ECONOMIC COMMISSION FOR EUROPE

INLAND TRANSPORT COMMITTEE

World Forum for Harmonization of Vehicle Regulations (WP.29)

Working Party on Lighting and Light-Signalling (GRE)
(Forty-ninth session, 30 September - 4 October 2002,
agenda item 3.2.)

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

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.

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

GE.02-23060

A.   PROPOSAL

Paragraph 6.2.1., amend to read:

"6.2.1.   Each lighting unit should have a means to aim vertically and/or
             horizontally. This means should enable aiming with vertical
             accuracy not less than [±0.1] degree and horizontal accuracy not
             less than [±0.5] degree using appropriate method and/or device
             specified by applicant and accessible for service, diagnostic
             stations and test houses. "Cut-off" line defined in annex 9 is the
             suggested means. The means described above is not required if in
             any possible tolerances of the mounting position of the
             installation unit on the vehicle, including after crash repairs
             tolerances and mass production, tolerances of replaceable light
             sources used do not affect the photometric results described in
             annex 3 more than [20 per cent] for each such unit in system."

Annex 9,

Paragraph 1.2.1., amend to read:

"1.2.1.   [80 per cent] of the "horizontal part" does not exceed a vertical
             extend of $\Delta\beta$ = 0.2 degree up or down within 0.5 degree and
             4.5 degree left from the "kink". It is determined as described in
             paragraph 4.1. below."

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 degree to 4.5 degrees left of v-v with the step not bigger than
             0.1 degree.

             .... "

Paragraph 3.2.3., amend to read:

             " ..... the vertical positions where $d^2(\log E)/d\beta^2=0$ of at least
             80 per cent of vertical scanning lines according to paragraph 3.1.
             above are located within bandwidth of $\pm 0.2°$ from the mean vertical
             position determined as described in paragraph 4.1. below.

Paragraph 4., amend to read:

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

Insert new paragraphs 4.1.1. and 4.1.2. , to read:

"4.1.1.   Vertical adjustment:

             Original vertical co-ordinate of horizontal part of "cut-off" line
             is obtained by averaging of all vertical co-ordinates of points

described in paragraph 3.1. in which $d^2 \log E/d\beta^2 = 0$ scanned from 0.5 degree left of v-v to 4.5 degrees left of v-v. Then the vertical co-ordinates lying in bandwidth of ± 0.2° from original co-ordinate of horizontal part are selected. In next step this selected vertical co-ordinates are averaged giving next vertical co-ordinate of horizontal part of "cut-off" line. Then selection and averaging is repeated until the next average vertical coordinate does not differ from the preceding one.

After each allocation of "mean" vertical co-ordinate of horizontal part of "cut-off" line the allocation off "shoulder line part" is done as in paragraph 4.1.2. below until the average vertical coordinate does not differ from the preceding one.

4.1.2.   Horizontal adjustment:

Original "shoulder line part" co-ordinates (angle and kink point) of cut-off line is obtained by averaging of all co-ordinates of points in which $d^2(\log E)/d\beta^2 = 0$ scanned horizontally from v-v to 3.5 degree the right and vertically under h-h, with the step not bigger than 0.1 degree. This is original "shoulder line part" and their co-ordinates (angle and "kink point") are calculated. Then the points with co-ordinates lying in bandwidth of ± 0.2 degree from original "shoulder line part" under h-h are selected. In the next step selected co-ordinates are averaged as above giving next co-ordinates of "shoulder part" of "cut-off" line. Then selection and averaging is repeated until the next average co-ordinates of "shoulder part" do not differ from the preceding one.

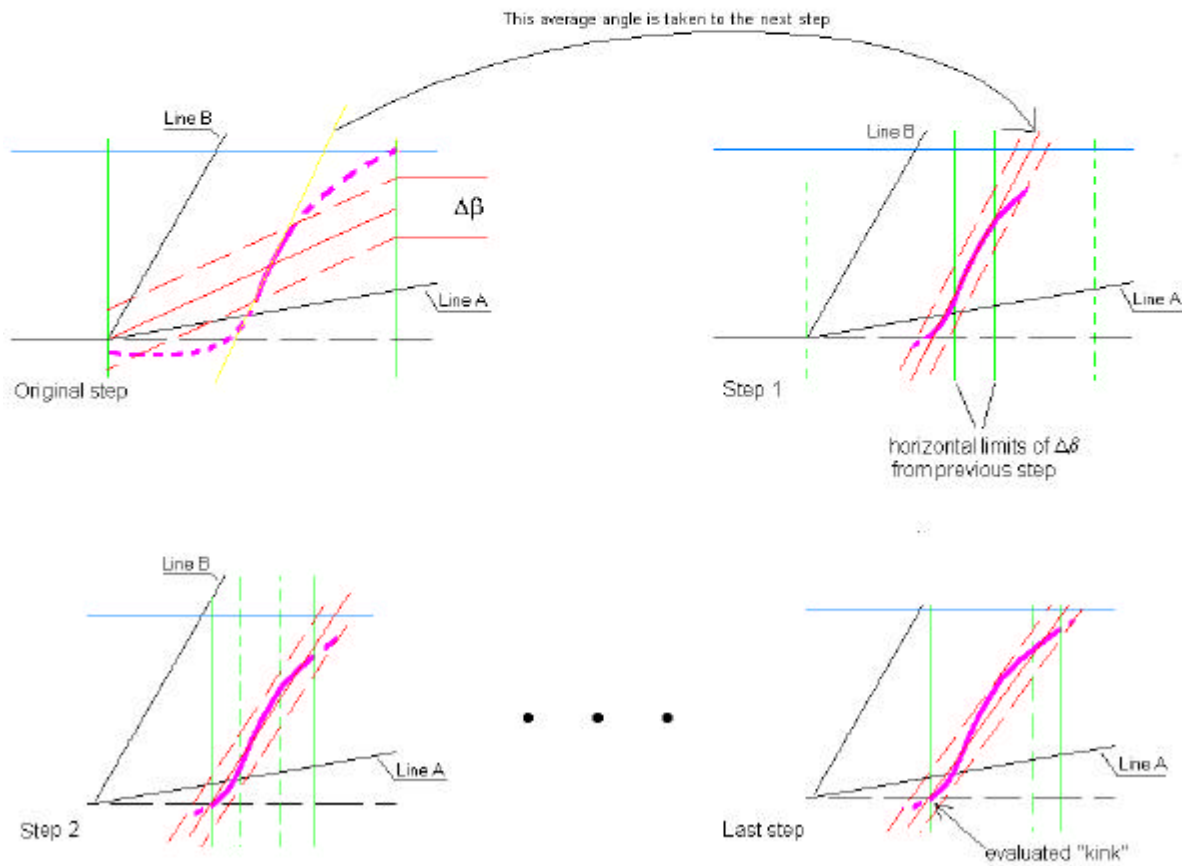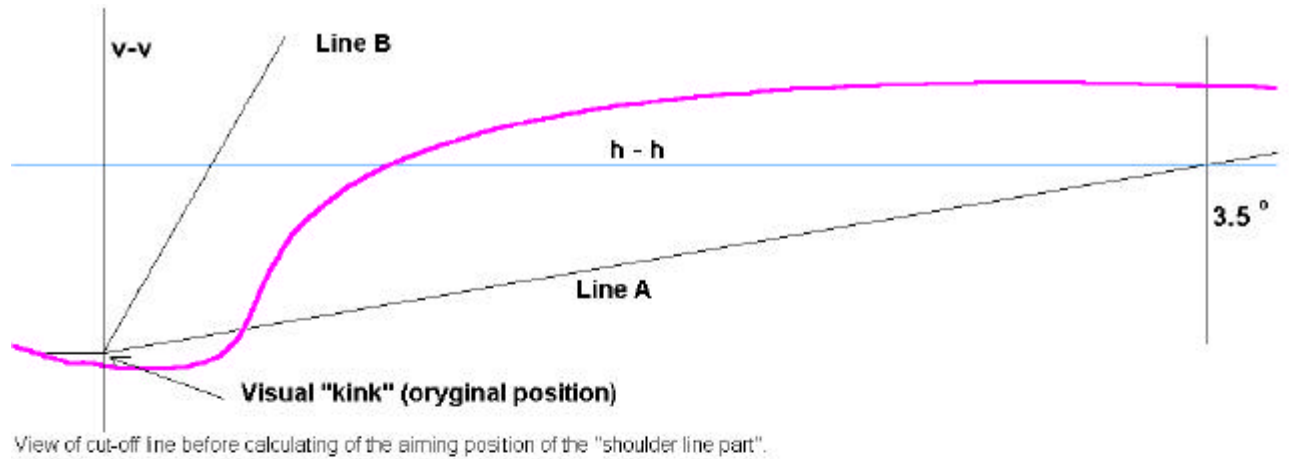An example of this procedure is shown on figure 1.

View of cut-off line before calculating of the aiming position of the "shoulder line part".

Figure 1: Idea of allocation of the "shoulder part".

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B.   JUSTIFICATION

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 degree to 0.23 D degree. 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 degree 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 degree difference on the 25 m aiming screen and 0.57 degree 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 above proposed analytical method of checking the "cut-off" line give such possibilities.

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