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agenda item 2.7.)

PROPOSAL FOR DRAFT AMENDMENTS TO REGULATION No. 112

(Headlamps emitting an asymmetrical passing beam)

Transmitted by the Expert from the Working Party "Brussels 1952" (GTB)

Note: The text reproduced below was prepared by the expert from GTB in order to incorporate into the Regulation the specifications of the definition and Sharpness of the "cut-off" Line for Headlamps. Only the amendments to the text of the Regulation (not to its annex 3) are marked in **bold** characters.

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Note: This document is distributed to the Experts on Lighting and Light-Signalling only.

**A. PROPOSAL**

Table of contents, annexes, amend to read:

"...

Annex 7 - Minimum requirements for sampling by an inspector

**Annex 8 - Definition and Sharpness of the "cut-off" Line for Headlamps"**

The text of the Regulation, paragraphs 6.2.1 to 6.2.2., amend to read:

"6.2.1. The passing beam shall produce a sufficiently sharp "cut-off" as defined in annex 8 to this Regulation, to permit a satisfactory adjustment with its aid.

6.2.2. The headlamp shall be visually aimed by means of the "cut-off" line which is specified in annex 8 of this Regulation, so that:"

Paragraph 6.2.2.1., amend to read (including the deletion of the footnote 8/ and its reference):

"6.2.2.1. in the case of headlamps designed to meet the requirements of right-hand traffic, the "cut-off" on the left-half of the screen 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.

The test screen for visual adjustment shall be positioned at

either a distance of 10 m and this horizontal part of the "cut-off" is situated on the screen 10 cm below the level hh (see annex 3); or at distance of 25 m and this horizontal part of the "cut-off" is situated on the screen 25 cm below the level hh (see annex 3);

and be sufficiently wide to allow examination and adjustment of the "cut-off" over of at least 5° on either side of the v-v-line."

Paragraph 6.2.2.2., amend to read:

"6.2.2.2. For horizontal adjustment: The kink or elbow of the "cut-off" line shall be situated at the V-V-line, as described in Annex 8. If the beam does not have a clear elbow, the lateral adjustment shall be effected in the manner which best satisfies the requirements for illumination at points 75R and 50R for passing beams for right hand side traffic and for points 75L and 50L for left hand side traffic."

Paragraph 6.2.2.3., amend to read (including the deletion of footnote 9/ and its reference):

"6.2.2.3. For vertical adjustment: The horizontal part of the "cut-off" line is moved from downward upwards and adjusted to its nominal position 1% below the H-H-line , as described in Annex 8, which is:

- 10 cm below the headlamp axis on the screen at 10 m distance or which is

- 25 cm below the headlamp axis on the screen at 25 m distance.

6.2.2.4. If, however, vertical adjustment cannot be performed repeatedly to the required position within the allowed tolerances, the instrumental method of ANNEX 8, paragraphs 4 and 5 shall be applied to test compliance with the required minimum quality of the "cut-off" line and to perform the beam vertical adjustment."

Paragraph 6.2.3., amend to read:

"6.2.3. When so aimed, the headlamp need, if its approval is sought solely for provision of a passing beam, 8/ comply only with the requirements set out in paragraphs 6.2.5. to 6.2.7. below; if it is intended to provide both a passing beam and a driving beam, it shall comply with the requirements set out in paragraphs 6.2.5. to 6.2.7. and 6.3.

8/ Such a special "passing beam" headlamp may incorporate a driving beam not subject to requirements."

Paragraph 6.2.4., amend to read:

"6.2.4. Where a headlamp, so aimed, does not meet the requirements as indicated in paragraph 6.2.3. above, its alignment may be changed, within 0.5 degrees to the right or left and vertically 0.2 degrees up or down, with respect to the initial aiming."

Annex 1,

Item 9, amend to read:

"...  
...  
Number and category(ies) of filament lamp(s): . . . . .  
. . . . .  
  
The determination of cut-off gradient was carried out at  
10m / 25m 2/"

Annex 5,

Insert a new paragraph 1.4., to read :

"1.4. At one of the sampled headlamps in a series of samples shall be tested the quality of cut-off according to the procedure described in to annex 8, paragraphs 2. and 3."

Annex 7,

Insert a new paragraph 1.3., to read :

"1.3. At one of the sampled headlamps shall be tested the quality of cut-off according to the procedure described in annex 8, paragraphs 2. and 3."

Insert a new Annex 8, to read:

"Annex 8

**Definition and Sharpness of the "cut-off" Line for Headlamps**

1. General:

The luminous intensity distribution of the headlamp shall incorporate a "cut-off" line which enables the headlamp to be adjusted correctly for the photometric measurements and for the aiming on the vehicle.

The "cut-off" line shall consist of

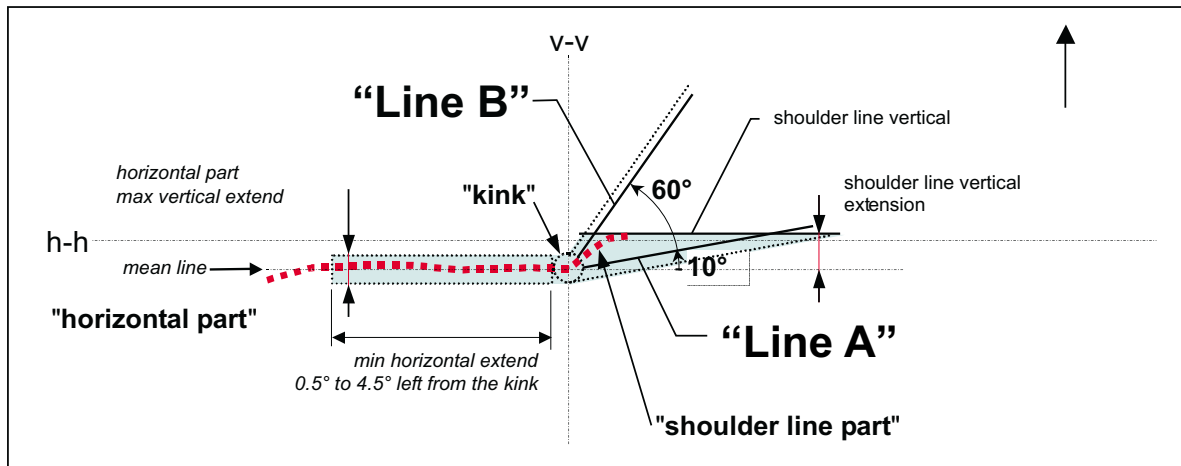
- i) a straight "horizontal part" towards the left
- ii) a "shoulder line part" towards the right
- iii) one clear "kink", in between and formed by the "cut-off" parts defined above,

The characteristics of the "cut-off" line shall comply with the requirements set out in paragraph 2. to 4. below:

2. Shape of the cut-off line:

For visual adjustment of the passing beam the cut-off line shall provide a horizontal line for vertical adjustment of the headlamp between  $0.5^\circ$  and  $4.5^\circ$  distant from the v-v-line (see Figure1), which does not exceed a vertical extend of  $\Delta\beta = 0.2$  degree up or down.

Figure 1:



3. Visual adjustment of the passing beam:

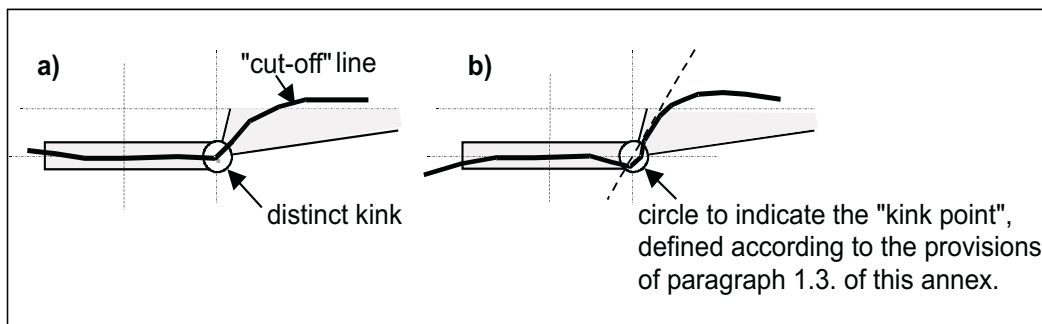
3.1 Horizontal adjustment:

The beam with its the "cut-off" line shall be moved from right to left (left hand traffic: from left to right) until the "kink" or

"elbow" is situated at the v-v-line. If the "elbow" forms no sharp enough edge, that point shall be taken, where the horizontal line through the straight part and the steepest tangential line onto the shoulder part of the cut-off line are crossing (for examples see Figure 2). The "shoulder line part"

- (a) does not extend the tangential line "B" going from the "kink" upwards to the right and being inclined versus h-h by  $60^\circ$ ;
- (b) does not extend the tangential line "A" going from the "kink" upwards to the right and being inclined versus h-h by  $10^\circ$ .
- (c) has a vertical extension of at least  $\Delta\beta = 0.57^\circ$  over a distance of  $2^\circ$  to the left (right hand traffic) and  $2^\circ$  to the right (left hand traffic).

Figure 2:



3.2. Vertical adjustment:

After horizontal adjustment of the passing beam according to paragraph 3.1. above, the vertical adjustment of the passing beam shall be performed in such a way that the beam with its cut-off line is moved from downwards upwards until the horizontal part of the cut-off line is situated at nominal vertical position. If the horizontal part is not straight but slightly curved or inclined, the cut-off line between the distant, as described in paragraph 2. above, shall not exceed the range between two horizontal lines situated at  $0.1^\circ$  above and below the nominal position (see Figure 2. above). The vertical adjustment shall be performed in the point 2.5 left (for beams for left hand side traffic: 2.5 ° right).

- 3.2.1. If the horizontal part of the cut-off line does not provide sufficient quality for visual adjustment or if the visual adjustments of three trained individuals differ by more than  $0.2^\circ$ , the quality of cut-off shall be tested instrumentally for compliance with requirements as follows.

#### 4. Measurement of the quality of cut-off:

Measurements shall be performed by vertically scanning through the horizontal part of the cut-off line in angular steps of  $0.01^\circ$  at either a measurement distance of:

- 10 m and a detector with a diameter of approximately 10 mm or at a measurement distance of
- 25 m and a detector with a diameter of approximately 30 mm.

The measurement of the cut-off quality shall be considered acceptable if the requirements of paragraph 3.1.2. of this Annex shall comply with at least one measurement at 10 m or 25 m.

The measuring distance at which the test was determined shall be noted down in paragraph 9 of the communication form (see annex 1 of this Regulation).

After visual horizontal adjustment according to paragraph 2.2 above, the scanning is done from downwards upwards through the cut-off line along the vertical lines at  $1.5^\circ$ ,  $2.5^\circ$  and  $3.5^\circ$  left (for left hand side traffic: right) of the v-v-line). If so measured, the quality of the cut-off shall meet the following requirements:

##### 4.1. No exposure of double lines:

The slope of the vertical gradient of the luminous intensities shall be continuous and not expose more than one vertical position leading to

$$\S \quad (d^2(\log I_\beta) / d\beta^2 = 0$$

where  $v$  is the vertical angular value in degrees and  $I_\beta$  is the luminous intensity in cd at vertical angle  $\beta$ .

This requirement is deemed to be met if within the vertical interval of  $\pm 1^\circ$  from the cut-off line, the slope of the gradient contains no two or more positions where

$d^2(\log I_{\beta_1}) / d\beta^2_1 = 0$  and  $d^2(\log I_{\beta_2}) / d\beta^2_2 = 0$  or ,  
when such positions are found, when

$$| I_{\beta_1} - I_{\beta_2} | / | \beta_1 - \beta_2 | > 0,005 \times (I_{\beta_1} + I_{\beta_2}) / 0.1^\circ.$$

##### 4.2. Sharpness of cut-off:

If scanned vertically through the horizontal part of the cut-off line at  $2.5^\circ$  distant from the V-V-line, the maximum value measured for

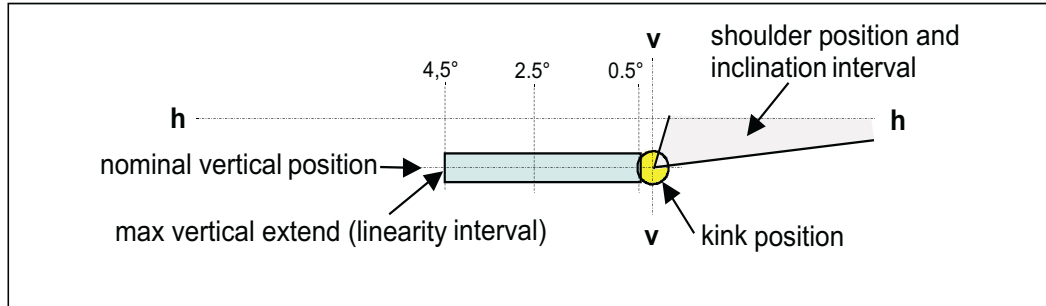
$$G = (\log E_\beta - \log E_{(\beta + 0,1^\circ)})$$

is called the sharpness factor  $G$  of the cut-off line. The value of  $G$  shall not be less than 0.13.

4.3. Linearity:

The part of the cut-off line which serves vertical adjustment shall be horizontal between 0.5° and 4.5° distant from the v-v-line. This requirement is deemed to be met when the vertical position of the inflection points (where  $d^2(\log E) / d\beta^2 = 0$ ) at 1.5°, 2.5° and 3.5° horizontal distance from the v-v-line are located within a band width of + 0.2° from the nominal vertical position of the cut-off line at 2.5° sideward of the v-v-line, see Figure 3.

Figure 3:



5. Instrumental vertical adjustment:

If the cut-off line complies with the above quality requirements, the vertical beam adjustment can be performed instrumentally. For this purpose the inflection point at 2.5° distant from the v-v-line where  $d^2(\log E) / dv^2 = 0$  is positioned at the nominal position below the h-h-line. The movement for measuring and adjusting the cut-off line shall be upwards from below the nominal position."

\* \* \*

B. JUSTIFICATION

A method for the numeric definition and measurement of cut-off position and sharpness has been developed, which can be used for instrumental aiming and for the decision whether the cut-off line of a passing beam headlamp yields sufficient sharpness such that proper vertical aim is possible, be it visually or instrumentally.

In order to adapt the shape of the cut-off line to the requirements of the harmonized passing beam pattern and to harmonize the requirements with FMVSS 108, GTB proposes to amend the proposed definition and sharpness of cut-off into the consolidated headlamp Regulation No. 112 for asymmetric passing beam pattern.

Literature:

The main background and references are given in the following publications:

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  - M. Sivak, M. Flannagan, D. Chandra, A. W. Gellaty, Visual Aiming of European and U.S. Low-Beam Headlamps, Report N0. UMTRI-91-34, University of Michigan, September 1991
  - CIE-Draft Publication: "Definition of cut-off ", Vienna 1993
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  - FMVSS 108 after implementation of cut-off and visual aim, 1998
  - NHTSA, Final Summary Minutes, Headlamp Regulatory Negotiation, Session 3, October 18 and 19 ,
  - K. Manz, ARE MEASUREMENTS FOR THE CUT-OFF GRADIENT OF HEAD LAMPS IN DIFFERENT MEASUREMENT DISTANCES POSSIBLE ?,paper presented at the SAE Lighting Conference 2000 in Detroit, Conference Paper # 2000-01-0803
  - K. Manz, Tolerances of Cut-Off-Measurements, Proceedings of Progress In Automobile Lighting, Vol. 8, PAL 2001, p. 635
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