Submitted by the Task Force on Substitutes / Retrofits (TF S/R)

Informal document **GRE-89-06**
(89th GRE, 24 to 27 October 2023,
agenda item 5)

GRE Task Force
LED Substitutes / Retrofits (TF S/R)

Status report for GRE89

13/10/2023

K. Manz, DE (Chairman)

Ph. Bailey, UK (Vice-Chairman)

Ph. Plathner, IEC (Secretary)

Meetings of TF S/R

- 16th meeting: 2023-March 07/08
  hybrid meeting in Bonn (report: TFSR-16-04)
- 17th meeting: 2023- June 15: Aachen incl. lab demo (report: TFSR-17-04)
- 18th meeting: 2023-July 11: online meeting (report TFSR-18-03)
- 19th meeting: 2023-October 04: online meeting (report: [TFSR-19-04])

Actions completed :

- Step 1: LED Substitutes
- Step 2: LED Replacements (“Retrofits”)
  - Step 2A: Administrative items
  - Step 2B: Technical items based on “full equivalence”

New work item:
re-evaluate equivalence criteria of high power LEDr, as assigned by GRE87 (GRE87 report, paragraph 15; see also GRE-87-02)

Excerpt from GRE-88 report

Documentation: Informal document GRE-88-13

15. The expert of the Task Force on Substitutes and Retrofits (TF SR) informed GRE about their activities (GRE-88-13) and announced the next meeting of TF SR on 14 June 2023. He reported that TF SR was considering two approaches for including high power light-emitting diode replacement (LEDr) light sources in UN Regulation No. 37 and in the Consolidated Resolution on the Common Specification of Light Source Categories (R.E.5), namely "intelligent equivalence" on the light source level and "application-level equivalence". The experts from the Netherlands and the United Kingdom supported the first approach.

Potential ways forward for high power LEDr (in R37 / R.E.5)

1 – "intelligent equivalence" on light source level
(bi-directional approach) for high-power categories

- Detailed light source specification via emission in two directions
- Making full use of LED technology benefits
- Several deviations from "full photometric equivalence"
  - Keeping LEA and contrast requirements (in 2 viewing directions only)
  - Modified far-field emission requirements
- Valid in all headlamps / vehicles
- No need to consider mis-use
- Not used in any country so far

2 – "application-level equivalence"
(also called "positive list approach")

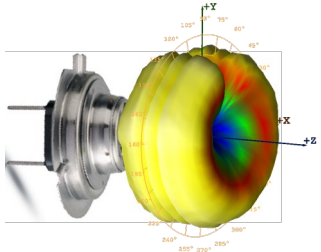
- Very limited requirements on light source level
- Making full use of LED technology benefits
- Confirmation of UN compliant photometry in the application by measurement
- Valid in tested vehicles / headlamps *
- Already accepted by several contracting parties (via national type approval)
  - Germany, and some countries accepting:
    - Austria
    - Czech Republic
    - Croatia
  - France
  - South Korea

Introducing alternative equivalence specification to allow bi-directional emission

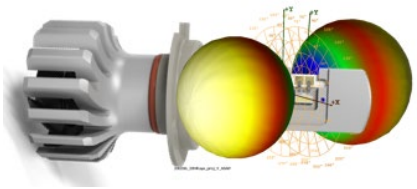
Key elements of the light source specification and PROPOSED amendments to H11_LEDr

“<u>Far-field</u>” → Normalized Intensity Distribution

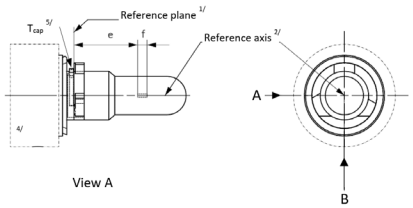
PROPOSAL: allow far-field emission characteristic of “bi-directional” LEDs with Lambertian radiation pattern



Filament / full photometric equivalence

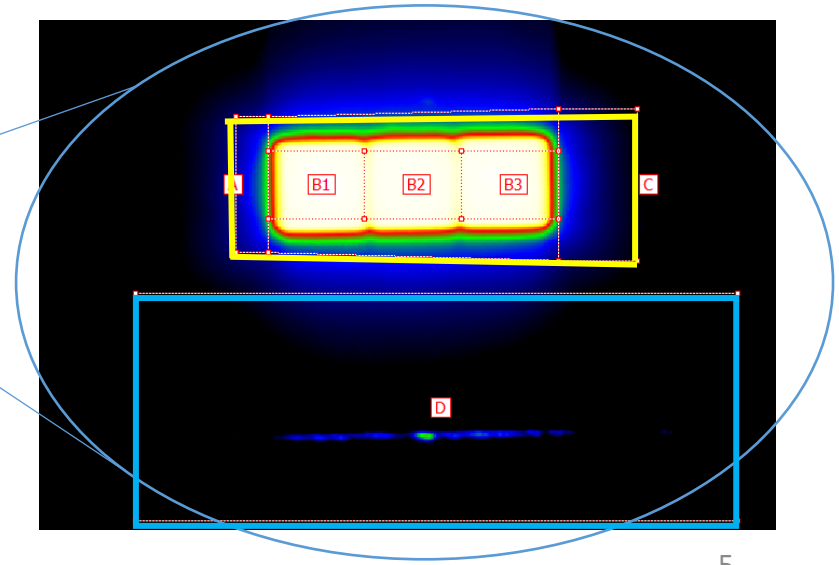


Bi-directional emission



“<u>Near-field</u>” → box and contrast requirements

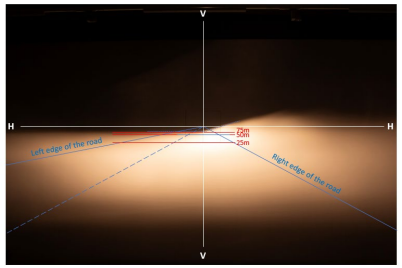
PROPOSAL: same Light Emitting Area (LEA) as “full-equivalent“, but only from view “A” and “-A”, i.e. exclude “B”



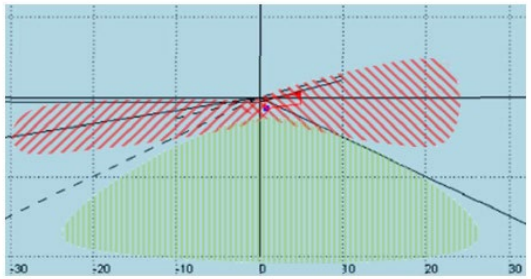
Changes in the category sheet: In a nutshell

- Starting from enforced H11 (LEDr) category sheet *(full photometric equivalence)*
- Keep all mechanical/geometrical, electrical and thermal specifications
- Keep specifications for luminous flux, colour and contrast
- Introduce alternative “configuration” as modification of
  - “Screen projection requirements” (near-field characteristics), and
  - “Normalized luminous intensity distribution “ (far-field characteristics)

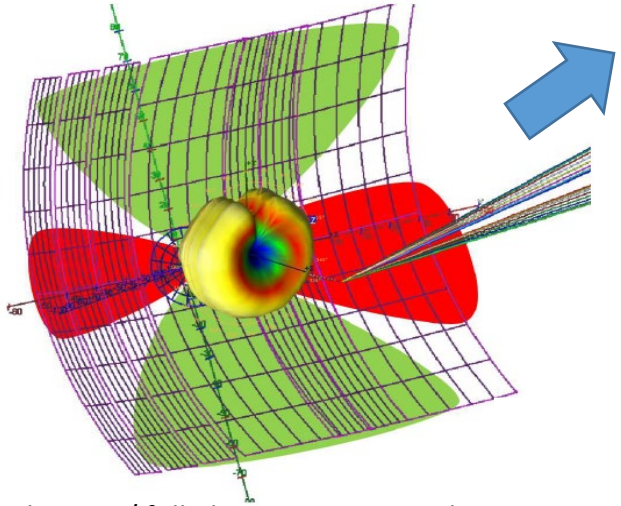
Halogen and bi-directional LEDr Beams on 25 m screen



Lab demo

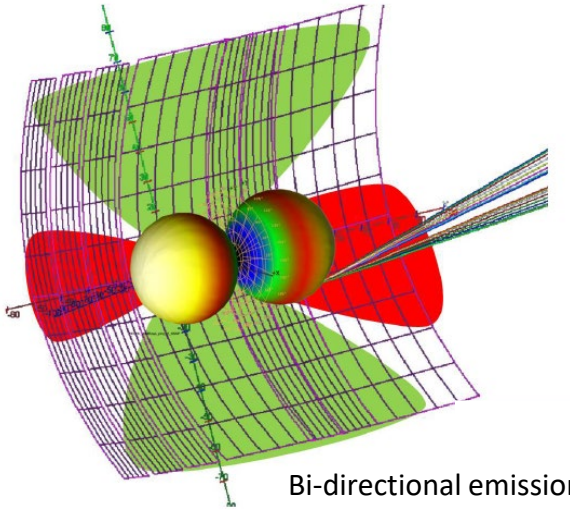


Illuminated reflector segment and corresponding light on the road



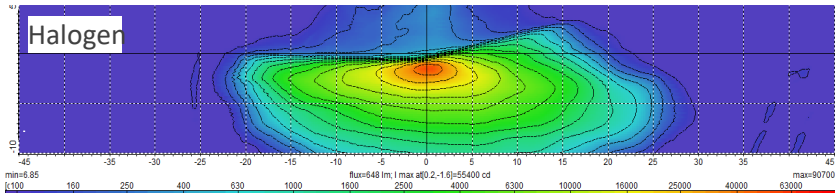
Filament / full photometric equivalence

Both light sources
1350 lm (H11)

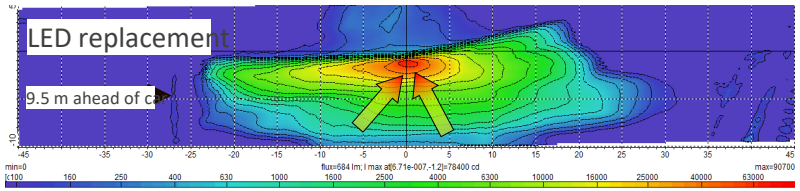


Bi-directional emission

~ 100 cd/klm in red and green direction



~170 cd/klm in “red“ direction
< 80 cd /klm in “green“ direction



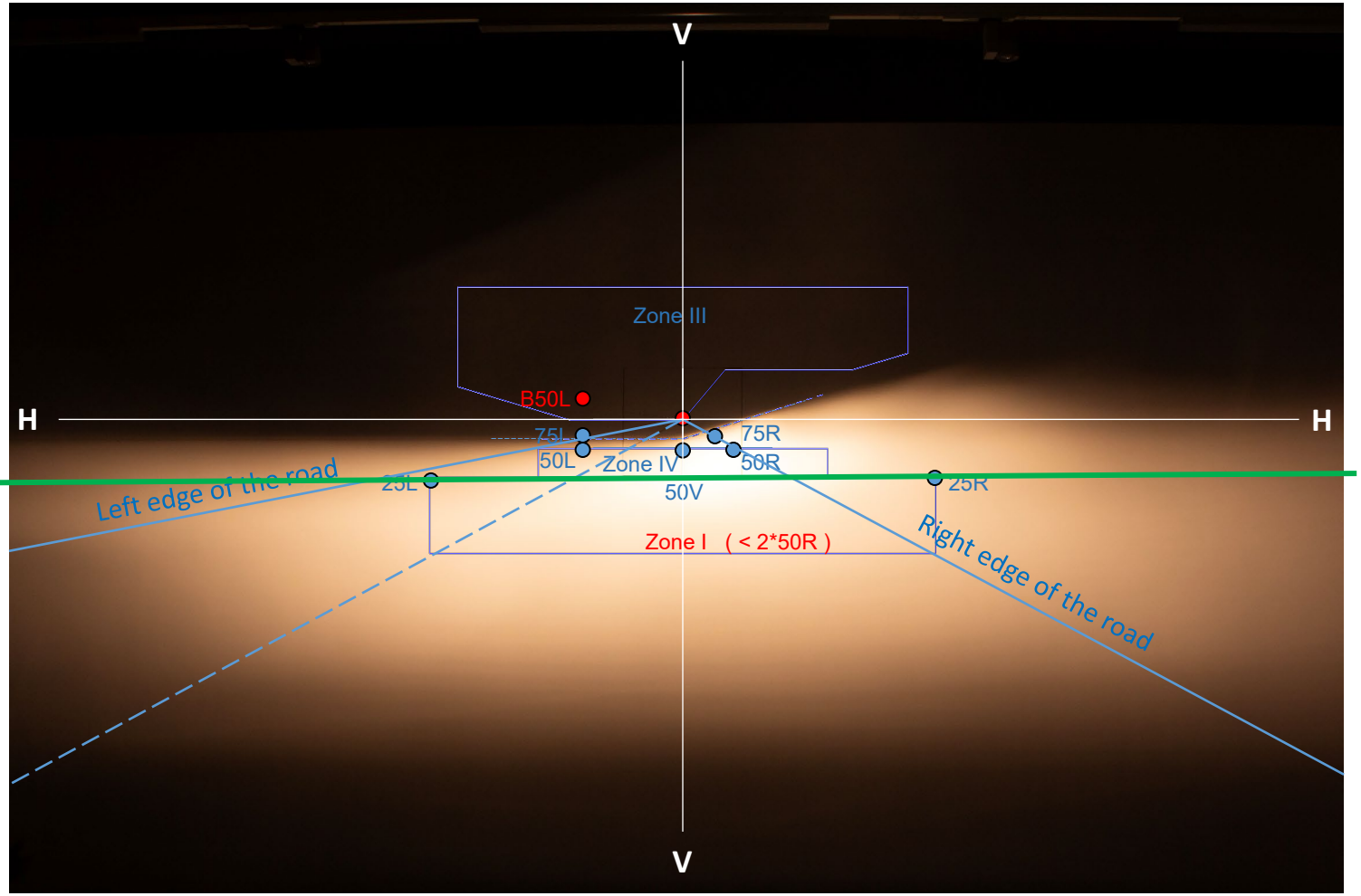
Lab demo summary

Part 1: Basic Principles
Part 2: bi-directional LEDr

Images taken from full lab demo report: TFSR-17-05

Part 1: Basic principles *(1/2)*

Headlamp A, H7 halogen



Legal test points and zone, R112 class B

- At 75m: 75R (min), 75 L (max)
- At 50m: 50R (min), 50V (min), 50L (max)
- At 25m: 25R (min), 25L (min)
- Zone I: no min., max. dep. on 50R value
- Zone III: max. to limit glare
- Zone IV: min. to enable min. homogeneity

→ There is no minimum intensity required at a distance closer than 25m to the vehicle!

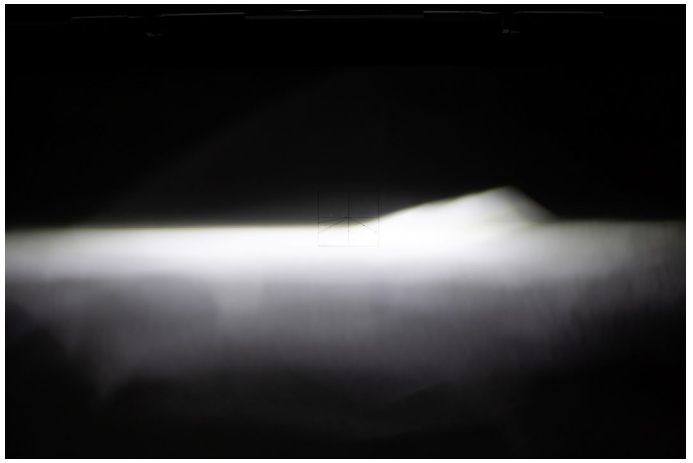
Note: this is a "goniometer view", ~10 m distant from the wall.

Part 1: Basic principles *(2/2)*

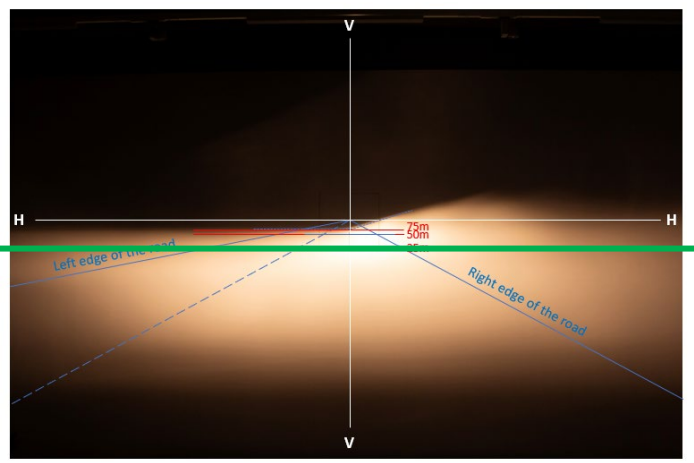
OEM Headlamp A, H7 halogen

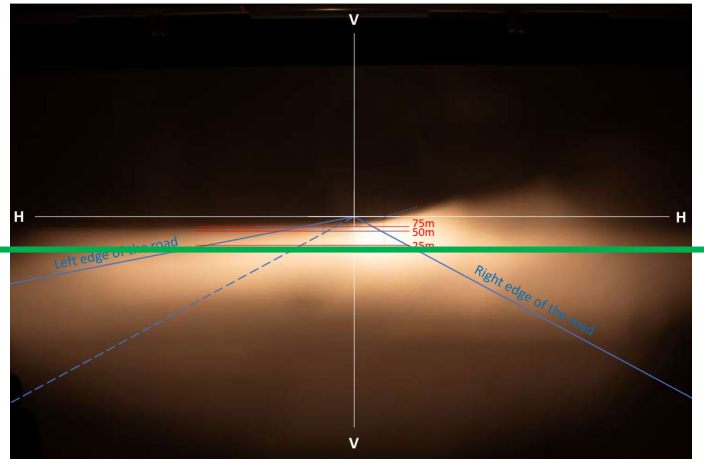
OEM Headlamp B, H7 halogen

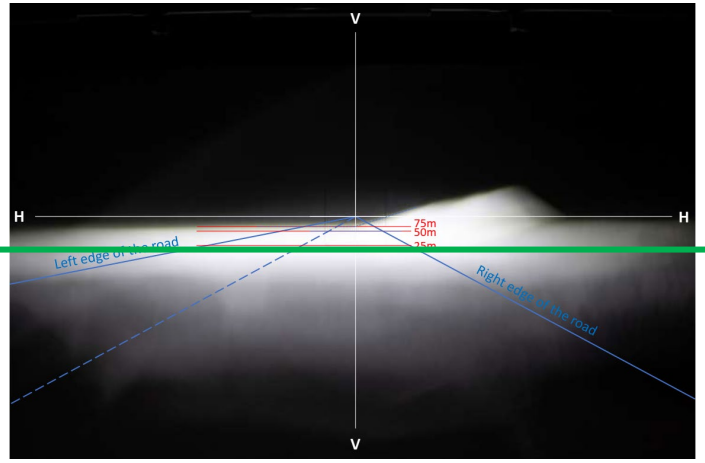
OEM Headlamp C, LED



R112 Class B type approved headlamps generating compliant beams show a variation in light distribution and colour temperature.







The most notable differences are in the unregulated foreground area (<25m) .

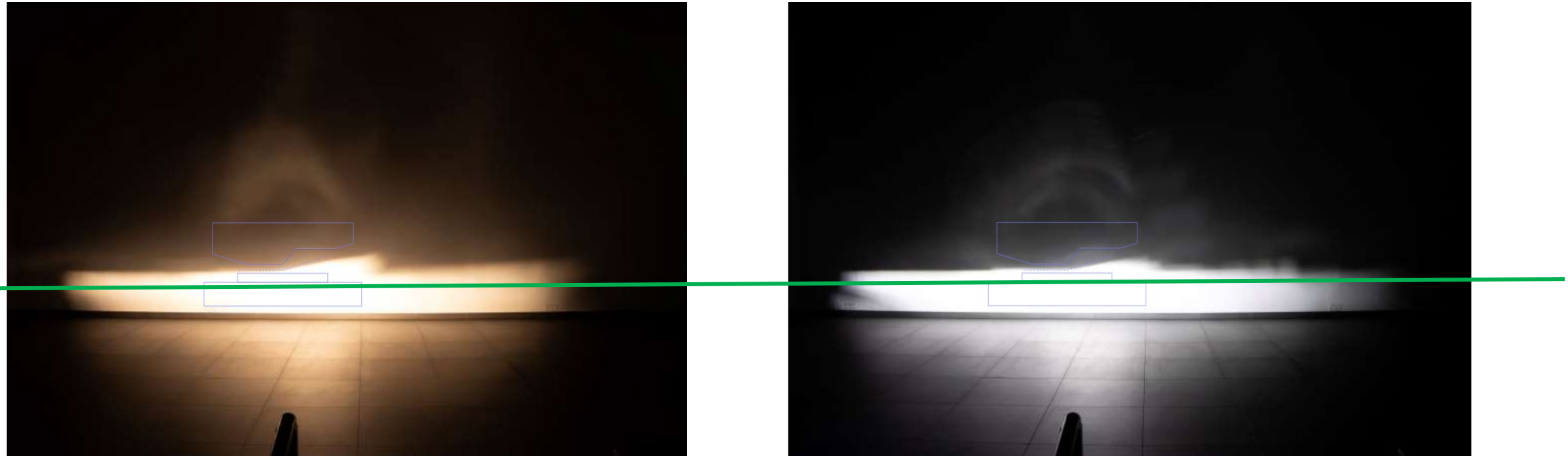
Summary of Part 1 of the lab demo

- Beam patterns can be significantly different (beam appearance and/or color) …
  … between different headlamp types (R112 class B)
  … between Originally-Equipped filament-based and Originally-Equipped LED-based solutions (R112 class B)

- The amount of light outside specified zones and points can vary significantly

Part 2: bi-directional LEDr

H7 halogen *and* *H7 LED replacement*



Headlamp E (one taken from the list of more than a hundred headlamps for which LEDr-use has national approval)

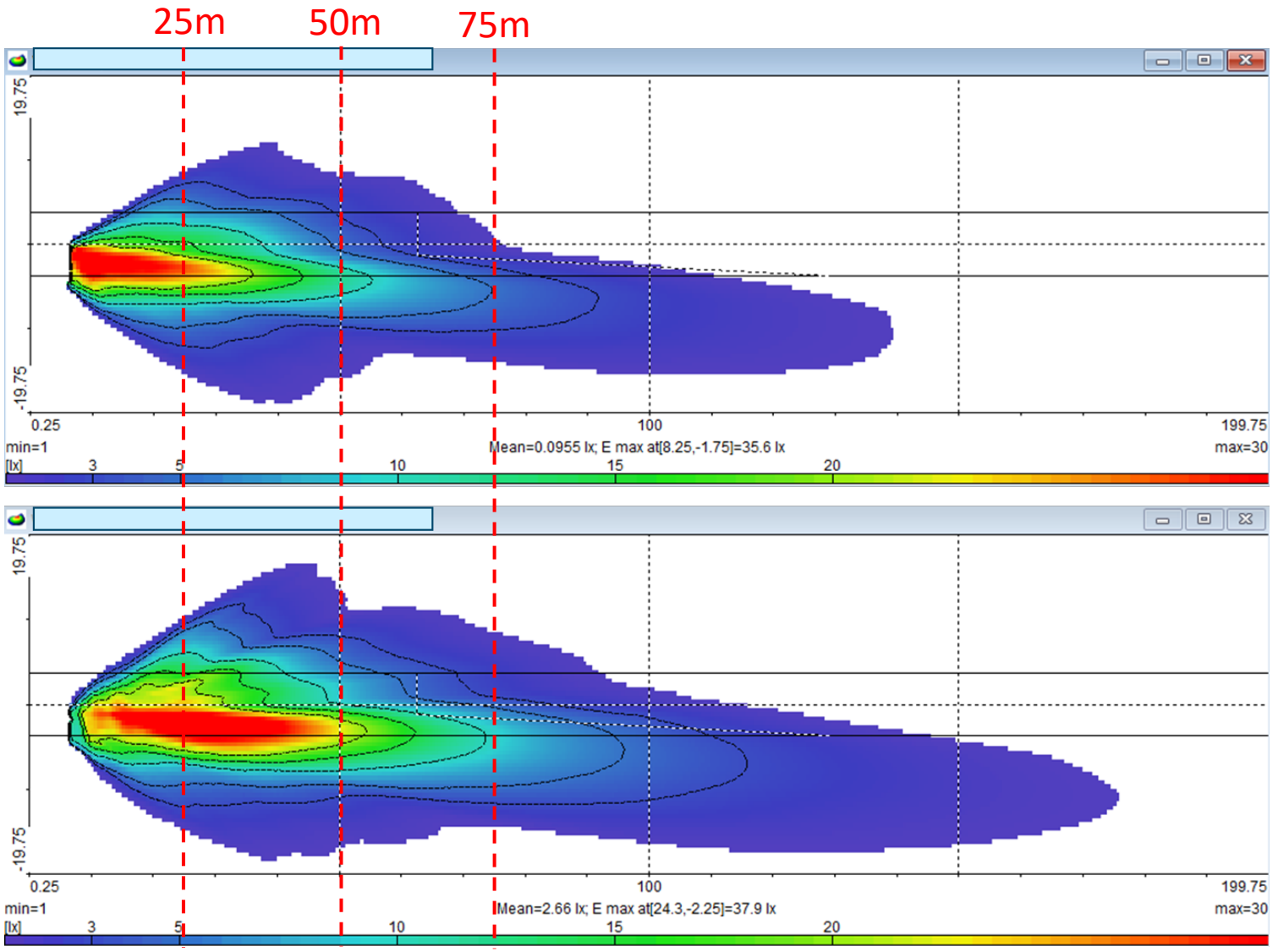
All nationally approved applications meet the R112 photometric requirements

Note: this is a different setting in the lab. The headlamps are mounted at ground floor at ~7 m distant from the wall.

Comparison Halogen and LEDr in an OEM headlamp

H7 Halogen

H7-LEDr



Note: this picture is not taken from the Aachen meeting, but was added based on discussions at TFSR19

Summary of Part 2 of the lab demo bi-directional LEDr

- Both beams (with H7 halogen and H7-LEDr) meet the R112 requirements
- There are no interferences of a bi-directional design to the regulated part of the beam
- Typically, there are changes in the non-regulated part of the beam, e.g. less light in the foreground

Reminder: this is also confirmed by approval tests of hundreds of vehicle types (left and right headlamps), in Germany and France, where bi-directional LEDr generate fully compliant beams

Limited changes in existing H11 (LEDr) category sheet *(WP.29/2021/145)*

Category H11 — Sheet H11_LEDr/1

The drawings are intended only to illustrate the essential dimensions (in mm) of the LED light source.

Figure 1
Main drawings

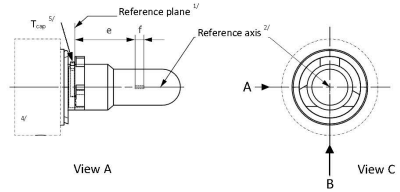
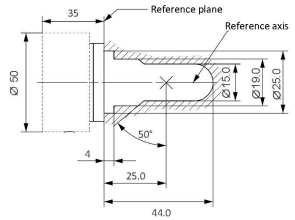


Figure 2
Maximum LED light source outline 3/



1/ The reference plane is the plane formed by the underside of the bevelled lead-in flange of the cap.
2/ The reference axis is perpendicular to the reference plane and passing through the centre of the 19 mm cap diameter.
3/ The LED light source shall not exceed the envelope as indicated in Figure 2.
4/ The light source shall function in either voltage polarity.
5/ Measurement point for cap temperature T_{cap}

Main drawings / dimensions

Keep

Sheet H11_LEDr/2

nal production

61 (sheet 7004-110-3)

24
27 11/
28.0
27 min. 10/
62 max. 11/
120 max. 10/
1000 min. 10/
(at 24-28 V DC)

±10% (at 24V)
±10% (at 28V)

Flux, power, thermal …

Keep

Sheet H11_LEDr/3

t emitting area of the LED
ned relative to the reference

gure 4 when operated at test
Dr/1, Figure 1) and from A
270 (as defined in Figure 6).
from the area(s) as defined

15%

t test voltage,
EDr/1, Figure

hese viewing
the contrast
finition of the

Screen projection

Modify

Sheet H11_LEDr/4

Contrast

Keep

Sheet H11_LEDr/5

stribution of the light source
section of the reference axis
he coordinate system origin.

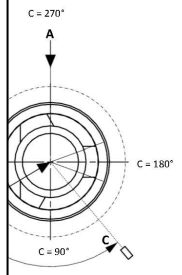
res. The plate is fixed to the
s up with one of the rotating
Figure 6.

easurement distance should
in the far field of the light

rsection coincides with the
es γ are specified in Table 3.

s flux of the individual light
of a 1000 lm light source.

C-Planes and angle γ



View from C

y distributions".

Measurement Set-up

Keep

Sheet H11_LEDr/6

kdm)
270

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s counterpart

kdm)

C_{90} and C_{270})
tive luminous
nt grid points.
oints given in

ee area of its

Intensity requirements

Modify

Sheet H11_LEDr/7

of the

kdm)

ween C_{150} and
s the relative
two adjacent
he grid points

H11 filament
) there is no

See GRE-89-05

Modify

Next steps for TF S/R

- Next meeting of TF S/R to finalise H11 category sheet proposal

➔7 December @12:00 CET hybrid / online only (to be confirmed)

- Submit formal proposal for GRE90 ➔ January

- After approval at GRE90 of H11 bi-directional category sheet
  - Develop proposal for H7-LEDr etc