Economic and Social Council

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Working Party on General Safety Provisions

One-hundred-and-fifty-fifth session
Geneva, 15–18 November 2011
Item 4.7.1 of the provisional agenda
**1958 Agreement – Consideration of draft amendments
to existing Regulations submitted by GRSG**

Proposal for the 03 series of amendments to Regulation No. 46 (Devices for indirect vision)

Submitted by the Working Party on General Safety Provisions *

The text reproduced below was adopted by the Working Party on General Safety Provisions (GRSG) at its 100th session. It is based on ECE/TRANS/WP.29/GRSG/2010/21/Rev.1, as amended by para. 22 of the report (ECE/TRANS/WP.29/GRSG/79, para. 22). It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee (AC.1) for consideration.

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* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, 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.

I. Proposal

Paragraph 2.1.2.6., delete footnote 2/ and amend to read:

"2.1.2.6.   "*Critical object*" means a cylindrical object with a height of 0.50 m and a diameter of 0.30 m."

Paragraph 2.1.2.7., amend to read:

"2.1.2.7.   "*Critical perception*" means the level of perception that can just be obtained under critical conditions via the viewing system used. This corresponds to the situation in which the representative scale of the critical object is multiple times larger than the smallest detail that can be perceived via the viewing system."

Paragraph 2.1.2.9., amend to read:

"2.1.2.9.   "*Detection distance*" means the distance measured from the centre of the lens of the camera to the point at which a critical object can just be perceived (as defined by the critical perception)."

Paragraph 2.1.2.10., amend to read:

"2.1.2.10.   (Reserved)"

Paragraph 2.1.2.11., amend to read:

"2.1.2.11.   (Reserved)"

Insert a new paragraph 2.1.2.14. to read:

"2.1.2.14.   "*Smear*" is a vertical bright bar displayed on the monitor while sun light or light from other bright light sources is directly hitting into the lens of the camera. Smear is an optical artefact."

Paragraph 5.2., amend to read:

"5.2.   An approval number shall be assigned to each type approved. Its first two digits (at present 03) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another type of device for indirect vision."

Paragraph 6.2.2.2.1., amend to read:

"6.2.2.2.1.   The camera shall function well in conditions in which sunlight falls on the camera. The saturated area, defined as the area in which the luminance contrast ratio ($C = L_w/L_b$) of a high contrast pattern falls below 2.0, shall not cover more than 15 per cent of the displayed image under the conditions of paragraph 6.2.2.2.1.1. to 6.2.2.2.1.4.

In case the camera system shows dynamical changes in the blooming area during the test the maximum blooming area should fulfill the requirement."

Insert new paragraphs 6.2.2.2.1.1. to 6.2.2.2.1.4., to read:

"6.2.2.2.1.1. A black and white test pattern, having a minimum contrast ratio of 20 shall be positioned in front of the camera.

The test pattern shall be evenly illuminated at an illumination of 3000 ± 300 Lx.

The test pattern shall be medium gray on average and cover the complete area viewed by the camera: the camera shall view no other objects than the test pattern.

6.2.2.2.1.2. The camera shall be hit by a (simulated sun) light of 40 kLx, spanning an angle between 0.6 and 0.9 degrees with an elevation angle of 10 degrees (directly or indirectly via a mirror) removed from the optical axis of the sensor.
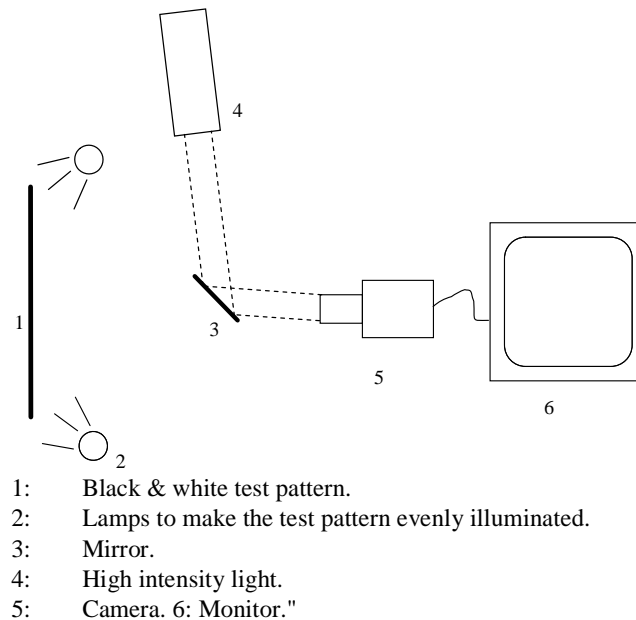
The light source shall:

(a)   have a spectrum D65 with a tolerance of ± 1500K,

(b)   be homogeneous in space and time within a tolerance of 2 kLx.

The emission of the light source in infrared shall be negligible.

6.2.2.2.1.3. There shall be no ambient illumination of the monitor during the test.

6.2.2.2.1.4. An example of the set-up is given in the figure A below.

Figure A
Diagram of the blooming measurement set-up.

1:    Black & white test pattern.
2:    Lamps to make the test pattern evenly illuminated.
3:    Mirror.
4:    High intensity light.
5:    Camera. 6: Monitor."

Paragraph 6.2.2.2.4., amend to read:

"6.2.2.2.4.   The measurements for the luminance contrast of the monitor shall be carried out according to ISO 15008:2009."

Paragraph 15.3.1., amend to read:

"15.3.1.   A device for indirect vision shall give such performances that a critical object can be observed by the driver over the entire required field of vision, taking into account the critical perception according the procedure of Annex 10.

Alternatively, the determination of the displayed object size shall be performed according to Annex 11."

Paragraph 15.3.3., amend to read:

"15.3.3.   (Reserved)"

Paragraphs from 21.1. to 21.8., amend to read:

"21.1.   As from the official date of entry into force of the 03 series of amendments to this Regulation, no Contracting Party applying this Regulation shall refuse an application for approval under this Regulation as amended by the 03 series of amendments.

21.2.   As from [12 months after entry into force of the 03 series of amendments to this Regulation], Contracting Parties applying this Regulation shall grant approvals to a type of device for indirect vision only if the type meets the requirements of this Regulation as amended by the 03 series of amendments.

21.3.   As from [18 months after entry into force of the 03 series of amendments to this Regulation], Contracting Parties applying this Regulation shall grant approvals to a type of vehicle with regard to the installation of devices for indirect vision only if the type of vehicle meets the requirements of this Regulation as amended by the 03 series of amendments.

21.4   As from [24 months after entry into force of the 03 series of amendments to this Regulation], Contracting Parties applying this Regulation may refuse to recognize approvals of a type of vehicle with regard to the installation of a camera-monitor device for indirect vision or type of camera-monitor device for indirect vision which have not been granted in accordance with the 03 series of amendments to this Regulation.

21.5.   As from 26 January 2010 for vehicles of category M_1 and N_1 and from 26 January 2007 for vehicles of other categories, Contracting Parties applying this Regulation may refuse to recognize approvals of a device for indirect vision which have not been granted in accordance with the 02 series of amendments to this Regulation.

21.6.   Approvals which were granted to devices for indirect vision of Classes I or III pursuant to this Regulation in its original form (00 series) or modified by the 01 or 02 series of amendments before the date of entry into force of this series of amendments shall remain valid.

21.7.   Notwithstanding the provisions of paragraph 21.2, approvals which were granted to mirrors of Classes II, IV, V, VI or VII pursuant to this Regulation as modified by the 02 series of amendments before the date of entry into force of this series of amendments shall remain valid.

21.8.   The provisions of this Regulation shall not prohibit the approval of a type of vehicle with regard to the mounting of devices for indirect vision pursuant to this Regulation as modified by the 03 series of amendments, if all or part of the devices for indirect vision of Classes I or III, with which it is fitted, bear the approval mark prescribed by this Regulation in its original form (00 series) or modified by the 01 or 02 series of amendments."

Insert new paragraphs 21.9. to 21.11., to read:

"21.9.   The provisions of this Regulation shall not prohibit the approval of a type of vehicle with regard to the mounting of devices for indirect vision pursuant to this Regulation as modified by the 03 series of amendments, if all or part of the rear-view mirrors of Classes II, IV, V, VI or VII, with which it is fitted,

bear the approval mark prescribed by the 02 series of amendments of this Regulation.

21.10.   Notwithstanding the provisions of paragraphs 21.2., 21.4. and 21.5. above, for the purpose of replacement parts, Contracting Parties applying this Regulation shall continue to grant approvals according to the 01 series of amendments to this Regulation, to devices for indirect vision of classes I to V and VII for use on vehicle types which have been approved before 26 January 2006 pursuant to the 01 series of amendments of Regulation No. 46 and to devices for indirect vision of class VI for use on vehicles which have been approved before 26 January 2007 pursuant to the 01 series of amendments of Regulation No. 46, and, where applicable, subsequent extensions to these approvals.

21.11.   Notwithstanding the provisions of paragraphs 21.2., 21.4. and 21.5. above, for the purpose of replacement parts Contracting Parties applying this Regulation shall continue to grant approvals according 02 series of amendments to this Regulation, to devices for indirect vision for use on vehicle types which have been approved before the date mentioned in paragraph 21.2 pursuant to the 02 series of amendments of Regulation No. 46, and, where applicable, subsequent extensions to these approvals."

Annex 5, amend to read:

"…
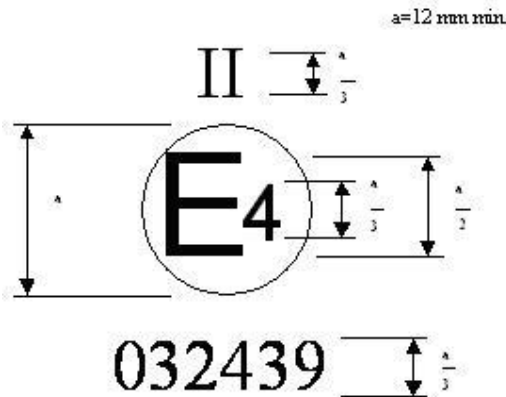
The above approval mark affixed to a device for indirect vision indicates that the mirror is a rear-view mirror, of Class II, which has been approved in the Netherlands (E 4) pursuant to Regulation No. 46 and under approval number 032439. The first two digits of the approval number indicate that Regulation No. 46 already included the 03 series of amendments when the approval was granted …"

Annex 10, paragraphs 1. to 1.2., amend to read:

"1.   Camera monitor device for indirect vision

1.1.   Determination of the smallest discernable detail

     The smallest discernable detail of the naked eye shall be defined according to standard ophthalmologic tests like the Landolt C test or the Triangle Orientation Discrimination (TOD) test. The smallest discernable detail at the centre of the viewing system can be determined using the Landolt C test or

the TOD test. In the rest of the viewing area the smallest discernable detail may be estimated from the centrally determined smallest discernable detail and the local image deformation. For instance, in the case of a digital camera the smallest discernable detail at a given pixel location (in the monitor) scales inversely with the solid angle of the pixel.

1.1.1. Landolt-C test

In the Landolt-C test, test symbols are judged by the subject under test. In accordance with this test the smallest discernable detail is defined as the visual angle of the gap size of the Landolt C symbol at threshold size and is expressed in arcmin. The threshold size corresponds to the size at which the subject judges the orientation correctly in 75 per cent of the trials. The smallest discernable detail is determined in a test involving a human observer. A test chart containing test symbols is placed in front of the camera and the observer judges the orientation of test symbols from the monitor. From the threshold gap size of the Landolt C test symbol d (m) and the distance between the test pattern and the camera D (m) the smallest discernable detail ωc (arcmin) is calculated as follows:

$$\omega_c = \frac{d}{D} \cdot \frac{180 \cdot 60}{\pi}$$

1.1.2. TOD test

The Landolt C test can be used to determine the smallest discernable detail of the camera-monitor system. However, for sensor systems it is more suitable to use the TOD (Triangle Orientation Discrimination) method which is similar to the Landolt C method, but involves equilateral triangular test patterns. The Triangle Orientation Discrimination method is described in detail by Bijl & Valeton (1999), who provide practical guidelines on how to perform a TOD measurement. In the method, triangular test patterns (see Figure 1) are viewed through the viewing system under test. Each triangle can have one out of four possible orientations (apex up, left, right or down) and the observer indicates/guesses for each triangle its orientation. When this procedure is repeated for many (randomly oriented) triangles of different sizes the fraction of correct responses can be plotted (see Figure 2), and increases with test pattern size. The threshold is defined as the point at which the fraction correct crosses the 0.75 level and can be obtained by fitting a smooth function through the data (see Bijl & Valeton, 1999). Critical perception is reached when the critical object diameter equals two times the width of the triangle at threshold size. The smallest discernable detail (ω_c) is equal to 0.25 times the width of the triangle at threshold size. This means that, from the threshold triangle width w (in m) and the distance between test pattern and the camera D (in m) the smallest discernable detail ω_c (in arcmin) is calculated as follows:

$$\omega_c = \frac{w}{4 \cdot D} \cdot \frac{180 \cdot 60}{\pi}$$

Figure 1
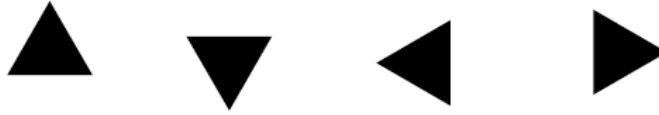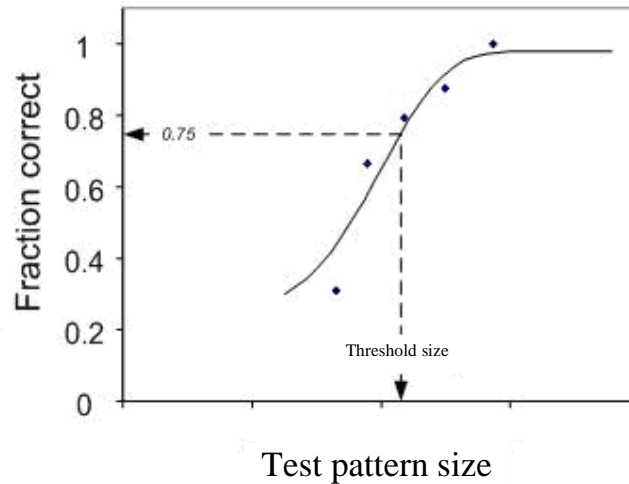Triangular test patterns used in the Triangle Orientation Discrimination (TOD) method

Figure 2
Typical relationship between the size of the triangle and the fraction of correct responses.

Test pattern size

1.2.   Determination of the critical viewing distance of the monitor

For a monitor having certain dimensions and properties, the distance to the monitor can be calculated within which the detection distance is dependent only on the performances of the camera. The critical viewing distance r_{mcrit} is defined as the distance at which the smallest discernable detail displayed on the monitor spans 1 arcmin measured from the eye (the acuity threshold of a standard observer).

$$r_{mcrit} = \frac{\delta \cdot 60 \cdot 180}{\pi}$$

where:

r_{mcrit} :   critical viewing distance of the monitor (m)

δ :   size of the smallest discernable detail on the monitor (m)"

Annex 10, paragraphs 1.3.1. and 1.3.2. amend to read:

"1.3.1.   Maximum detection distance within the critical viewing distance where, due to the installation, the distance eye-monitor is less than the critical viewing distance, the maximum attainable detection distance is defined as:

$$r_{dclose} = \frac{D_0 \cdot 60 \cdot 180}{\omega_c \cdot \pi \cdot f}$$

where:

r_{dclose} : detection distance (m)

D_0 : diameter of the critical object (m) according to paragraph 2.1.2.6.; for the calculation of r_{dclose} for class V and VI devices, a representative value of 0,30 m shall be used

f : threshold increasing factor, which is equal to 8

ω_c : smallest discernable detail (arcmin)

1.3.2. Detection distance greater than the critical viewing distance. Where, due to the installation, the distance eye-monitor is more than the critical viewing distance, the maximum obtainable detection distance is defined as:

$$r_{dfar} = \frac{r_{mcrit}}{r_m} \cdot r_{dclose} \qquad \text{(m)}$$

where:

r_{dfar} : detection distance for distances larger than the critical viewing distance (m)

r_{dclose} : detection distance for distances smaller than the critical viewing distance (m)

r_m : viewing distance, i.e. distance between eye and monitor (m)

r_{mcrit} : critical viewing distance (m)"

Insert a new Annex 11, to read:

"Annex 11

Determination of the displayed object size

1. Camera monitor device for indirect vision

1.1. General

Determination of the displayed object size considers the possible appearance of smear. The impact on the monitors image and consequence is the occultation of the field of view and therefore of the object. The following differentiation is made:

1.2. Case A: Smear appears

1.2.1 Step 1: Under the condition described in paragraph 6.2.2.2.1.2., measure the width (s) of the vertical bar displayed on the monitor e.g. with a measurement microscope.

1.2.2 Step 2: Place the object at a defined distance from the camera. Measure the width of the object displayed on the monitor (b) in a situation without real sun light condition e.g. with a measurement microscope.

1.2.3 Step 3: Calculate the residual object width (α) according to the following equation:

$$\alpha['] = 60 \times 2 \times \arctan \frac{b-s}{2 \times r}$$

where:

α: residual width of the object displayed on the monitor (with smear) (minutes of arc)

b: width of the object displayed on the monitor (without smear) (mm)

s: width of the smear (mm)

r: viewing distance (mm)

1.3. Case B: Smear does not appear

1.3.1. Step 1: Place the object at a defined distance from the camera. Measure the width of the object displayed on the monitor (b) in a situation without real sun light condition e.g. with a measurement microscope.

1.3.2. Step 2: Calculate the object width (α) according to the following equation:

$$\alpha['] = 60 \times 2 \times \arctan \frac{b}{2 \times r}$$

where:

α: width of the object displayed on the monitor (without smear) (minutes of arc)

b: width of the object displayed on the monitor (without smear) (mm)

r: viewing distance (mm)

1.4. Data supplied by the instructions for use

In case of Class V and VI camera monitor devices the instructions for use shall include a table that shows the minimum and maximum mounting height of the camera above ground under consideration of different viewing distances. The camera must be mounted within the applicable height range. The viewing distances shall be selected from the intended context of use. The following table shows an example.

Viewing distance	0.5 m	1.0 m	1.5 m	2.0 m	2.5 m
Minimum mounting height	Para. 1.4.1.	Para. 1.4.1.	Para. 1.4.1.	Para. 1.4.1.	Para. 1.4.1.
Maximum mounting height	Para. 1.4.2.	Para. 1.4.2.	Para. 1.4.2.	Para. 1.4.2.	Para. 1.2.2.

1.4.1. The value of the minimum mounting height is the same for all viewing distances as it is independent of the viewing distance. It is determined by the dimensions of the field of vision and the field of view of the camera. Use the following working steps for determination of the minimum mounting height.

1.4.1.1. Step 1: Draw the intended field of vision on ground.

1.4.1.2 Step 2: Place the camera above the field of vision in such a way that the camera is viewing the field of vision. The lateral position shall be in accordance with the intended mounting position at the vehicle.

1.4.1.3.   Step 3: Change the height of the camera above ground in such a way, that the field of vision displayed on the monitor covers an area at least as large as the field of vision. Furthermore, the field of vision display should encompass the entire monitor screen.

1.4.1.4   Step 4: Measure the height between camera and ground which is the minimum mounting height. Report the result value.

1.4.2.   The value of the maximum mounting height is different for different viewing distances as the displayed object size varies with the mounting height. Use the following working steps for determination of the maximum mounting height:

1.4.2.1.   Step 1: Determine the minimum width b_{min} of the critical object displayed on the monitor for each viewing distance.

$$b_{min} = 2 \times r \times \tan \frac{8'}{2 \times 60}$$

where:

r: viewing distance in mm

b_{min}:   minimum width of the critical object displayed on the monitor in mm

1.4.2.2.   Step 2: Place the critical object inside the drawn intended field of vision in a position at which the distance between the critical object and the camera is largest. The illumination conditions shall be in such a way that the critical object is clearly visible on the monitor.

1.4.2.3.   Step 3: Select the first value of the possible viewing distances.

1.4.2.4.   Step 4: Change the height of the camera above ground in such a way, that the residual width B of the object displayed on the monitor is equal to the minimum width allocated to that viewing distance.

B=b_{min}

where:

B: residual width of the object displayed on the monitor (which is "b" in cases without smear and "b – s" in cases with smear) in mm (see paragraph 1.1. General)

1.4.2.5.   Step 5: Measure the height between camera and ground which is the maximum mounting height allocated to that viewing distance. Report the result value.

1.4.2.5.   Step 6: Repeat the aforementioned steps 4 and 5 for the other viewing distances."

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