Transmitted by the expert from Poland

Informal document **GRE-79-24**
(79th GRE, 24 - 27 April 2018,
agenda item 6 (b))

DETAILED EXPLANATIONS TO SUMMARY OF INITIAL AIMING AND LEVELLING TOLERANCE ISSUE (GRE-79-23)

A) PRESENT STATE OF AIMING AND LEVELLING IN REG. 48 INFLUENCE FOR NIGHTTIME TRAFFIC SAFETY

1) GLARE IS TREATED AS THE MOST IMPORTANT ISSUE

Glare is influenced by many factors. But for most cases which are covered by present regulation glare occur when cut-off is over horizon or if headlamp are mounted higher than minimum eye height (95cm).

2) TYPE APPROVAL LIMITS ONLY GUARANTEE 20m ROAD ILLUMINATION DISTANCE - WORST CASE (SEE GRE-72-27, GRE-70-41-Rev.1)

Present Reg.48 guarantee worst case the road illumination distance of only 20 m beyond vehicle (not including measurements uncertainty). It cannot be accepted from traffic safety point of view.

B) IMPROPER PRESENT „BOX" REQUIREMENTS

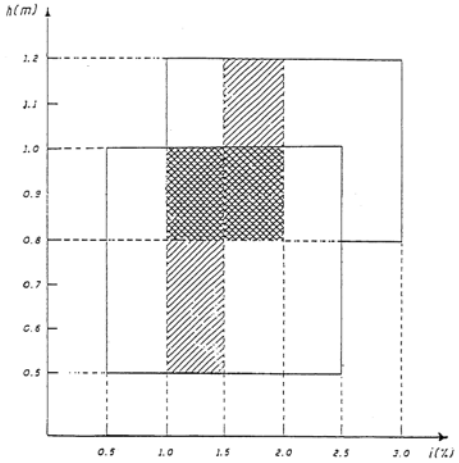
From beginning of 1958 Agreement there was no direct prescription for cut-of inclination even nominal value of inclination 1.0% was included in component (headlight) regulation. During first 24 years was no levelling device and requirement. Cut-off aim was left to manufacturer or garage decision but device for setting initial aim was invented and used. For relatively low intensities of first headlamps it was not very sensitive matter. However this caused glare complaints especially for significant load in the trunk etc. With introducing halogen light sources problem increased.

Starting from January 1982 first version of Reg 48:

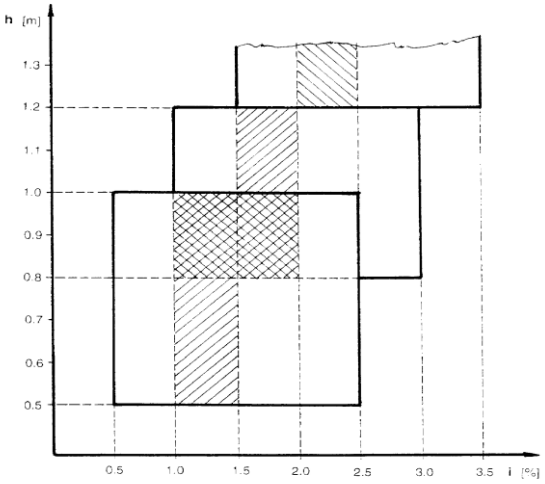
> "6,2.5.1. The vertical orientation of the passing beam measured in the static condition and in all the states of loading defined in „annex 5 to this Regulation shall remain between **-0.5 per cent** and **-2.5 per cent** without manual adjustment. In the "unladen" state, with one person in the driver's seat, this vertical orientation shall be initially set between -**1 per cent** and **-1.5 per cent**. For each type, of vehicle the manufacturer shall specify this initial orientation, which shall be shown on a plate on each vehicle."

Requirements were not depend on headlamp mounting height and legally allowed for road illumination distance starting from 20 m !
Because of low precision, high cut-off inclination range and no correction according load (pitch angle) there still complaints for glare caused by "incorrect aiming"

From February 1994 Reg. 48 Rev. 1 there were introduced two overlapping levels of height and inclination



Finally from December 1995 Reg. 48 Rev 1 Amend.1 separate gas discharge to have obligatory automatic levelling. Then Amend.2. introduced 1.5 m max height.



In February 2004 Revision 2 - Amendment 5 change automatic levelling obligation from “gas discharge” to 2000 lm “objective luminous flux"

C) ARTIFICIAL FLUX BASED AUTOMATIC LEVELLING OBLIGATION

1) TYPICAL AUTOMATIC LEVELLING PERFECTLY CONTROL INCLINATION

Therefore it was decided to use it as safeguard to provide reassurance when higher flux light sources were being introduced.

2) 2000 lm FLUX SEPARATION BETWEEN MANUAL AND AUTOMATIC LEVELLING WAS INTRODUCED WHEN HID LIGHT SOURCES WERE BEING INTRODUCED BUT THIS CRITERION IS QUESTIONABLE

The effectiveness and appropriateness of this criteria is questionable firstly because exist component restriction for intensity (Reg. 98) and are similar for halogen and secondly because some tests (e.g. Klettwitz) does not confirmed significantly higher glare feelings for HID.
After change “gas discharge” to “2000 lm” people start to believe that 2000 lm is kind of “performance” requirement which justify use of automatic levelling device as well an that automatic levelling should guarantee good road illumination and glare protection.

3) LACK IN Reg. 48 SPECIFICATION OF AUTOMATIC LEVELLING SYSTEM - E.G. PRECISION AND CHARACTERISTICS (STATIC, DYNAMIC, ETC.)

Most automatic levelling systems can control aim better than possible to measure. Therefore in practice there was observed much better behaviour of automatic systems than manual regarding glare and also road illumination. However minimum requirements of Reg. 48 (20 m road illumination distance) remain unchanged. Because of lack of detailed provision for automatic systems precision and behaviour low quality automatic levelling can control aim in presently required range but they can cause driver complains because of impaired driving comfort.

D) MISTAKES OF CURRENTLY PRESENTED POSITIONS

During the time there was many discussions regarding changes in aiming/levelling. From 2010 was proposed obligation to have automatic levelling for all kind of headlights. It start long discussion in different groups (GTB, OICA, IWG VGL, plenary GRE) with many different expectations and position. Some of them are based on misunderstanding of the issue.

1) LOOKING AT GLARE ONLY AND IGNORING ROAD ILLUMINATION DISTANCE

- BOTH ROAD ILLUMINATION AND GLARE PROTECTION ARE IMPORTANT FOR SAFETY

It is very difficult visually recognise that visibility is not sufficient because light close to the vehicle is very bright but in most cases useless. Contrary for far distance is difficult to sse “lack of light”. Therefore there is not much complaints for “range”. After the accident headlamps are usually destroyed and it is really difficult to reconstruct lack for road illumination distance.

- ROAD USERS COMPLAINTS ARE NOT SUFFICIENT AS JUSTIFICATION

Practical experience and glare complaints received from many drivers cause governments to believe that glare is most important problem. In fact road illumination is true but “hidden” problem.

- OBJECTIVE SAFETY SHOULD BE BASE FOR DECISION

It need in depth understanding of problem.

2) REQUEST FOR AUTOMATIC LEVELLING ONLY

- QUALITY AND PRECISION OF AUTOMATIC SYSTEM IS CRUCIAL

- NOT TECHNOLOGY NEUTRAL

Most automatic levelling systems work well and precisely control aim. But it is not obligation and exists some really poor automatic levelling because of present Reg. 48 requirements ("box" shape and size). Therefore request for automatic levelling without proper define of "tolerances box" will not solve the problem.

3) REQUEST TO FIND ALTERNATIVE TO ARBITRAL 2000 lm CRITERION

- NOT POSSIBLE AND NO NEED TO FIND SUCH CRITERION

"2000 lm" was receded by "gas discharge" requirement. It is artificial requirement not connected with real glare as was shown by many studies and experiments. Therefore it is **not possible to find replacement for 2000 lm**. Real problem is improper defined tolerances box. More details you can find in IWG VLG document: VGL-10-05 Rev.2

4) CARMAKERS REQUEST TO REQUIRE 1.6% CUT-OFF INCLINATION RANGE FOR MANUFACTURING PURPOSES

- SAFETY AND WORST CASE ARE PRIORITIES FOR TYPE APPROVAL

- AUTOMATIC LEVELLING PERFECTLY COMPENSATE MANUFACTURING NON REPEATABILITY AND THERE IS NO JUSTIFICATION TO REQUEST SUCH 1,6% RANGE AT THE EXPENSE OF SAFETY

There are many misunderstanding and misinterpretations. 1.6 % request was not confirmed. There were not answered detailed questions regarding this issue (see VGL-10-04). For low mounted height it might be needed narrowed tolerances to obtain proper road illumination and glare protection. It is always possible to use automatic levelling. The choice is on manufacturer side. Safety cannot be impaired because of manufacturing convenience or style.

- MANUAL LEVELLING MIGHT BE CONDITIONALLY ALLOWED PROVIDING NO NEGATIVE IMPACT FOR ROAD ILLUMINATION AND GLARE

E) GTB/OICA PROPOSAL BASED ON INADEQUATE ASSUMPTIONS

1)) IT IS BASED ON CIE 188:2010 STANDARD WHICH IS RELATIVE ONE AND NOT SUITABLE FOR NEW DESIGN. IT WAS INTEND TO COMPARE HEADLAMPS WHICH WERE EARLIER TYPE APPROVED

2) IT IS BASED ON RESULTS OF SIX ARBITRAL CHOSEN TYPE APPROVED AND GOOD PERFORMING HEADLAMPS BEAM PATTERN (Reg. 112, Reg. 98,) ON REAL CARS MOUNTING HEIGHT Reg. 48

3) THERE ARE NOT THE MINIMUM WORST CASE REQUIREMENTS

IWG VGL decided to change road illumination line of GTB/OICA proposal and to use 50m road illumination line of Polish proposal presented in 2011. More explanations and

calculations regarding glare showing inappropriate use of CIE 188:2010 Standard you can find in VGL-10-09 document.

- ROAD ILLUMINATION

4) PROPOSAL IS BASED ON 50 m RANGE COMBINATION OF SIX ABOVE DIFFERENT HEADLAMPS. EACH AT DIFFERENT HEIGHT

Not proper base for worst case minimum type approval requirements

- GLARE

5) FIXED GLARE WINDOW AT 50 m (CIE 188:2010) AND AVERAGE FLUX IN WINDOW :
- INADEQUATE TO REAL GLARE
- NOT RELEVANT FOR DISTANCE DIFFERENT THAN 50m AND FOR RELATION HEIGHT TO INCLINATION

6) VEHICLE TYPE APPROVED ACCORDING GTB/ OICA MIGHT CAUSE GLARE OR POOR ILLUMINATE THE ROAD

F) MANUAL OR AUTOMATIC LEVELLING SYSTEM

1) THE MAIN ISSUE IS TO GUARANTEE PROPER CUT-OFF INCLINATION FOR ANY LOAD CONDITION

The main problem is not the choice between automatic or manual levelling but prober “box” shape. Automatic levelling of adequate precision together with proper “box” range will serve visibility and glare protection.

2) TYPICAL CONTEMPORARY AUTOMATIC LEVELLING CONTROLS AIMING BETTER THAN POSSIBLE TO MEASURE

3) SOME AUTOMATIC LEVELLING MAY PERFORM REALLY VERY POOR AND SHOULD NOT BE USED

4) AUTOMATIC LEVELLING IS NOT EXPENSIVE

5) MANUAL LEVELLING CAN PERFORM ALSO PROPERLY BUT ONLY UNDER SPECIFIC CONDITION (PRECISION, DRIVER AWARENESS AND COOPERATION)

G) POLISH PROPOSAL - STARTING 2011 - TILL NOW

Poland proposed already in 2011 smart “performance based” proposal which guarantee the same minimum road illumination distance for any mounting height. Recently it was supplemented with the glare requirements based on simple and transparent calculations - so called IWG VGL “line 6” (For details see document VGL-10-09).

1) TRUE PERFORMANCE BASED AND TECHNOLOGY NEUTRAL

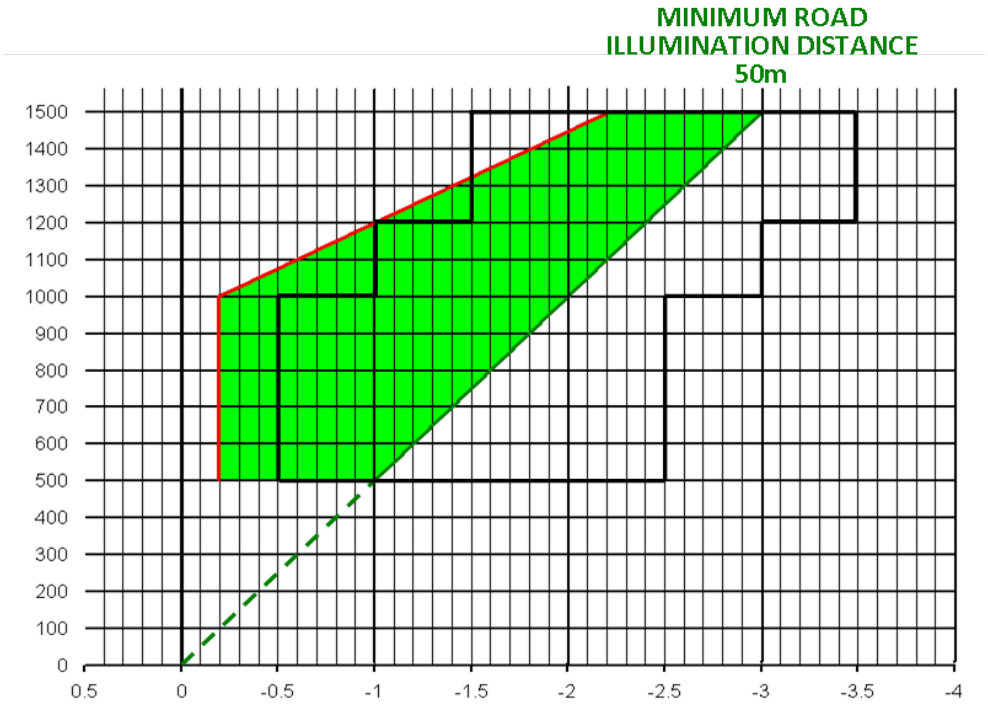
2) MINIMUM ROAD ILLUMINATION DISTANCE 75m (50m) BASED ON SIMPLE AND OBVIOUS GEOMETRIC CALCULATION

3) SIMILAR GEOMETRIC GLARE CALCULATION AND JUSTIFICATION

4) COVER ALL MOUNTING HEIGHTS AND VEHICLES (M, N)

GTB/OICA proposal was restricted to M vehicles only. Therefore beside the glare and visibility imperfections does not cover all needed road situation and finally would not improve real traffic problems because of many heavy vehicles in real traffic.

Polish “box” (green) proposal



Unfortunately it is “tie-like” and not “regular” as previous one but reflect real behaviour of headlighting and guarantee the same minimum road illumination distance and glare protection and is true performance and safety based.
It is more narrow than today requirements but removes mistakes and imperfection of present box. Therefore its adoption will indeed improve safety and reduce complaints.

Depending on headlamp mounting height and vehicle design it is still possible to use high quality manual levelling for some vehicles. However the best solution is automatic levelling as best accessible technology (BAT). The cost is not very high (starting from 40 EUR) while manual levelling device needs some costs as well. Therefore cost to benefit relation will be really profitable.