Transmitted by the expert from GTB

Informal Document No. **GRE-65-17**
(65th GRE, 28-31 March 2011
agenda item 5 (d)

Automatic Static Headlamp Levelling

Implications of Mandatory Fitment to all Vehicles

The Way Forward

A first evaluation by GTB
Presented to GRE65 – March 2011

GRE/2011/2, GRE/2011/27, GRE/2011/24
The GTB reaction

- The debate relating to the proposal to introduce the 25w gas discharge light sources should be separated from discussions concerning the mandatory installation of auto-levelling (static) and the headlamp cleaning requirements.

- The 25w gas discharge light sources have been designed within the current rules of Regulation 48 and do not exceed the current 2000 lumen criterion.

- The 25w gas discharge light sources offer significant advantages in terms of road safety through improved illumination and reduced energy consumption.

The GTB reaction to GRE/2011/2

- The proposal of Germany (GRE/2011/2) is basically acceptable providing that:

  a) It is accompanied by an adequate transitional provision (GTB Proposal ECE/TRANS/WP.29/GRE/2011/22)

  b) There is agreement that this transitional provision could be reviewed depending upon the results of a detailed study of the traffic safety implications led by GTB.

  c) The validity of the 2000 lm criterion is reviewed in the context of results of new studies.

The GTB reaction to GRE/2011/24 and GRE/2011/27

- No decision to revise the current provisions relating to the mandatory requirement for automatic (static) levelling and headlamp cleaning should be taken without supporting data relating to traffic safety benefits and related economic impact

  - No data are available to show that glare causes accidents
  - The public "perception" of glare does cause many complaints that have to be addressed by governments
  - GTB considers that research data is necessary to confirm that auto (static) levelling makes a significant contribution to safety.

The GTB approach

Since GRE64, GTB has undertaken the following activities:

- Reviewed the discussion at GRE64 and decided to initiate an activity to study the road safety implications of auto-levelling. This is being managed by the Front Lighting Working Group led by Dr Rainer Neumann.

- Carried out an evaluation of the potential glare caused by vehicle loading conditions using the recently published CIE Headlamp Performance Assessment Procedure. This was intended to help to identify an alternative to the 2000lm criterion

- Conducted a forum during the GTB working group meetings in Turin, Italy on 25 January 2011 (attended by 46 lighting experts).

Investigation to Understand the Relevance of the 2000 Lumen Criteria

Initial Results

Survey of headlamp misaim due to loading conditions defined in ECE Regulation 48

-Annexes 5 &6 (i.e. BEFORE installation of a levelling device but taking into account any levelling of the chassis)

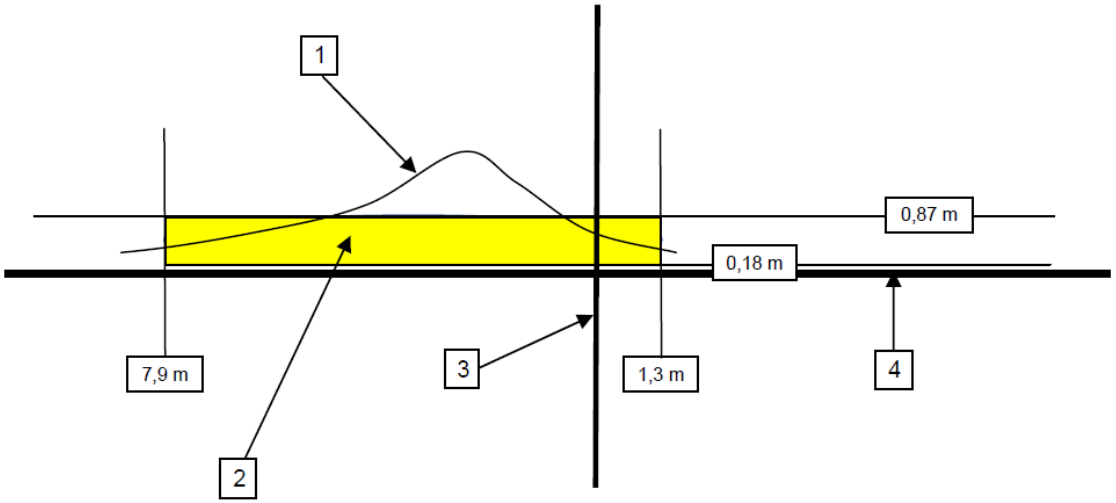
Data (vehicle inclination due to loading – degrees) provided by 6 vehicle manufacturers

The very extreme case!!

	1 driver and 400kg load in trunk					
Vehicle Manufacturer	**VM1**	**VM2**	**VM3**	**VM4**	**VM5**	**VM6**
A- MINI CARS			2.18			
B- SMALL CARS		1.28	2.32			
C- MEDIUM CARS	2.12	1.16	1.44	1.66	1.60	
D- LARGE CARS	1.66	1.21	1.19			
E- EXECUTIVE CARS		1.10	1.45			0.58
F- LUXURY CARS						
S- SPORT COUPES						
M- MULTI PURPOSE CARS	2.15		1.46		2.59	1.28
J- SPORT UTILITY CARS	0.51	1.47	1.88		2.38	
				Average of all values =	1.58	
				Average of C Category =	1.60	

Value of 1.50 degrees used for the calculation because the decision was taken before all data were available

CIE 188:2010 -Calculation Method – Glare Zone



Key

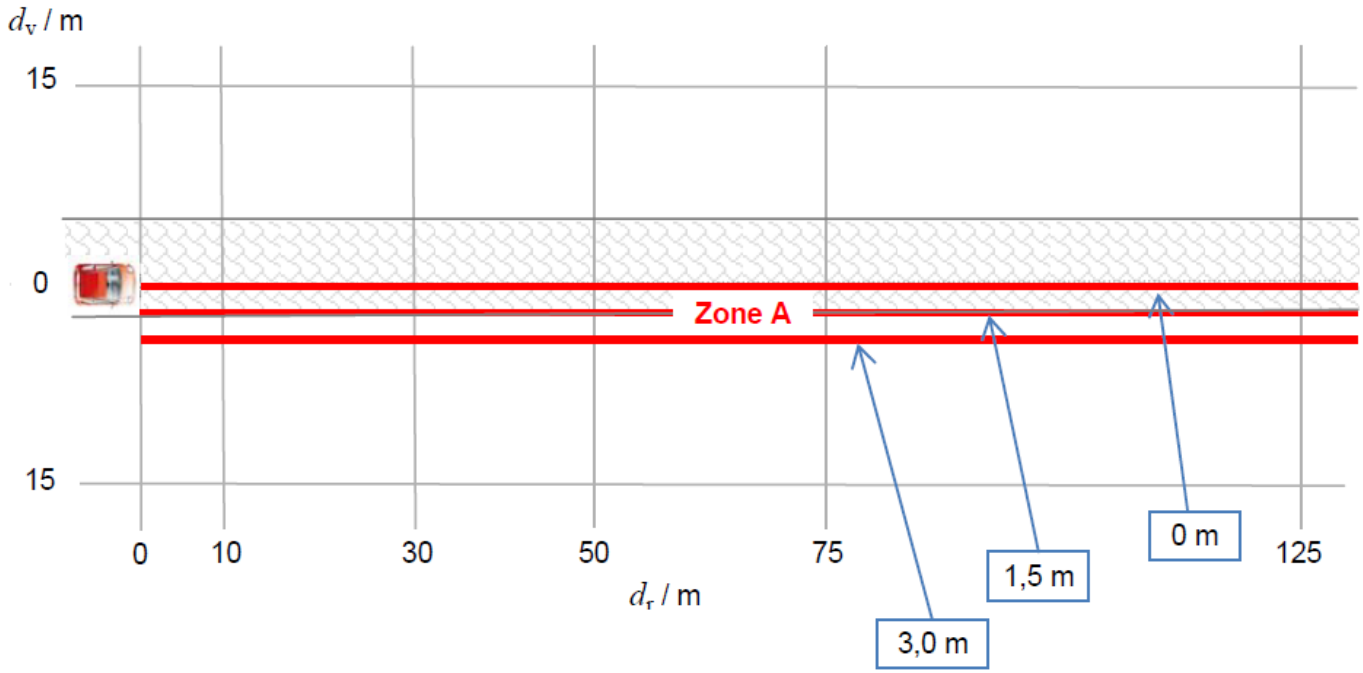
1 the curve indicates the probable location of the oncoming driver's eyes as a percentage of all instances on a range of road types based upon the work of Damasky [3]
2 for detail of this zone see Figure 16
3 vertical line through the longitudinal axis of vehicle
4 this horizontal line is located at a height of 0,75 m above the road surface

NOTE Detail of the location of the glare zone and the probability factors used for the weighting factors are given in Figure 10.

Figure 15. Corresponding layout of the glare test zone on a vertical plane at 50 m from the headlight.

CIE 188:2010

Calculation Method – Range Zone A



Key

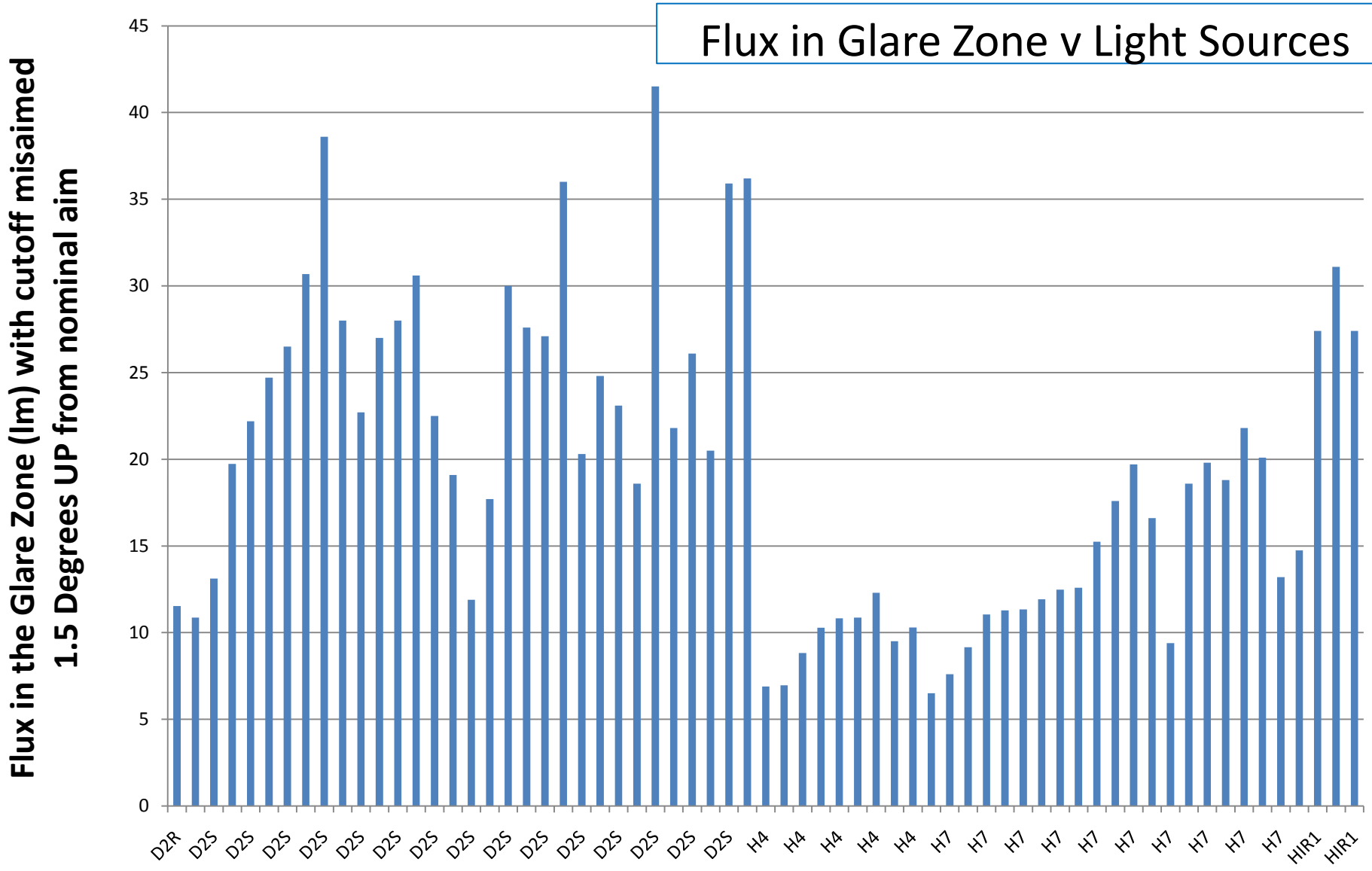
d_r distance along the road

d_v distance from vehicle longitudinal axis

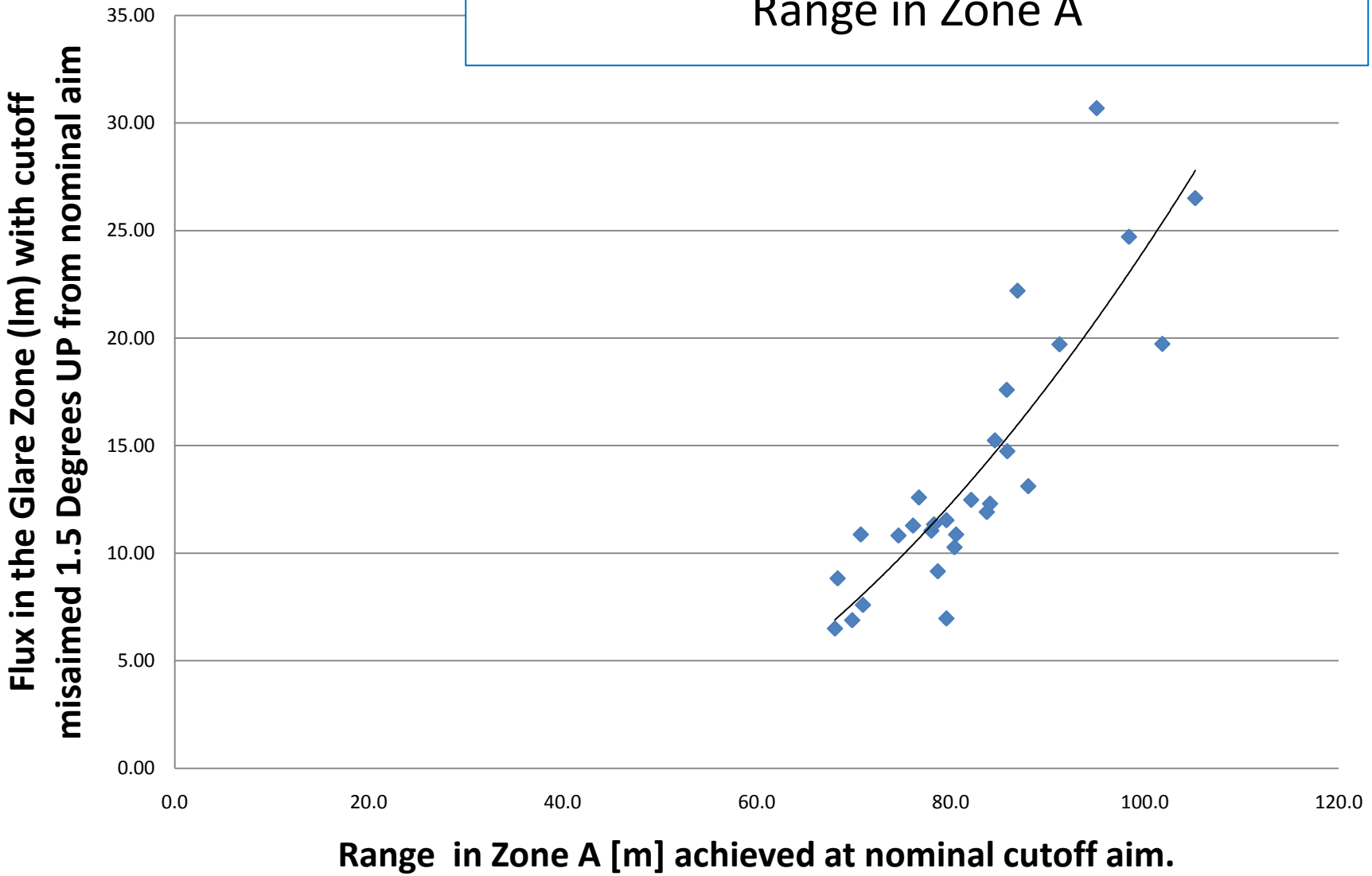
NOTE The longitudinal lines in Zone A are situated at 0 m, 1,5 m and 3,0 m to the nearside of the longitudinal axis of the vehicle.

Figure 8. Zone A – range assessment for straight road.

Flux in Glare Zone v Light Sources



Relationship of Flux in Glare Zone and Range in Zone A



Observations

1. The 2000 lm criterion differentiates between light sources but has no relation to the potential glaring effect of headlamps misaimed due to vehicle loading conditions.
2. It may be possible to establish a maximum flux in the glare zone but it is necessary to determine the maximum value of glare that is tolerated by opposing drivers.
3. The imposition of a maximum luminous flux in the glare zone would result in headlamps being designed to **respect the glare criteria at the expense of headlamp performance**. This will mean a serious reduction in visibility distances.
4. The 2000 lm criterion is not a satisfactory measure to determine whether auto levelling should be required but it is unlikely that a substitute can be identified.

The GTB Front Lighting Working Group Forum
Turin, Italy – 25 January 2011

“The Contribution of Mandatory Installation of Static Auto-Levelling to Reduced Glare”

6 Speakers, 40 GTB experts

An Overview of the Main Points

Note: The following data is the result of work carried out between the GTB meeting held in Poland at end October 2010 and the Turin meeting at the end of January (3 months)

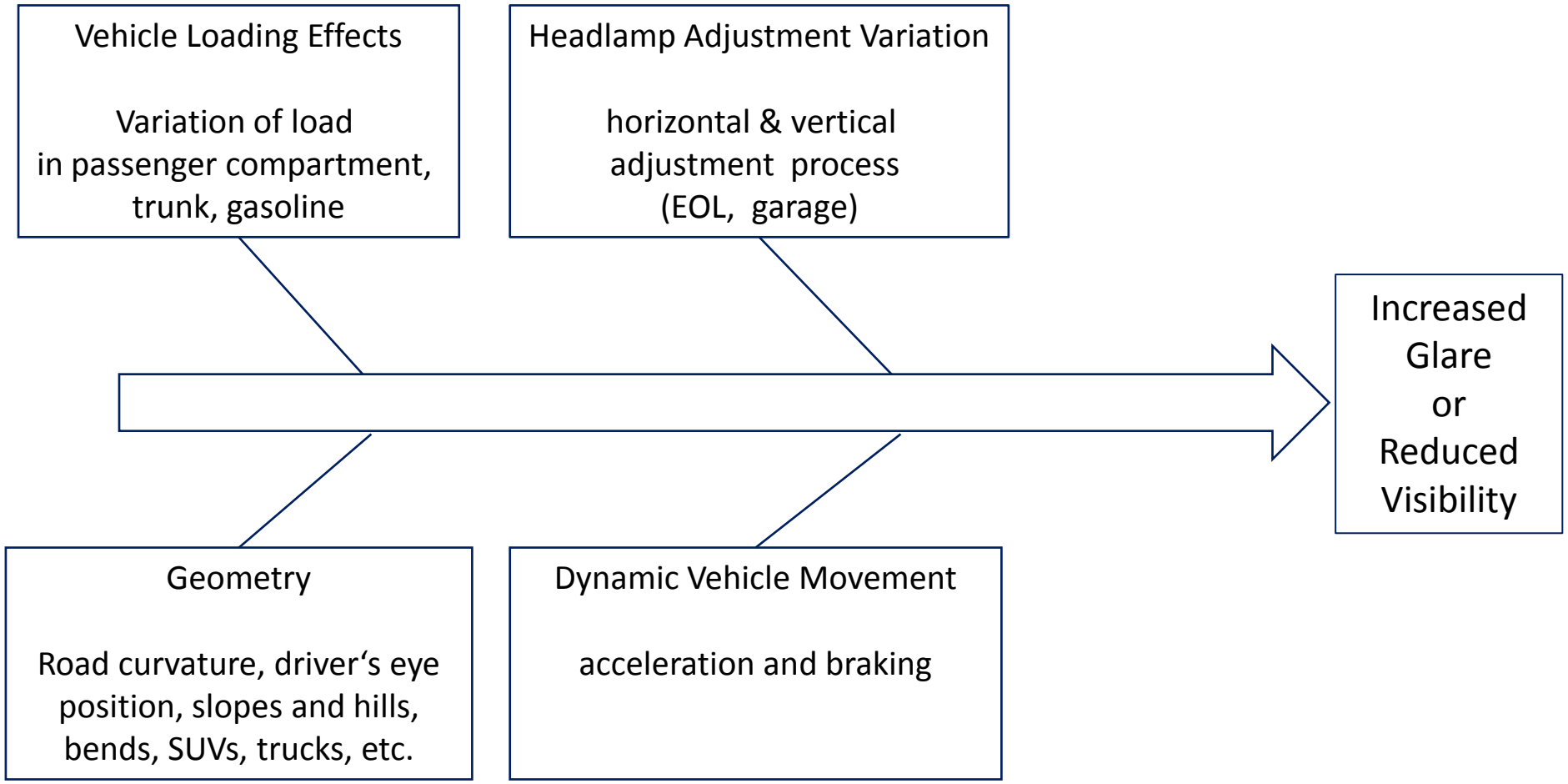
The GTB Front Lighting Working Group Forum
Turin, Italy – 25 January 2011

Presenters

Dr. Wolfgang Huhn:	"Cost-Benefit Analysis of mandatory requirement of auto levelling".
Dr. Ernst-Olaf Rosenhahn:	"Glare and Auto-Levelling: degree of influence and future outlook."
Paul-Henri Matha:	"Reality of car production tolerances and automatic levelling involvement"
Aurélie Darnoux:	"Automatic Levelling: Safety aspects and real application in motor vehicles."
Dr. Tomasz Targosinski:	"Aiming influence for visibility distance and glare"
Dr. Thomas Reiners:	"Headlamp cleaning effectiveness."

Copies of these presentations are available upon request

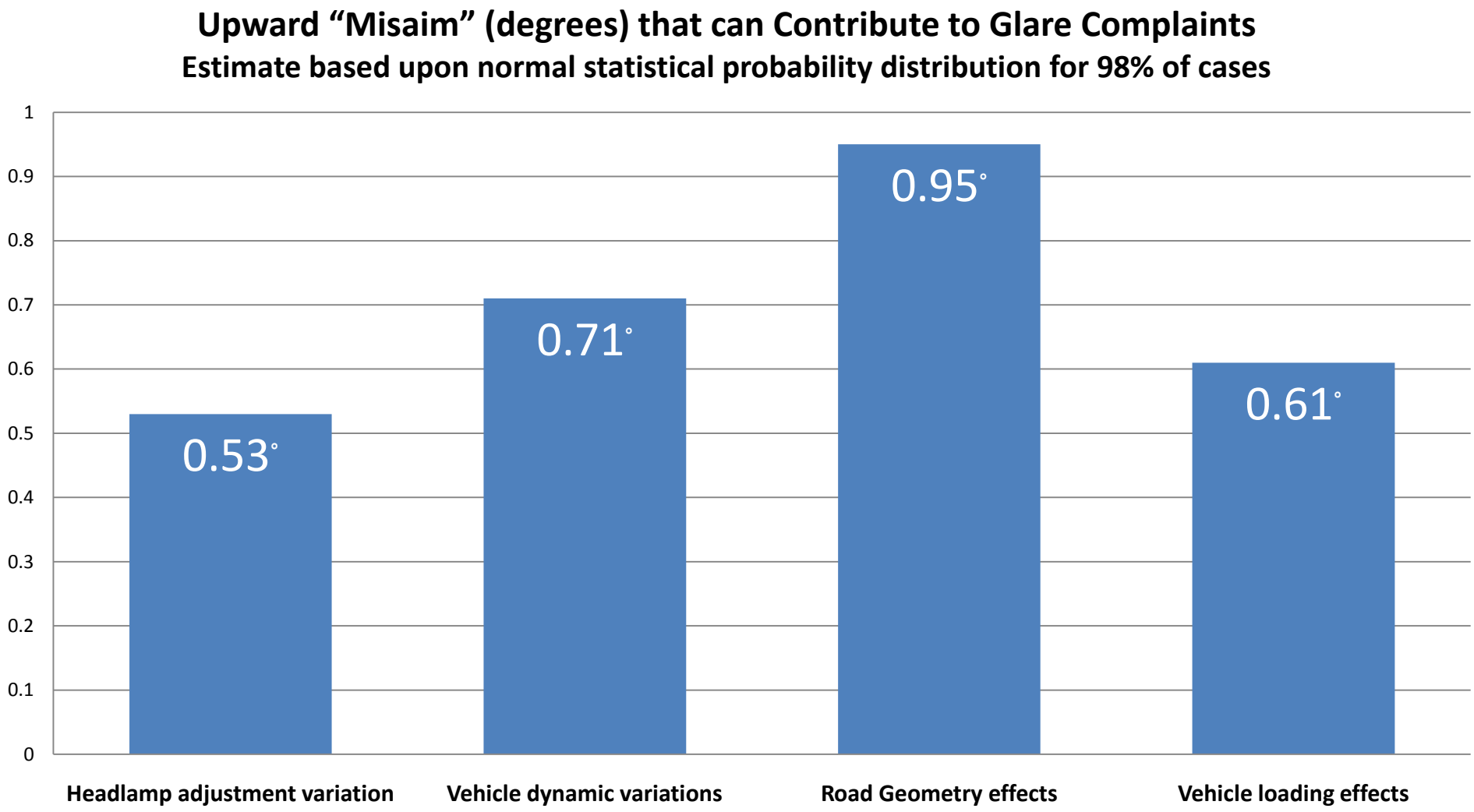
Factors Influencing Passing Beam Misaim resulting in Increased Glare or Reduced Forward Visibility



Research Data Applied to the GTB Study

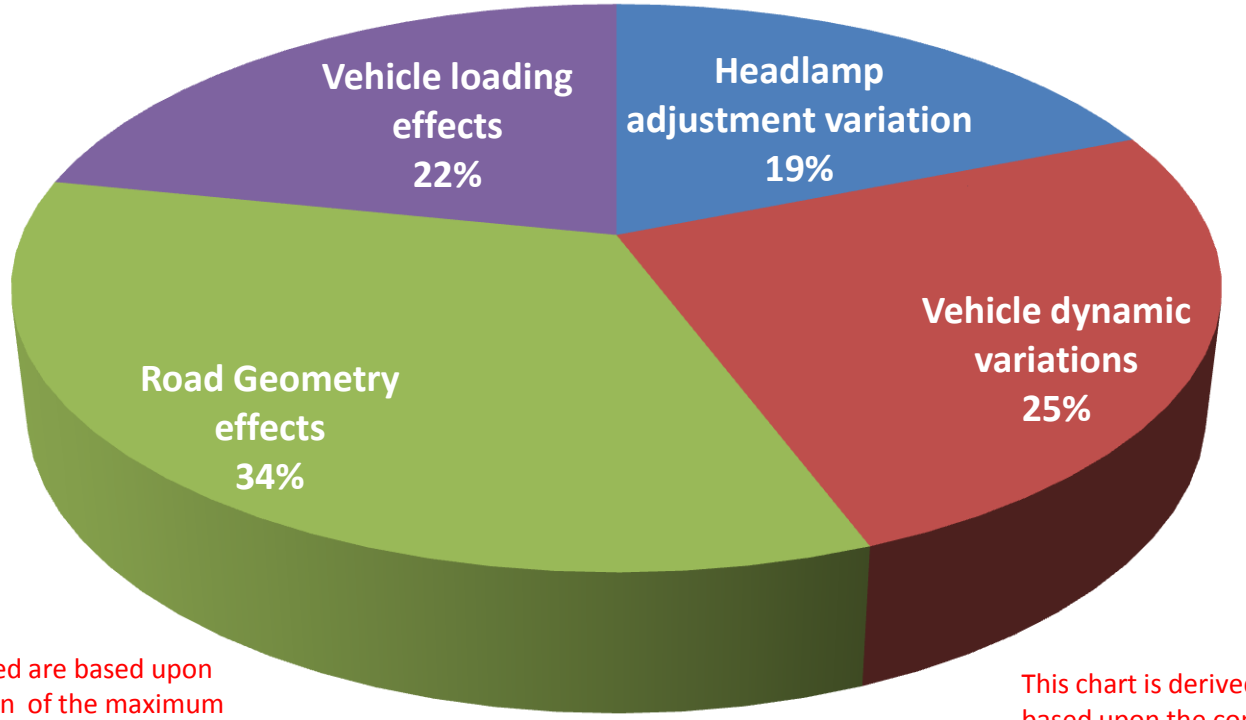
Factor	Research Findings
Headlamp Adjustment Variation horizontal & vertical adjustment process (End of vehicle assembly line, garage)	PAL1999 – Huhn "Lichtest" Germany (2001 -2007) UK- VCA Survey 2007 Motor Transport Institute – Warsaw, Poland
Dynamic Vehicle Movement acceleration and braking	PhD Dissertation 1995 - Joachim Damasky
Geometry Road curvature, driver's eye position Slopes and hills, bends, SUVs, trucks, etc.	PhD Dissertation 1995 - Joachim Damasky
Vehicle Loading Effects Variation of load in passenger compartment, trunk, gasoline	UMTRI 2007 Matha 2010 Mobility Investigation 2008 (Funded by German MOT) GTB study 2011

Contribution of the Influencing Factors to Glare



Contribution of the Influencing Factors to Glare

Upward "Misaim" (degrees) that can Contribute to Glare Complaints
Estimate based upon normal statistical probability distribution for 98% of cases



The % values indicated are based upon the statistical addition of the maximum angular effects of the individual influencing factors

This chart is derived from assumptions based upon the content of the GTB document GTBWGFL174

Under what conditions will static auto levelling contribute to road safety?

Loading of the car

Lifetime Use Data (LAB)*:

- ✓During 80% of the lifetime of a vehicle the trunk is empty
- ✓15% of the lifetime of a vehicle is for shopping or holidays
- ✓5% of the lifetime of a vehicle is for exceptional loading

*LAB (Laboratory Accident Analysis, Biomechanics and Study of human behaviour that is part of GIE (Economic Interest Grouping) between PSA Peugeot Citroën and Renault)

Under what conditions will static auto levelling contribute to road safety?

Loading of the trunk

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

*EACS: European Accident Causation Study. The objective of EACS was to investigate accident causation. Project partners were: ACEA, CEESAR, Hannover Univ., ELASIS, DEKRA, Univ. of Oulu, INRETS.

*EDA: The European Safety, Reliability & Data Association

Under what conditions will static auto levelling contribute to road safety?

Loading due to the occupants of the vehicle

Accidental data : LAB Data*

- ✓70% of accidents occur with only the driver
- ✓20% of accidents occur with the passenger in the front
- ✓10% of accidents occur with passengers in the back

*LAB (Laboratory Accident Analysis, Biomechanics and Study of human behaviour that is part of GIE (Economic Interest Grouping) between PSA Peugeot Citroën and Renault)

Under what conditions will static auto levelling contribute to road safety?

Use of the vehicle at night

Approximately 30 % of the usage of the vehicle is at night (LAB*)

Accidental data : SETRA 2009*

✓70% of accidents occur in day light
✓25% of accidents occur at night (16% with public lighting / 9 % without any light)
✓5% of accidents occur at twilight and dawn

*LAB (Laboratory Accident Analysis, Biomechanics and Study of human behaviour that is part of GIE (Economic Interest Grouping) between PSA Peugeot Citroën and Renault)

**SETRA* - French road studies bureau

Implications of Mandatory Installation of Auto (Static) Levelling for all vehicles

Additional Cost and Weight

- Automatic (static) levelling, requires an additional cable harness, a calculator and two or more additional sensors (having the required sensitivity).

- Additional cost between 20 and 40 euro depending upon the electronic complexity of the vehicle. Estimated total costs: 500 Million Euro per year in Europe !
- Additional weight per vehicle: 400-500g

GTB Conclusion and Recommendation (1)

- There is no evidence that glare causes road accidents. However it does provoke complaints.
- There is strong evidence that good road illumination produced by efficient headlamps reduces accidents.
- The 2000lm criterion cannot be justified on safety grounds and it incorrectly distinguishes between light source technologies.
- There is no scientific basis for the requirement for automatic (static) levelling. The initial study by GTB has identified research findings that suggest that there is only limited road-safety benefit to be derived from the mandatory installation of auto levelling that would justify the additional costs.

GTB Conclusion and Recommendation (2)

- It is time to carry out a detailed study of the relationship of headlamp alignment and glare in the real-world road traffic conditions. The recent work of CIE TC4-45 and the SAE Pedestrian Visibility Taskforce provides a good basis for glare/visibility investigations.

- Until the completion of the proposed study, no changes should be introduced into Regulation 48 and the existing 2000lm criterion should be retained to allow the adoption of 25W Gas Discharge light sources without the requirement for auto levelling, according to the existing Rules.

- This detailed study will require the involvement of institutions engaged in glare and human factors research. This may require adequate funding from Government and Industry.

- This is a good opportunity for GRE and GTB to work together to further knowledge concerning the impact that good headlighting and glare control can have upon real-world traffic safety.

Thank you for your attention

This subject will be further discussed during the presentations by the GTB working groups