GTB Task Force

Coordination of Automotive Visibility and Glare Studies

Report April 2014
Agenda

1. **GTB**
   Introduction

2. **Poland**
   Explanation of the background of the Polish proposal for R48

3. **GTB**
   Literature Review
   Night-time Field Test
   Discussion
   Comparison Klettwitz Outcome with Literature
   Enrichment of Data by Calculation (CIE TC4-45)

4. **OICA**
   Explanation of load conditions

5. **Joint GTB/Poland/OICA**
   Conclusion
   Suggestion
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Introduction

Ad de Visser
chair TF CAVGS
Introduction

Arrangement of presentations in the program is a mix of

– activities in chronological order
– building blocks to constructing the puzzle
– in logical order for a better understanding
Start

- Proposal\(^1\) to introduce gas discharge light sources with an objective luminous flux of 2000 lm
- Proposal\(^2\) to require automatic levelling for all low beam headlamps independent from
  - the light source technology
  - the light source luminous flux

\(^1\) WP.29/2011/101
\(^2\) WP.29/2011/99 and Corr.1
Automatic leveling proposal

- Long transitional period of 90 months
- GRE indicated
  - to be open for relaxation of this new requirement
  - for adopting alternatives based upon study
  - in the beginning of this transitional period
- Proposal\(^2\) stalled in the GRE agenda and discussion was deferred for \(~2\) or 3 years
  - until today
- The expert from Poland worked on new initial aiming requirements
  - Different approach
  - OICA commented on this proposal

This is why Poland and OICA contribute with presentations to provide background information

\(^2\) WP.29/2011/99 and Corr.1
GTB study\(^1\) 'Visibility and Glare'

- Task force TF CAVGS
  Coordination of Automotive Visibility and Glare Studies
- Publically accessible home page
  [http://www.gtb-lighting.org/VGS/indexVGS.htm](http://www.gtb-lighting.org/VGS/indexVGS.htm)
- Concentrated on levelling in relation to load
- Major objectives
  - to improve the understanding of different factors that influence visibility and glare; start of the presentations
  - to identify results of the study that might reveal alternatives for automatic static levelling; end of the presentations

\(^1\) GRE-66-21
GRE-67-39
GTB Task Force CAVGS

Chair
A de Visser
Vice Chair/Secretary
B Terburg

M Gorzkowski

CIE
SAE

OICA Experts
CLEPA Experts
WG-SL Experts
WG-SVP Experts
WG-FL Experts

GTB Document No. CE-5001
Presentations
Part: “Understanding”

- Extending earlier presentations
  - Literature review by WG SVP\textsuperscript{2/}
  - Field test by WG FL\textsuperscript{1/}
    - Cooperation with DEKRA and TUD
- Discussion in response to comments/questions
  - From GRE68
  - From GTB in several sessions
  - By simulations based upon assumptions
    - See next slide
  - Field test and simulations were “validated” with literature
  - Simulations were compared with those from the expert from Poland
- Conclusion of the study

\textsuperscript{1/} GRE-68-38
\textsuperscript{2/} GRE-68-39
Assumptions

• Every testing and simulation is based upon certain assumptions and choice of parameters
  – Each set of assumptions has its weaknesses
  – GTB used an international accepted standard
  – The expert from Poland
    • will explain their set of assumptions
    • agreement with GTB to disagree on some aspects
Presentations
Part “Identifying alternatives”

• Alternatives for automatic static levelling
  – Based upon the outcome of the studies

• Headlamp aiming is always a compromise
  – There is no perfect solution possible
  – Glare complaints are inherent to visibility of the road ahead for the driver
After presentations

Consideration by GRE

Guidance for next steps
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75R is 1% below Hp-Hp

50V and 50R are 1.5% below Hp-Hp
75R is 1% below Hp-Hp

50V and 50R are 1.5% below Hp-Hp
TRANSLATION OF **SCREEN PHOTOMETRY** TO ROAD $H=0.75m$, $I=1\%D$
For 75R the minimum value is 16.8 lux @25m
    Illuminance at 75 m = $16.8/ (75/25)^2 = 1.87 \text{ Lux}$ at the road surface.

For 50R the minimum value is 16.8 lux @25m
    Illuminance at 50m = $16.8/ (50/25)^2 = 4.2 \text{ Lux}$ at the road surface.

For 50V the minimum value is 8.4 lux @25m
    Illuminance at 50m = $8.4/ (50/25)^2 = 2.1 \text{ Lux}$ at the road surface.
TRANSLATION OF SCREEN PHOTOMETRY TO ROAD $H=0.75m$, $I=1\%D$
HOW DEPEND ROAD ILLUMINATION OF AIMING
AND BEAM PATTERNs
CALCULATION EXAMPLES

<table>
<thead>
<tr>
<th>Illumination Level</th>
<th>HEADLAMP A</th>
<th>HEADLAMP B</th>
<th>HEADLAMP C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3lx</td>
<td>Minimum performing headlamp just over type approval minimums</td>
<td>LED headlamp with horizontally nearly symmetrical beam pattern</td>
<td>High efficiency HID headlamp much more than required minimum</td>
</tr>
<tr>
<td>6lx</td>
<td>LED headlamp with horizontally nearly symmetrical beam pattern</td>
<td>High efficiency HID headlamp much more than required minimum</td>
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<tr>
<td>12lx</td>
<td>High efficiency HID headlamp much more than required minimum</td>
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<tr>
<td>25lx</td>
<td>High efficiency HID headlamp much more than required minimum</td>
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<tr>
<td>50lx</td>
<td>High efficiency HID headlamp much more than required minimum</td>
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</tbody>
</table>
FIXED AIMING (1.0% D) AND DIFFERENT MOUNTING HEIGHTS
= 0.50m, 0.75 m and 1.00m

Different headlamps illuminates road differently by the same aiming and mounting height
AIMING $1.0\% \, D$

MOUNTING HEIGHT $0.50\, m$

GTB Document No. CE-5001
ROAD ILLUMINATION, AIMING 1% D, HEIGHT 0.5m
AIMING 1.0% D
MOUNTING HEIGHT 0.75m
ROAD ILLUMINATION, AIMING 1% D, HEIGHT 0.75m
GTB Document No. CE-5001

The International Automotive Lighting and Light Signalling Expert Group

Groupe de Travail "Bruxelles 1952"
ROAD ILLUMINATION, AIMING 1% D, HEIGHT 1.0m
HEADLAMP A, AIMING 1%D, HEIGHT CHANGE 0.5 m, 0.75m 1.0m
HEADLAMP C, AIMING 1% D, HEIGHT CHANGE: 0.5 m, 0.75 m, 1.0 m
COMPARISONS OF RANGE FOR DIFFERENT AIMING AND BEAM PATTERN
Reg. 48 aiming / levelling provisions

OR
ESSENCE OF POLISH PROPOSAL

NO MEASURABLE CHANGE OF ROAD ILLUMINATION IN REFERENCE POINTS WITH MOUNTING HEIGHT
ESSENCE OF POLISH PROPOSAL

GTB Document No. CE-5001
ESSENCE OF POLISH PROPOSAL
ESSENCE OF POLISH PROPOSAL

GTB Document No. CE-5001
ESSENCE OF POLISH PROPOSAL

GTB Document No. CE-5001
GLARE

In Polish proposal is assumed that over horizon should not to be significantly more light then allowed by type approval headlamp regulation.

These requirements are based on research concerning disability glare.

Presently Reg.48 does not allow aiming higher than 0.5% down
GLARE PROTECTION ZONE

INTERMEDIATE (NOT CONTROLLED) ZONE
VALUES MORE THAN 1 - 2lx@25m
(625 - 1200 cd)

GTB Document No. CE-5001
GLARE PROTECTION ZONE

INTERMEDIATE (NOT CONTROLLED) ZONE
VALUES MORE THAN 1 - 2 lx@25m
(625 - 1200 cd)

AIMING NOT HIGHER THAN 100m CUT-OFF & ROAD CROSSING
AIMING HIGHER AND NOT CONTROLLED

INTERMEDIATE (NOT CONTROLLED) ZONE

GLARE PROTECTION ZONE

50m 75m 100m

1.0 0.75 0.5
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GTB Document No. CE-5001
Literature Studies regarding Glare and Visibility on Road Traffic

Carried out in GTB WG SVP for GTB TF CAVGS

Karl Manz
Chairman GTB WG SVP ....

Geneva, 01 April 2014
Literature studies regarding glare and visibility on road traffic

The current list contains more than 300 references, which are still under review and furthermore secondary literature is investigated.

In the following slides only a small number of references are highlighted!
• Basic documents and further literature reviews are:

• Hanno Westermann, History and Scientific Back-up, Informal Document No. 30 (48th GRE, 9-12 April) 2002 (Concept Basis)

• Ernst-Olaf Rosenhahn; Headlamp Glare and Auto-Levelling: Degree of Influence and Future Outlook; Presentation at WG FL, Turin, January 25, 2011

• (Basis mainly investigations of TU Darmstadt)


• (More general view)

• Bullough J. D.; Skinner N. P.; Pysar R. M.; Radetzky L. C.; Smith A. M.; Rea M. S.; Nighttime Glare and Driving Performance: Research Findings; DOT HS 811 043; NHTSA Washington DC, September 2008

• Hills B. L., PhD; Visibility under night driving conditions Part:
  - 1. LABORATORY BACKGROUND AND THEORETICAL CONSIDERATIONS ; Lighting Research and Technology, 1975, Vol.7(3), pp.179-184
  - 2. FIELD MEASUREMENTS USING DISC OBSTACLES AND A PEDESTRIAN DUMMY.; Lighting Research and Technology, 1975, Vol.7(4), pp.251-258
  - 3. DERIVATION OF ( DELTA L,A) CHARACTERISTICS AND FACTORS IN THEIR APPLICATION.; Lighting Research and Technology, 1976, Vol.8(1), pp.11-26
Targosiński T. ; Testing of headlamps beam patterns using computerized device with photometrical image analysis ISAL 2007 Darmstadt 09.2007
- headlamps photometric characteristics and aiming in real road in use condition research.

Targosiński T.; Passing Beam Visibility Distance - Technical Possibilities, Legal Requirements and Road Safety, JOURNAL OF KONES Vol. 18, No. 4 2011 ss. 511-517
- Analysis of real road illumination distance possibilities and practice


Hanno Westermann, History and Scientific Back-up
Ernst-Olaf Rosenhahn; Headlamp Glare and Auto-Levelling

Estimation of Pitch Angle Frequency Spectrum caused by Vehicle Load

Assumption: Frequency distribution of cut-off line position variation caused by vehicle load

Median: $\pm 0.09^\circ$ (non symmetric distribution)

$\pm 0.44^\circ$ for full load (average: $p = 0.01\%$)
Geoff Draper (Chairman);
Performance Assessment Method for Vehicle Headlighting Systems
CIE 188:2010
The Work in CIE TC4-45 continues under the chairmanship of Gert Langhammer
Geoff Draper (Chairman); *Pedestrian Visibility - Low Beam Optimization to Reduce Night-time Fatalities*; SAE SURFACE VEHICLE INFORMATION REPORT J2829 - 2011-02-24;
Geoff Draper: *Pedestrian Visibility*

**Weighted Flux in Glare Zone Related to Headlamp Mounting Height**

- 570mm
- 700mm
- 830mm
- 1100mm

** Flux - Lumen **

** Downward Inclination % **
Downward inclination (pitch angle) and mounting height of head lamps control visibility distance and glare in the opposite direction!
Glare

Adrian, Werner; "Proceedings of the First International Symposium on Glare"; New York: Lighting Research Institute;

Schmidt-Clausen, H. J. and Bindels, J. T. H.; “Assessment of discomfort glare in motor vehicle lighting.”; Lighting Research and Technology, 6(2), 79-88.


Gibbons Ronald B.; Edwards Christopher J.; A Review of Disability and Discomfort Glare Research and Future Direction, Submitted for Presentation at the TRB Biennial Visibility Symposium 2007

Von Hoffmann Alexander; Lichttechnische Anforderungen an adaptive Kraftfahrzeugscheinwerfer für trockene und nasse Fahrbahnoberflächen; Publikationsreihe Nr. 4; Thesis TU Ilmenau 2003

Stephan Völker; Hell- und Kontrastempfindung – ein Beitrag zur Entwicklung von Zielfunktionen für die Auslegung von Kraftfahrzeug-Scheinwerfern; Habilitationsschrift der Universität Paderborn Fakultät für Maschinenbau; Paderborn 2006
Special item for Road Traffic - SMALL GLARE ANGLES


Blendung durch kleine Lichtquellen hoher Leuchtdichte im peripheren Gesichtsfeld / Paul W. Schmits; Berlin, Techn. Univ., Diss., 1988


Sprute, Jan Holger; "Entwicklung lichttechnischer Kriterien zur Blendungsminimierung von adaptiven Fernlichtsystemen"; Dissertation D17 , Darmstadt 2012
Disability Glare:

\[
L_{seq} = K \cdot \frac{E_G}{\Theta^2}
\]

\[
C = \frac{(L_T + L_{seq}) - (L_B + L_{seq})}{(L_B + L_{seq})} = \frac{(L_T - L_B)}{(L_B + L_{seq})}
\]

- \(L_{seq}\): equivalent veiling luminance;
- \(E_G\): illuminance at the eye
- \(\Theta\): Glare angle between fixation point and glare source (Holladay Exponent 2)
- \(k\): Proportional factor which depends on the age of the observer, typical value 9.2
- \(L_T\): Luminance of the target; \(L_B\): surrounding luminance (Adaptation level)
Disability Glare:

For practical reasons, it is very helpful to describe disability glare as the so called threshold increment TI according to CIE. TI described the percentage with which the threshold luminance of the target must be increased to compensate the glare effect.

\[
TI = 65 \cdot \frac{L_{seq}}{L_B^{0.8}} \cdot [%]
\]

For further calculations it is better to define a “Threshold Increment Factor” TIF as:

\[
TIF = 1 + \frac{TI}{100}
\]

Which describe directly the amount of increase to guarantee the visibility of the target.

\[
TIF = 1 + 0.65 \cdot \frac{L_{seq}}{L_B^{0.8}}
\]
For discomfort glare under road traffic geometry the formula from Schmidt-Clausen, H. J. and Bindels, J. T. H. is very useful:

\[
W = 5.0 - 2.0 \log_{10} \frac{E_i}{0.003 \left(1 + \sqrt{\frac{L_a}{0.04}}\right) \theta_{\text{max}}^{0.46}}
\]

- \(W\) = mean value on deBoer’s scale
- \(E_i\) = Average level of illumination directed towards the observer’s eye from the headlamps (lux)
- \(\theta_{\text{max}}\) = glare angle between observer’s line of sight and the headlamps at location where maximum illumination occurs (minutes)
- \(L_a\) = adaptation luminance (cd/m²)
Disability versus Discomfort for different Glare Levels

- Disability for TIF = 2.0
- Discomfort for W = 3
- Disability for TIF = 1.1
- Discomfort for W = 5

*Typical Road Traffic Conditions*

- Discomfort dominates
- Disability dominates
- Glare free Zone

**GTB Document No. CE-5001**

*Groupe de Travail “Bruxelles 1952”*
Conclusion:

At typical road traffic conditions at night we must not differentiate between disability and discomfort glare, because if we feel glared we are objectively glared!

That means, we can simply speak about glare and the terms disability and discomfort glare are related only to the methods to evaluate or to measure this phenomena.
Disability glare and visibility of pedestrians on straight traffic roads

Some input from SAE TF Pedestrian Protection;

Walter Kosmatka and Rainer Rattunde Criteria:

\[ E_{\text{required}} = L_{\text{threshold}} \times F_{\text{expectancy}} \times F_{\text{Vad.}} \times F_{\text{adaptation/glare}} \times F_{\text{age}} / (r) \]

determined a value for \( E_{\text{required}} = 3\text{l}x \) to produce on the target a minimum luminance necessary for the detection of that obstacle.

Road scene with targets and a glare source

By the influence of glare the value for \( E_{\text{required}} \) became higher:

\[ E_{\text{required+glare}} = TIF \cdot E_{\text{required}} \]
48m with glare
Illuminance of 0.5lx

71m without glare
(3 lx line)

ΔS = 23m

H7 head lamp (H7 – Diagram: private communication from Rainer Neumann)
With oncoming vehicle (glare source) with H4 head lamp

\[ v_b = 75 \text{ km/h} \]
\[ \varphi_0 = 0.33 \]

Distance between the two oncoming vehicles

Glare reduces the visibility and therefore the visibility distance;

Visibility distance is a key factor for safe driving!
Dynamic (Transient) Glare


Diem, Carsten ; "Dynamic glare"; AFS-research report FO-xx/98, TU-Darmstadt, 1998

van Derlofske, Chen, Bullough and Akashy ; Headlight Glare Exposure and Recovery, SAE Paper 2005-01-1573; SAE World Congress Detroit 2005
Illuminance Readings Taken on Route 460 at Night with and without Overhead Lighting and Glare. from Jason Clark
Lenhert, P.

Maximum Glare Pulse Illuminance [lx] at the maximum pitch angle as a function of the distance between two meeting vehicles

van Derlofske, Chen, Bullough and Akashy

Evaluation of correlation between rating of discomfort and recovery time
This diagram shows the glare situation of driver as a function of the distance to the oncoming vehicle.
A Result of the Klettwitz Study:

Evaluation of Illuminance

- Maximum of illuminance $E_{v\text{,} \text{max}}$
- Exposure in 400 m (Sprute): 80 km/h $\rightarrow$ 18 sec exposure time

$$H_v = \int_0^{18} E_v(t) \, dt$$

![Graph showing the evaluation of illuminance with a peak at 18 seconds and crossing point for vehicles at 80 km/h.](image)
Accident Studies:
Risk factors for road traffic injuries

Risk factors influencing crash involvement

— inappropriate and excessive speed;
— presence of alcohol, medicinal or recreational drugs;
— fatigue;
— being a young male;
— having youths driving in the same car;
— being a vulnerable road user in urban and residential areas;
— travelling in darkness;
— vehicle factors – such as braking, handling and maintenance;
— defects in road design, layout and maintenance, which can also lead to unsafe behaviour by road users;
— inadequate visibility because of environmental factors (making it hard to detect vehicles and other road users);
— poor eyesight of road users.
Road Safety Research Report No. 80

Analysis of the On the Spot (OTS) Road Accident Database

<table>
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<tr>
<th>Visual impairment or obscuration</th>
<th>21</th>
<th>18</th>
<th>20</th>
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<td>Cross from behind parked car</td>
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<td>View obscured from window</td>
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<tr>
<td>Glare from sun</td>
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<tr>
<td><strong>Glare from headlights</strong></td>
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<tr>
<td>Surroundings obscured by stationary or parked car</td>
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<td>Surroundings obscured by moving vehicle</td>
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<tr>
<td>Obscuration due to weather</td>
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<td>Failure to see pedestrian in blind spot</td>
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</tbody>
</table>
Despite evidence that glare sensitivity and glare recovery are important age-related visual changes, evidence is sparse that glare is associated with actual driving performance. Burg’s (1967) study and the reanalysis by Hills and Burg (1977) demonstrated a significant relationship between glare recovery rate and crash rate; however, the relationship was relatively weak.

Headlight glare was attributed as a possible “environmental” factor in approximately 2.3 percent of night accidents in another study (Indiana University, 1975) cited in Mortimer, 1988).
Glare was mentioned as a factor in 3 of 30 crashes where drivers ran off of the road, in a study by Boyce, Hochmuth, Meneguzzer, and Mortimer (1987; cited in Mortimer, 1988).

Further, glare was named as a factor in 30 of 231 crashes in which adverse environment was involved (Sabey and Stoughton, 1975; cited in Mortimer, 1988).

The time needed to recover from glare was also included in Burg’s (1971) study, and was found to correlate weakly with accident rates.

Other studies, however, have failed to find a direct relationship between glare sensitivity measures and driving performance (Shinar et al., 1977; Wolbarsht, 1977; Burg, 1967; Owsley et al., 1991)

Investigation from the Light.Sight.Safety Group:

With the conclusion: Headlamps with improved light distribution and better performance are also a clear improvement for road safety.

Schlager Walter, Philips Technologie; Geywitz-Senn Johannes, Automotive Lighting Xenon-Licht zur Reduzierung des Unfallrisikos bei Nacht.; Light.Sight.Safety Report
Headlamp Load-levelling Devices

Numerous methods have been devised to provide automatic headlamp aim compensation for changes in vehicle loading; however, very few have ever been incorporated in production vehicles available to the public. More numerous designs have been developed and made available, for providing vehicle load-levelling. This latter concept accomplishes the effect of headlamp aim control but also provides improved vehicle handling characteristics. It is seldom, if ever, promoted or incorporated on vehicles primarily to improve headlamp aim.

With the trend toward higher intensities for vehicle headlamps to improve highway vision, it is essential that better headlamp aim be achieved and maintained. Automatic headlamp levelling would appear to be essential to this effort.
Literature studies regarding glare and visibility on road traffic

Thank you for your attention
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GTB Field Test

Dr. Rainer Neumann
Chairman GTB WGFL

Geneva, 1.4.2014
Agenda

Introduction: Glare and Visibility
Klettwitz Field Test 2012
Discomfort Glare
Disability Glare
Special WGFL Meetings in Darmstadt (9/2013), Vienna (11/2013), and Torino (2/2014)
Summary
Introduction

- Influencing Parameters for discomfort glare in Night Time Driving *
  - Initial aiming of the headlamps
  - geometry of the road
  - weather conditions
  - dynamic behaviour of vehicle

* : GTB Lighting Forum Torino 1/2011
Introduction

• and loading condition of vehicles

• Report of statistical analysis of cars involved in accidents (France):

  – Accidental data: EACS + EDA
    ✓ 74% of cars involved in an accident have an empty trunk
    ✓ 21% of cars involved in an accident contain 0 - 40kg in the trunk
    ✓ 4% of cars involved in an accident contain 40 - 100kg in the trunk
    ✓ 0.5% of cars contain 100 - 190kg in the trunk
Questionaire - de Boer Scale

Discomfort Glare Rating – (Please perform rating from top to bottom)

<table>
<thead>
<tr>
<th></th>
<th>Unnoticeable</th>
<th>Satisfactory</th>
<th>Just Admissible</th>
<th>Disturbing</th>
<th>Unbearable</th>
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</tbody>
</table>

GTB Document No. CE-5001
Results for Halogen, Xenon, LED

De Boer scale

<table>
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<th>Unnoticeable</th>
<th>9.00</th>
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<tbody>
<tr>
<td>Satisfactory</td>
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<td>Just Admissible</td>
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<tr>
<td>Disturbing</td>
<td>3.00</td>
</tr>
<tr>
<td>Unbearable</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Headlamp Type

- HAL
- HID
- LED

* Width of the bars covers app. 70% of all ratings
Results for all Light Sources

Histogram: Pitch with 50% loading

N=25 vehicles tested

Pitch in 10 m, measured from 1% cut-off dip / cm
Pitch Angle Results

* For all light sources and loading conditions
Disability Glare

- Findings from Discomfort Glare based on de Boer rating have been verified by studying the results on luminance and illuminance values of the tested vehicles
Measured Quantities

- Luminance \( L_v \)
  - \( L_v \) @ 25 m and 50 m, driver position
- Illuminance \( E_v \)
  - \( E_v (t) \), driver- and co-driver position
Luminance

- Total luminance
  - \( \text{Lv}_\text{mean}, \text{Lv}_\text{max} \)

- Area with \( \text{Lv} > 310 \text{ cd/m}^2 \), adaptation was 3.1 cd/m²:
  - In this area: \( \text{Lv}_\text{mean}, \text{Lv}_\text{max}, \text{Size} \)

\[ \text{Lv}_\text{mean} = \text{Lv}_\text{mean}_\text{total} - \text{Lv}_\text{mean}_\text{dark} \]

\[ \text{Lv}_\text{mean}_\text{dark} = 3.1 \text{ cd/m}^2 \]
Luminance VS Loading Condition

Luminance Max VS LC

Total Luminance Mean VS LC

GTB Document No. CE-5001
Evaluation of Illuminance

- Maximum of illuminance $E_{v_{\text{max}}}$
- Exposure in 400 m (Sprute): 80 km/h $\rightarrow$ 18 sec exposure time

\[ H_v = \int_0^{18} E_v(t) \, dt \]
Illuminance VS Loading Condition

Max Illuminance VS LC

Exposure VS LC

GTB Document No. CE-5001
Summary

- Results of Discomfort Glare and disability glare show clearly, that the behaviour of the vehicle is the important factor for deciding on levelling needs.
- Light source is not significantly contributing.
- Pitch angle is a qualified parameter for new regulation criteria.
Summary

• The results show clearly, that the pitch angle as a parameter to measure the reaction of the vehicle according to loading could lead to a definition, where levelling is required and where it is not needed

• Car makers have to analyze, how a prediction of the pitch angle of a car under development could be determined
Action

• Special meeting in WGFL was organized in Darmstadt in 9/2013
• Continued discussion in GTB meeting (11/2013) in Vienna and GTB Intermediate Meeting WGFL in Torino (2/2014)
Summary

• Input from various car makers to a prediction of the behaviour of future vehicles
• Discussion on a method to generate a classification with pitch angle to forecast the sensitivity of loading of newly developed vehicles
• Some car makers presented loading results on pitch angles of existing vehicles
• Statements from car makers have been collected
Summary

• Contributions from car makers show positive signals in being able to predict pitch angle of a vehicle in advance
Acknowledgements

• Thanks to TU Darmstadt Prof. Khanh, Dipl.-Ing. Bastian Zydek
• Thanks to DEKRA
• Thanks to GTB / GRE participants
• Thanks to car makers

Project within GTB TF CAVGS
Agenda

1. **GTB**
   - Introduction

2. **Poland**
   - Explanation of the background of the Polish proposal for R48

3. **GTB**
   - Literature Review
   - Night-time Field Test
   - Discussion
     - Comparison Klettwitz Outcome with Literature
     - Enrichment of Data by Calculation (CIE TC4-45)

4. **OICA**
   - Explanation of load conditions

5. **Joint GTB/Poland/OICA**
   - Conclusion
   - Suggestion
Intermediate Summary

- Night Test Measurement Conditions
  - 50% load
  - 1 % aiming

- Visibility and Glare
  - GTB conducted a test drive focused on glare
  - Poland presented a proposal focused on visibility distance

- Correlation Night Test Experimental findings with Literature?
Agenda

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Klettwitz Results in View of the Literature Study of WG SVP

Karl Manz
Chairman GTB WG SVP

Geneva, 01 April 2014
Question 1:

How does the distribution of the pitch angles of the Klettwitz study and of a French investigation fit into the results from Hanno Westermann or rather into the estimation of E.-O. Rosenhahn?
Histogram for pitch angle for 50% loading of the Klettwitz Study

Pitch in 10m measured from the 1% cut-off aiming position in cm

N = 25 vehicles
Estimation of Pitch Angle Frequency Spectrum caused by Vehicle Load

Assumption: Frequency distribution of cut-off line position variation caused by vehicle load

Median: +0.09° (non-symmetric distribution)

+0.9° for full load (average: p = 0.01 %)

Data from Klettwitz Study
Question 2:

Mr. Zydek from TUD has found a good correlation between glare and exposure. How does this fit into the literature findings?
Evaluation of Illuminance

- Maximum of illuminance $E_{v\_max}$
- Exposure in 400 m (Sprute): 80 km/h $\rightarrow$ 18 sec exposure time

$$H_v = \int_0^{18} E_v(t) \, dt$$

Crossing point Of vehicles

18 sec 80 km/h 0 sec

400 m

24.06.2013 | Technische Universität Darmstadt | Laboratory of Lighting Technology | Dipl.-Ing. B. Zydek, Prof. T. Q. Khanh | 15
Glare Illuminance as a Function of the Distance Between Oncoming Vehicles

![Graph showing the relationship between Glare Illuminance / lx and Distance Between the Oncoming Vehicles / m. The graph indicates a sharp decrease in glare illuminance as the distance between oncoming vehicles increases.]
Visibility Distance and Glare Illuminance as a Function of the Distance Between Oncoming Vehicles

Distance between the two oncoming vehicles

Visibility distance

Glare Illuminance / lx

With oncoming vehicle (glare source) with H4 head lamp

\[ v_b = 75 \text{ km/h} \]

\[ \theta_o = 0.33 \]
Question 3:

How do the results of the glare ratings, over all headlamp technologies used in the Klettwitz study, as a function of the pitch angles of the Klettwitz study fit e.g. to the results from Pedestrian Visibility investigation?
Pitch Angle Results

* For all light sources and loading conditions
The bright red values with the error bars are the Klettwitz results;

The lines show the results from a H4 headlamp, used in TC 4/45, for different mounting heights as a function of the pitch angle. To transform the values from TC 4/45 glare criteria to the de Boer scale, the 1-lumen threshold of TC 4/45 was set to the de Boer rating 5 (just admissible).
Weighted Flux in Glare Zone Related to Headlamp Mounting Height

Flux - Lumen vs. Downward Inclination %
Comparison of Results from Klettwitz and Pedestrian Study

- Mounting Height 570mm
- Mounting Height 700mm
- Mounting Height 830mm
- Mounting Height 1100mm

Pitch Angle in cm vs de Boer Scale
Thank you for your attention
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   Suggestion
Headlamp Glare and Range –
Enrichment of Data by Calculations

Gert Langhammer
Chairman CIE TC4-45

Geneva, 01 April 2014
Headlamp Glare and Range – Enrichment of data by calculation

**Agenda**

- The role of passing beam cutoff
- CIE TC4-45 - objective method of assessing headlamp glare and range
  - History of CIE TC4-45
  - Headlamp glare and range in TC4-45
- Headlamp glare and range under different conditions – collection of data as result of TC4-45 calculations
- Calculation results in relation to Klettwitz field test outcome
The role of the passing beam is to provide good illumination of the road scene without causing unacceptable glare to oncoming drivers. This is achieved by a combination of the control of the performance of the passing beam by means of the provisions in the applicable headlamp regulation and the correct installation according to Regulation 48.

The requirements in the installation regulation would ideally be performance based but as these are fundamentally photometric requirements it is not possible to carry out objective performance testing on a complete vehicle. This means that the control of the headlamp performance must be achieved through the application of the requirements in the headlamp regulations and the “on-road” performance must be assured by correct installation according to the provisions relating to the initial aim and the maintenance of aim in Regulation 48.
The passing beam cutoff

The Passing Beam Cutoff is the visible line perceived by the eye when the beam pattern is projected onto a vertical screen.

H-H lies on a horizontal plane passing through the reference axis of the headlamp

Normally, the beam pattern is viewed at a distance of 25m for visual aiming prior to photometry but a viewing distance of 10m is also allowed for practical reasons.
The passing beam cutoff

The clarity of the cutoff line varies from diffuse to sharp. Sharpness is defined in the headlamp regulations to ensure that the beam can be visually aimed by means of the cutoff but equally the cutoff is not too sharp as this contributes to glare complaints and driver fatigue.

2.2. Sharpness of “cut-off”

The sharpness factor $G$ is determined by scanning vertically through the horizontal part of the “cut-off” at $2.5^\circ$ from the V-V where:

$$G = (\log E_\beta - \log E_{(\beta+0.1^\circ)})$$

where $\beta$ = the vertical position in degrees.

The value of $G$ shall not be less than 0.13 (minimum sharpness) and not greater than 0.40 (maximum sharpness).

There is no significant relationship between the cutoff sharpness and the performance of the headlamp on the road. A headlamp that just meets the minimum requirements of the regulation may have a sharper cutoff than a headlamp that exceeds the minimum requirements by a factor of several times.
CIE TC4-45
Performance Assessment Method
for Vehicle Headlamps

Two passing beam patterns compared – the passing beam cutoff

Halogen Headlamp with horizontal cutoff aimed 1% down

Range based upon assumption that the horizontal (left side) cutoff line will intersect the road surface at \( D = \frac{H}{1\%} \)

\( D = \text{Range}; \ H = \text{mounting height} \)

Mounting Height = 0.63m
Assumed Range = 63m

HID Headlamp with horizontal cutoff aimed 1% down

Range based upon assumption that the horizontal (left side) cutoff line will intersect the road surface at \( D = \frac{H}{1\%} \)

\( D = \text{Range}; \ H = \text{mounting height} \)

Mounting Height = 0.72m
Assumed Range = 72m
Two passing beam patterns compared – Range according to TC4-45

Range based upon CIE TC4-45 Criteria = 32m Left / 59 m Right
Mounting Height = 0.63m

Range based upon CIE TC4-45 Criteria = 51m Left / 85 m Right
Mounting Height = 0.72m
Conclusion

Halogen Headlamp with horizontal cutoff aimed 1% Down

- Range based upon CIE TC4-45 Criteria
  - 32m Left / 59 m Right
  - Mounting Height = 0.63m

- Range based upon assumption that the horizontal (left side) cutoff line will intersect the road surface at D= H/1% (D = Range; H = mounting height)
  - Mounting Height = 0.63m
  - Assumed Range = 63m

Discrepancy

<table>
<thead>
<tr>
<th></th>
<th>Left Side</th>
<th>Right Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual (Calculated)</td>
<td>32m</td>
<td>59m</td>
</tr>
<tr>
<td>Assumed</td>
<td>63m</td>
<td>**</td>
</tr>
</tbody>
</table>

HID Headlamp with horizontal cutoff aimed 1% Down

- Range based upon CIE TC4-45 Criteria
  - 51m Left / 85 m Right
  - Mounting Height = 0.72m

- Range based upon assumption that the horizontal (left side) cutoff line will intersect the road surface at D= H/1% (D = Range; H = mounting height)
  - Mounting Height = 0.72m
  - Assumed Range = 72m

Discrepancy

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<tbody>
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<td>51m</td>
<td>85m</td>
</tr>
<tr>
<td>Assumed</td>
<td>72m</td>
<td>**</td>
</tr>
</tbody>
</table>

** The assumption of the range is based upon the position of the horizontal part of the cutoff so it does not apply to the Right Side figures
TC4-45 - objective method of assessing headlamp glare and range

History of CIE TC4-45
In 2003 GTB and NCAP created a taskforce with the aim of developing a headlamp performance rating system to be proposed to the European New Car Assessment Programme (Euro NCAP).

After Euro NCAP decision in 2005 not to continue to introduce a headlight rating system the work of this taskforce was transferred into CIE structure.

CIE Technical Committee 4-45, working in conjunction with GTB, continued to work on the refinement of the assessment of headlamp range and glare.
Experts from 52 manufacturers, institutions and test services worldwide were taking part in the development of an objective method of assessing vehicle front lighting. The aim was to create a method which is based just on photometric measurements and calculations.

In 2010 the work of TC4-45 was finalized with the publication of a CIE Technical Report (CIE188: 2010).

In 2011 CIE released the new standard:

CIE S021/E:2011
Vehicle Headlighting Systems
Photometric Performance – Method of Assessment
CIE TC4-45
Performance Assessment Method for Vehicle Headlamps

Standard CIE S021/E:2011

Vehicle Headlighting Systems
Photometric Performance - Method of Assessment

This Standard specifies a method to consistently assess the photometric performance of vehicle headlighting systems to enable the performance of different systems to be compared. The requirements are given in relation to road scene illumination and the limitation of glare, and the performance is assessed using parameters relevant to lane guidance and the detection of pedestrians and objects.

The Standard includes a measurement and calculation procedure. It does not specify the format of an assessment report.

The Standard is written in English and has been approved by CIE National Committees. It is readily available at the National Committees of the CIE or via the website of the Central Bureau of the CIE (www.cie.co.at).

The price of this Standard is EUR 135,- (Members of the National Committees of the CIE get 66.7% discount).

Technical Report CIE 188:2010

Performance Assessment Method for Vehicle Headlighting Systems
Headlamp Glare and Range in TC4-45 – input parameters

The system Headlamps + Car is evaluated …

…by recording mounting positions and supply voltage on the car …

…and by measuring the photometric values in a laboratory.
Headlamp Glare and Range in TC4-45 – Definition of Glare Zone
Headlamp Glare and Range in TC4-45 – Definition of Glare Zone

Key
1. the curve indicates the probable location of the oncoming driver’s eyes as a percentage of all instances on a range of road types based upon the work of Damasky [3]
2. for detail of this zone see Figure 16
3. vertical line through the longitudinal axis of vehicle
4. this horizontal line is located at a height of 0,75 m above the road surface
Headlamp Glare and Range in TC4-45 – Definition of Passing Beam Range

Zone A

Zone B

Zone C
Headlamp Glare and Range in TC4-45 – Definition of Passing Beam Range

Road width 6m (3m per lane), 500m curve radius

d_x distance along the road
d_y distance from vehicle longitudinal axis
1 Zone A range assessment – straight road
2 Zone B range assessment – curved road
3 Zone C range assessment – pedestrian visibility
CIE TC4-45
Performance Assessment Method for Vehicle Headlamps

Headlamp Glare and Range in TC4-45 – Definition of Passing Beam Range

Zone A: Range of Passing Beam on a straight road

\[ d_v / m \]

\[ 0 \]

\[ 15 \]

\[ 0 \]

\[ 125 \]

\[ 1,5 \ m \]

\[ 3,0 \ m \]

\[ 15 \]

\[ 0 \]

\[ 10 \]

\[ 30 \]

\[ 50 \]

\[ 75 \]

\[ d_r / m \]

\[ d_v \] distance along the road

\[ d_r \] distance from vehicle longitudinal axis

NOTE The longitudinal lines in Zone A are situated at 0 m, 1.5 m and 3.0 m to the nearside of the longitudinal axis of the vehicle.
Collection of data:

Glare and Range for headlamps

- with different types of light sources
- at different mounting heights
Luminous Flux in Glare Zone - H7, D3S and LED types of passing beams

- vertical inclination of 0% means horizontal cut-off at H-H
- vertical inclination of -1,0% means horizontal cut-off 0,57° below H-H
Zone A - H7, D3S and LED types of passing beams

→ vertical inclination of 0% means horizontal cut-off at H-H
→ vertical inclination of -1.0% means horizontal cut-off 0.57° below H-H

GTB Document No. CE-5001
Glare – H7 headlamp at different mounting heights
Glare – D3S headlamp at different mounting heights
Glare – LED headlamp at different mounting heights

![Graph showing glare performance assessment for vehicle headlamps at different mounting heights.](image-url)
Range in Zone A – H7 headlamp at different mounting heights
CIE TC4-45
Performance Assessment Method
for Vehicle Headlamps

Range in Zone A – D3S headlamp at different mounting heights
CIE TC4-45
Performance Assessment Method for Vehicle Headlamps

Range in Zone A – LED headlamp at different mounting heights
Collection of data:

Glare and Range for headlamps at different initial aiming settings
Glare – D3S headlamp at different initial aiming settings
CIE TC4-45
Performance Assessment Method
for Vehicle Headlamps

Range in Zone A – D3S headlamp at different initial aiming settings
Calculation Results

in Relation to

Klettwitz Field Test Outcome
The results of the Klettwitz field test show a clear relationship between pitch angle and discomfort glare.

Pitch angles which lead to a passing beam cut-off movement above the horizon increase the discomfort glare for oncoming drivers – depending on the headlamps mounting height – to values below rating 5 ("just admissible") according to de Boer – scale.

Cut-off positions above horizon lead – undependendly of light source types – to weighted luminous flux values in TC4-45 glare zone above 1 lumen.
Headlamps glare – correlation between de Boer and Luminous Flux

Klettwitz Observations (GTBWGFL245Rev1)
Note colour key differs from the large diagram

Glare Calculations

De Boer scale

Unnoticeable
Satisfactory
Just Admissible
Disturbing
Unbearable

Headlamp Type
HAL
HID
LED

Flux [ft\(^2\)]

HAL
H=711mm

HID
H=774

LED
H=665

Horizontal cut-off at H-H

Cutoff moved below H-H

Cutoff moved above H-H

Leading Condition
CIE TC4-45
Performance Assessment Method for Vehicle Headlamps

Headlamp Glare – correlation between de Boer and Luminous Flux
CIE TC4-45
Performance Assessment Method for Vehicle Headlamps

Headlamp Glare – correlation between de Boer and Luminous Flux

- Comparison of Klettwitz field test results and TC4-45 calculations leads to the conclusion that de Boer-Rating of „5 – just admissible“ correlates with a weighted luminous flux in TC4-45 glare zone of 1 lumen.

- This correlation opens the possibility to use TC4-45 glare calculations for the assessment of glare impact to oncoming drivers in real traffic situations.
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   Explanation of load conditions

5. **Joint GTB/Poland/OICA**
   Conclusion
   Suggestion
Automatic Headlamp Levelling “50% Loading” Conditions
LOADING CONDITIONS OF VEHICLES INVOLVED IN ACCIDENT
ECE/TRANS/WP29/GRE/65/16

Trunk load

- 0 - 40kg: 21%
- 40 - 100kg: 4%
- 100 - 190kg: 1%

Passengers load

- Driver only: 70%
- + Front passenger: 20%
- + Passenger(s) at the back: 10%
CUSTOMER HABITS REGARDING LOAD IN VEHICLE’S TRUNK

ECE/TRANS/WP29/GRE/65/16

- Day: 70%
- Night: 30%

- Empty trunk: 80%
- Shop/holid.load: 13%
- Exceptional load: 7%
DEFINITION OF “50% LOAD” CONDITION FOR A VEHICLE

- Load Condition 0% : $M_{0\%}$
  - Mass of the vehicle with 90% min. fuel tank and 75kg driver
    (as described in Reg. 48, paragraph 2.4 and Annex 6 paragraph 4.2 plus mass of the driver)

- Load Condition 100% : $M_{100\%}$
  - Mass of the vehicle with maximum load authorized
    (F1 information on Type Approval certificate)

- Load Condition 50% : $M_{50\%}$
  - $M_{50\%} = M_{0\%} + \left( \frac{M_{100\%} - M_{0\%}}{2} \right)$

- The size of a 50% load $\left( \frac{M_{100\%} - M_{0\%}}{2} \right)$ will be approximately 150kg to 300kg and is dependent on the vehicle type.
  - From 74% to 99% of trunk load involved in accident
  - More than 90% of passengers load involved in accident
“50% LOAD”- DISTRIBUTION IN THE VEHICLE

- 1 Passenger (75 kg) on the front seat
- 1 - 2 Passengers (75 kg + 75 kg) on the row closest to driver
- Rest of the “50 % Load” in the trunk (if necessary)
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Summary

and

Suggestion for Amendment to UN Regulation No. 48

Geoffrey R Draper - GTB President

Headlamp levelling is a challenging subject because glare complaints are inherent to visibility of the road ahead for the driver. There is no perfect answer!
Today’s presentation has considered:

- Visibility Range
  - The Polish approach
  - The GTB approach
- Acceptable Glare Limit
  - The GTB approach
  - The Polish approach

- The results of the comprehensive literature search
- Calculations using the CIE method based upon actual vehicle system data
- The Klettwitz tests clearly identifying the significance of vehicle pitch due to load
- The concept of “50% loading” resulting from French research data
Focus on maintaining adequate visibility range

- Based upon the translation of the photometric requirements at the test points of the headlamp regulations into an estimate of values produced at points on the road surface.

- "Worst Case" – Takes account of lowest performing headlamps that meet the type approval requirements

Avoidance of glare is not directly addressed

- Assumes that the horizontal cutoff should not extend beyond 100m distance from car.

Long debate at GRE resulting in the revised proposal GRE/2014/11
Vehicle pitch is the influencing factor

Glare remains acceptable providing the horizontal cutoff remains below the H-H line as defined in the headlamp regulations (Based on a mounting height of 750mm).

It is necessary to consider the relationship between action to avoid glare complaints with the need to assure sufficient visibility range.

The initial aim declared by the vehicle manufacturer becomes an important factor

Data produced to enrich the Klettwitz results to validate the glare conclusions and investigate the relationship with visibility range

Calculations using the CIE assessment method
Example calculations using the CIE assessment method

- 0.65% UP
- 0.1% Down
- 0.75% Down

Glare Calculation
Example calculations using the CIE assessment method

<table>
<thead>
<tr>
<th>Visibility Range Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone A</td>
</tr>
<tr>
<td>1.75% Down</td>
</tr>
<tr>
<td>2.2% Down</td>
</tr>
<tr>
<td>2.5% Down</td>
</tr>
</tbody>
</table>

Example calculations using the CIE assessment method
GTB Proposal for Acceptable aiming limits

Summary of Results of Glare and Visibility Calculations
Based upon calculations using CIE method

<table>
<thead>
<tr>
<th>Mounting Height</th>
<th>H7</th>
<th>D3S</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glare</td>
<td>Visibility</td>
<td>Glare</td>
</tr>
<tr>
<td>500</td>
<td>0.65</td>
<td>-1.75</td>
<td>0.6</td>
</tr>
<tr>
<td>665</td>
<td>-0.1</td>
<td>-2.25</td>
<td>-0.12</td>
</tr>
<tr>
<td>744</td>
<td>-0.15</td>
<td>-2.25</td>
<td>0.12</td>
</tr>
<tr>
<td>850</td>
<td>-0.75</td>
<td>-2.5</td>
<td>-0.85</td>
</tr>
<tr>
<td>907</td>
<td>-0.75</td>
<td>-2.5</td>
<td>-0.85</td>
</tr>
<tr>
<td>1200</td>
<td>-0.75</td>
<td>-2.5</td>
<td>-0.85</td>
</tr>
</tbody>
</table>

The highlighted values indicate the position of the cutoff for the maximum permissible glare and the minimum permissible visibility range (i.e. The boundary conditions)
GTB Proposal for Acceptable aiming limits

- Mounting Height (mm):
  - 500
  - 600
  - 700
  - 800
  - 900
  - 1000

- Vertical position of horizontal cutoff:
  - 0.15% \(D\) (H7)
  - 0.2% \(D\) (LED)
  - 0.12% \(U\) (D3S)
  - 0.4% \(U\) (LED)
  - 0.5% \(U\) (LED)
  - 0.85% \(D\) (LED)
  - 2.25% \(D\) (H7)
  - 2.5% \(D\) (H7)
  - 2.25% \(D\) (D3S)
  - 1.75% \(D\) (H7)

- Conversion factors:
  - 0% \(D\)
  - 1% \(D\)
  - 2% \(D\)
  - 3% \(D\)

GTB Document No. CE-5001
GTB Proposal for Acceptable aiming limits

- Initial aim is declared by the manufacturer.
- Upper limit of aim based upon “Just Acceptable Glare Criteria”.
- Lower limit of aim based upon maintaining a 50m range along the nearside edge of the road.

Acceptable range for the variation in the vertical static aim of the passing beam.

Note the position has been chosen to favour both glare and visibility between 500mm and 1000 mm mounting heights.
How can we consider allowing the upper aiming limit to be above the H-H line?

- Vertical aim of horizontal cutoff is relative to the H-H plane through the centre of reference of the headlamp
- The headlamp height will vary between 500mm and 1200mm
- The mean height of the oncoming driver’s eye is 1250mm
- Glare is assessed at a distance of 50m from the headlamp
- At 50m the important factor concerning glare is the separation of the oncoming driver’s eye and the position of the horizontal cutoff

☐ This factor has not been taken into account in the current R48 requirements
Angular relationship of horizontal cutoff and oncoming driver’s eye

Oncoming Driver’s eye height 1.25m

Angle (Ø) representing the location of the oncoming drivers eye relative to the H-H plane through the centre of reference of the headlamp

Ø = ((1.25-h) / 50) * 100 %

| Height of oncoming driver’s eye | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 |
| Headlamp mounting height mm     | 500  | 600  | 700  | 800  | 900  | 1000 | 1100 | 1200 |
| angular difference Ø - %        | 1.5  | 1.3  | 1.1  | 0.9  | 0.7  | 0.5  | 0.3  | 0.1  |
GTB proposal with oncoming driver’s eye position superimposed

Location of the oncoming driver’s eye

Zone indicating the acceptable separation of oncoming driver’s eye and the horizontal cutoff

1% separation at the 750mm mounting height is implied by the existing photometric requirements in the headlamp regulations.

This is validated as acceptable by the Klettwitz tests
How can we consider raising the upper glare limit when there are already glare complaints from road users?

- The proposed GTB upper aiming limit is based upon research reported in the CIE188: 2010. This established a correlation between the calculated light flux in the glare zone and observations using the De Boer scale.

- A similar correlation was found between the calculations and the observations in the Klettwitz tests.

- Glare complaints are common but there are no data to show the relationship between initial aim and glare complaints, despite studies in Europe and USA.

- Current R48 requirements have assumed HID headlamps will create more glare and are required to have auto-levelling. Klettwitz tests and calculations show that halogen headlamps produce higher values in the CIE glare zone. Halogen headlamps are rarely installed with auto levelling.
1. Vehicle loading* condition (as defined in R48 Annex 5 – section 2.1.1.1)

Cutoff position does not remain within the defined limits

Automatic Static Levelling mandatory

Cutoff position remains within the defined limits

(move to loading condition 3)

2. Vehicle loaded to the new 50% Condition

3. loaded to the maximum condition (as defined in R48 Annex 5 – paragraph 2.1.1.5.)

Cutoff position does not remain within the defined limits

Manual Levelling mandatory

Cutoff position remains within the defined limits

No correction (levelling) is necessary

* Note the mass of the passengers shall be 75 kg per person.
Comparison of Polish & GTB Proposals with Current R48
The Polish Proposal

- based upon current photometric requirements of the headlamp regulations defines the aiming limits that have to be respected for all loading conditions described in R48 Annex 5.

- intended to apply to all vehicle installations that will use any headlamp type approved to the existing headlamp regulations.

- assumes that the horizontal cutoff levelling tolerances are such that:
  a) to achieve adequate range the position of the cutoff does not exceed the maximum allowed downward inclination corresponding to a point on the road at 50 m distance.
  b) for glare avoidance the position of the cutoff does not exceed a vertical position that corresponds to a point on the road at 100 m distance from the car. In this condition the glare values at the oncoming driver’s eye are assumed to not significantly exceed the values specified in the headlamp regulations.

- results in tolerances that are significantly smaller that those currently allowed in Regulation 48.
The GTB proposal

- based upon headlamp systems typical of the standard of performance currently achieved in popular Western European and Japanese type approved vehicles.

- these headlamps are achieving performance levels in excess of the minimum requirements of the headlamp regulations.

- does not attempt to represent the worst-case situation as is represented by the Polish proposal.

- glare and visibility range values have been determined by calculations based upon actual measured headlamp performance data, using the CIE validated method.

- result is a proposal for aiming tolerances that are similar to those currently specified in Regulation 48 but with an upward shift.

- requires the vehicle manufacturer to declare the vehicle pitch under the specified loading conditions at the early design stage.
The GTB and Polish proposals present possibilities:

- Determine and declare the pitch characteristics of the vehicle at the time of type approval and confirm compliance with the aiming tolerances in the GTB proposal, or:

- Apply for a type approval without the requirement to declare the pitch characteristics and confirm compliance with the levelling tolerances in the Polish proposal.
Depending upon the reaction of GRE:

April 2014  Presentation to GRE / feedback from GRE experts

May 2014   GTB ready for preparation of proposals to amend the text of Reg.48 including revision to annex 5 loading conditions (GTB Meeting – Spain)

July 2014  Deadline for submission of formal proposals to GRE-72
GTB Task Force

Coordination of Automotive Visibility and Glare Studies

Thank you for your attention