of Annex 5 to this regulation.

Ideally, the measurements shall be made using the CIE 45°a:0° (or 0°:45°a), called the forty-five annular / normal geometry (or the normal/ forty-five annular geometry) defined in CIE 15 (see paragraph 12. of Annex 5.) The measurement area shall be minimum 4.0 cm<sup>2</sup>.

For this geometry CIE 15 recommends that:

- (a) The sampling aperture be irradiated uniformly from all directions between two circular cones with their axes normal to the sampling aperture and apices at the centre of the sampling aperture, the smaller of the cones having a half angle of 40° and the larger of 50°;
- (b) The receiver uniformly collects and evaluates all radiation reflected within a cone with its axis on the normal to the sampling aperture, apex at the centre of the sampling aperture, and a half angle of 5°.

The annular geometry can be approximated by the use of a number of light sources in a ring or a number of fibre bundles illuminated by a single source and terminated in a ring to obtain the CIE 45°c:0° (circumferential / normal geometry) (Note 2, Note 3).

An alternative manner of approximation is to use a single light source, but rotate the sample during measurement with a rotational speed that ensures that a number of revolutions takes place during the exposure time interval for a measurement so that all wavelengths are given equal weight (Note 2, Note 3).

In addition, the apertures of the light source and the receiver shall have sufficient dimensions in proportion to distances to ensure a reasonable compliance with the above-mentioned recommendations.

---

*Note 1* 'Flares' or 'sparkles' are caused by characteristic paths of rays that enter and leave the sheeting surface at different angles. A characteristic path will dominate by raising the luminance factor value significantly and possibly distorting the chromaticity coordinates if it is included within narrow beams of illumination and measurement. However, the average contribution to the daylight reflection is normally small.

*Note 2* In practice the recommendations can be approximated only. The important issue is that the annular principle is applied and that illumination and collection occur in directions forming fairly large solid angles, as this will reduce the influence of the above-mentioned 'sparkles' of micro-prismatic materials and of other variations with the precise geometry shown by some of these materials.

*Note 3* In spite of such precautions, the practical difficulties of establishing the annular geometry in accordance with the recommendations introduce uncertainty of measurement."

---