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PROPOSAL FOR DRAFT AMENDMENTS TO DRAFT REGULATION ON
ADAPTATIVE FRONT-LIGHTING SYSTEM (AFS)

This revision allows to easier understanding of "cut-off" line determination.

Transmitted by the Expert from Poland

Note: The text reproduced below was prepared by the expert from Poland, in order to improve the definition of the "cut-off" line and aiming the AFS lighting unit(s). It refers to document TRANS/WP.29/GRE/2002/18.

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

A. PROPOSAL

Add new paragraph 1.5.4., to read:

"1.5.4. "Initial lighting unit" means lighting unit specified by applicant used for aiming before photometric measurements. "

Paragraph 6.2.1., amend to read:

"6.2.1. Each lighting unit should have means of vertical and/or horizontal aiming. This means should enable aiming with vertical accuracy not less than $[\pm 0.1]$ deg and horizontal accuracy not less than $[\pm 0.5]$ deg using appropriate method and/or device specified by Applicant which is accessible by the technical service, diagnostic stations and test houses. "Cut-off" line defined in Annex 9 is the means that is suggested above. "Cut-off" line is not required if any possible tolerances of installation unit mounting position on the vehicle (including after crash repairs tolerances and mass production tolerances of using replaceable light sources) do not affect the photometric results described in Annex 3 more than [20 percent] per each installation unit in system."

Annex 9,

Paragraph 1.2.1., amend to read:

"1.2.1. 80 percent of the "horizontal part" does not exceed a vertical extend of $\Delta\beta = 0.1$ deg up or down within 0.5 deg and 4.5 deg left from the "kink". It is determined as defined in paragraph 4.1."

Paragraph 1.2.2., amend to read:

"1.2.2. ...
(a) does not extend above the line "B" going from the "kink" upwards to the right ...
(b) does not extend below the line "A" going from the "kink" upwards to the right ..."

Paragraph 1.3., amend to read:

"1.3. If there is no distinct "kink", the "kink point" shall be considered as described in paragraph 4.1.2."

Paragraph 3.1., amend to read:

"...

After visual horizontal the scanning is done from 0.5 deg to 4.5 deg left of v-v with the step not greater than 0.1 deg. "

Paragraph 3.2.3., amend to read:

" the vertical positions where $d^2(\log E)/d\beta^2=0$ of at least 70 percent of vertical scanning lines according to paragraph 3.1. above are located within bandwidth of $[\pm 0.1]$ deg from the mean vertical position determined as described in paragraph 4.1.

Paragraph 4., amend to read:

4. "Instrumental adjustment of "cut-off" line is done as follows:"

Insert new paragraphs 4.1. and 4.2., to read:

"4.1. Vertical adjustment:

After initial visual adjustment of horizontal part of "cut-off" line instrumental adjustment shall be done as determined as below:

4.1.1. *The original vertical position of horizontal part of "cut-off" line is the arithmetical average of vertical co-ordinates of all points described in paragraph 3.1. in which $d^2 \log E / d\beta^2 = 0$.*

4.1.2. *The next vertical position of horizontal part is the arithmetical average of vertical co-ordinates of points taken from the previous determination excluding point(s) with the greatest distance from the previous vertical position of horizontal part.*

4.1.3. *The procedure described in paragraph 4.1.2. is repeated until no more point can be excluded.*

4.2. Horizontal adjustment:

The approximation of shoulder line part of „cut-off" line is the slant line determined by the following co-ordinates: angle γ and kink point position. The slant line is the one determined below, for which the result of multiplication of number of all points lying in 0.05 deg vertical bandwidth from this line and this line inclination (angle γ) tangent is the highest. Approximation of shoulder line part of „cut-off" line is determined as follows.

4.2.1. *The original approximation of "shoulder line part" for a given angle γ is the line with inclination γ to h-h line, which lies in arithmetically averaged distance from points in $d^2 \log E / d\beta^2 = 0$ scanned vertically in steps of 0.01 deg from v-v to 3.5 deg on the right of v-v and horizontally under [U 0.57] deg, with the horizontal step not bigger than 0.1 deg.*

4.2.2. *The next approximation of shoulder line part for a given angle γ is line with inclination γ to h-h line, which lies in arithmetically averaged distance from points taken from the previous determination excluding point(s) with the biggest distance from the previous approximation of shoulder line part.*

4.2.3. *The procedure described in paragraph 4.2.2. is repeated until no more point can be excluded.*

4.3. *Procedures defined in paragraphs 4.1.1. to 4.1.3. and paragraphs 4.2.1. to 4.2.3. are repeated until co-ordinates of shoulder line part approximation (angle γ and kink point position) do not differ from the preceding one.*

B. JUSTIFICATION

Because of some remarks concerning the lack of clarity in the description of the procedure of the "cut-off" line determination, document TRANS/WP.29/GRE/2002/44 was rearranged and made simpler. The procedure was rewritten and Figure 1 was removed.

The procedure is based on visual aiming of the "cut-off" line and gives exactly the same results. However, these results are repeatable, clear-cut and unambiguous. The procedure is determining the horizontal part as a horizontal line and the shoulder part inclined by angle γ to h-h line. Angle γ is fixed in the range from 10 deg to 60 deg for a particular approximation of the "cut-off" line, as suggested in Draft XXX. This approximation is identical with the description of the "cut-off" line of standard headlamp and is commonly known and understandable for industries and authorities.

To obtain good functioning of AFS in practice very precise aiming is needed. It should be much more precise than the standard passing beam for at least two reasons.

First is the change of horizontal and vertical position of the light beam(s) during changing modes depending on the driving conditions - especially bending and motorway modes. The vertical position of the horizontal part of the „cut-off" line between basic and motorway classes changes from 0.57 D deg to 0.23 D deg. The road lighting range change in this case (by 75 cm of lamp mounting height) from 75 m to 190 m. The acceptable inaccuracy of the „cut-off" line horizontal part vertical position is not described in TRANS/WP.29/GRE/2002/18. It is possible to estimate that this is equal to the bandwidth of ± 0.2 deg as described in paragraph 3.2.3. of Annex 9. In such situation, the range of light is ambiguous in an unacceptable manner, especially, if the inaccuracies of aiming during exploitation are added. The method of checking „cut-off" line quality proposed in TRANS/WP.29/GRE/2002/18 introduces some more inaccuracy because testing in three vertical sections rests unchecked quality for the most part of the „cut-off" line which is used for visual aiming.

The other reason is the need to correctly aim all of the lighting units to obtain required road illumination. The lighting units can be dispersed on the front of the vehicle. The value of inclination for each unit can differ from the other because of the different heights of mounting lighting units realizing the same mode. For example, 10 cm difference of mounting height by the same aiming means 0.22 deg difference on the 25 m aiming screen and 0.57 deg at 10 m aiming screen. This can cause the presence of a double „cut-off" line at least at one of these distances.

In this situation, the description used in paragraph 6.2.1.: "The class C (basic) passing beam shall produce a „cut-off" as defined in annex 9 to this Regulation, which is sufficiently sharp and permits aiming for each side of the system." is ambiguous: what is the meaning of aiming of the system or side of the system? It is possible to aim the lighting module but to aim the whole system needs a precise description on how to aim each part of it and it will depend on the system design.

The conclusion is that each lighting unit needs a means for aiming ("cut-off" line) and aiming should be described for each unit separately. The quality of „cut-off" line should be estimated for the whole length used for aiming with enough density of sampling, not only in 3 points. Definition, methods of checking „cut-off" line quality and methods of aiming should guarantee enough precision and repeatability. The analytical method of checking the "cut-off" line proposed above gives such possibilities.
