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

Informal document **GRE-88-13**
(88th GRE, 25 to 28 April 2023,
agenda item 5)

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

Status report for GRE88

19/04/2023

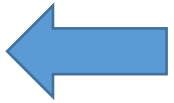
K. Manz, DE (Chairman)

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)



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

Actions completed :

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

Excerpt from GRE-87 report

- Section 15 *(copied and emphasis added)*:

The expert from IEC analysed the approval process of LED replacement light sources according to UN Regulation No. 37 (GRE-87-02), based on the full photometric equivalence according to the guidelines (GRE-83-15). According to him, full-equivalence solutions were not feasible for high flux categories with the today's LED technology. As a consequence, some countries were issuing national approvals deviating from the full photometric equivalence, based on extensive testing (in headlamps and vehicles) for limited light source specifications and resulting in a positive list for particular vehicle models. ***GRE stressed the advantages of harmonization at the United Nations level*** *and noted that* ***several contracting parties were in favour of cautious re-evaluation of the equivalence criteria*** *for LED replacement light sources.* ***GRE invited IEC to start this work as a new activity of the Task Force on Substitutes and Retrofits (TF SR) in cooperation with those contracting parties****.*

- <u>Target of discussion in this Task Force:</u>
  - Create foundation for a converging discussion to achieve LEDr unification in all UNECE countries

The document scope

R37
Filament Light Sources
• By thermal radiation (incandescence) • By LED technology

R99
HID light sources

R128
LED light sources
LED substitute light sources
Excluding LEDr

The fundamental concept of LEDr in R37 is not under discussion

Equivalence Document GRE-83-15

R.E.5 Category sheets
Filament light sources by thermal radiation
LED replacement light sources incl H11, C5W
HID light sources
LED light so…s, including LED substitute light sources

Under discussion is a bi-directional approach for high power LEDr

Reminder:
what is already covered for LEDr in R37 and RE5

- „administrative“ framework for LEDr approval
- Electrical requirements (incl. AE device, if any)
- Thermal requirements
- Mechanical requirements (incl. installation items)
- EMC requirements

→ **These items are NOT under discussion**

→Only certain photometric requirements needs to be re-evaluated to optionally allow a „bi-directional“ emission characteristic

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

1 – "intelligent equivalence" on light source level
(also called "EQ+")

- 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

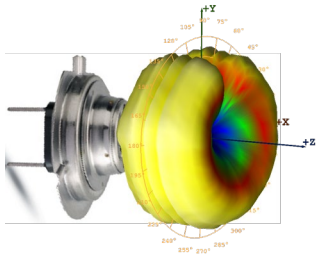
* Mis-use can be addressed via "special measures" to prevent glare , to be discussed further

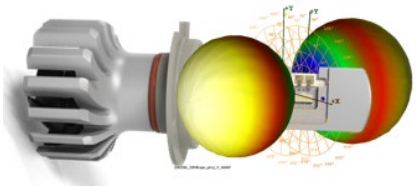
Idea to introduce alternative equivalence specification to allow bi-directional emission

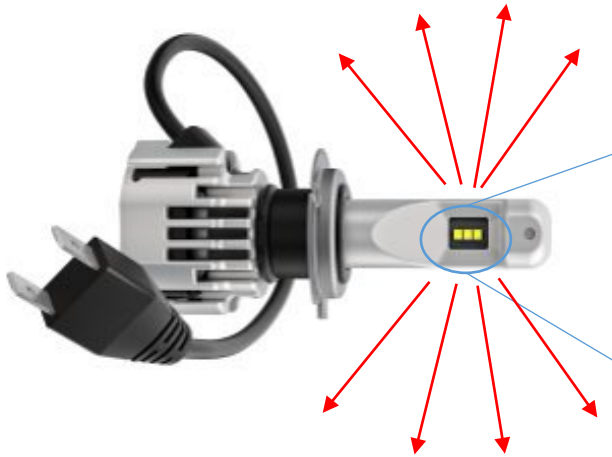
Key elements of the light source specification and PROPOSED amendments to H11_LEDr

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

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

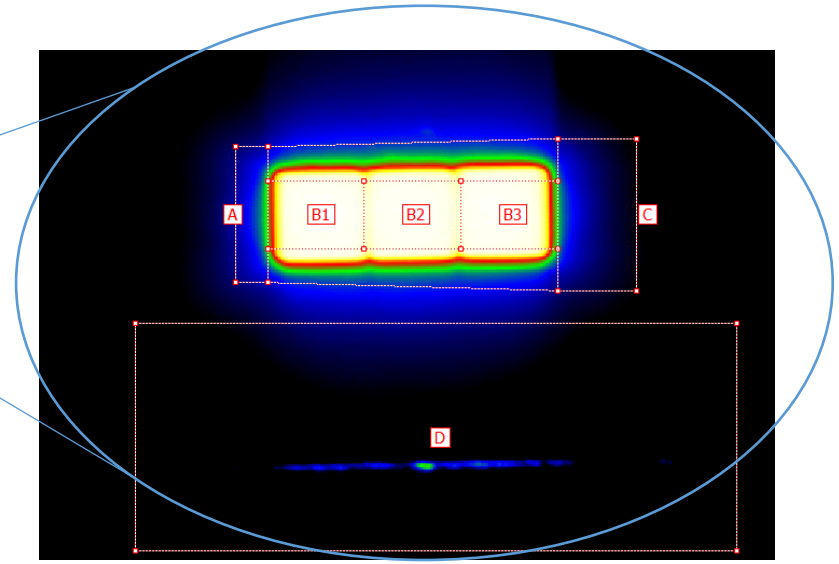






“<u>Near-field</u>” → box and contrast requirements

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



IMPACT on existing H11-LEDr sheet

Under discussion

„Near-field“

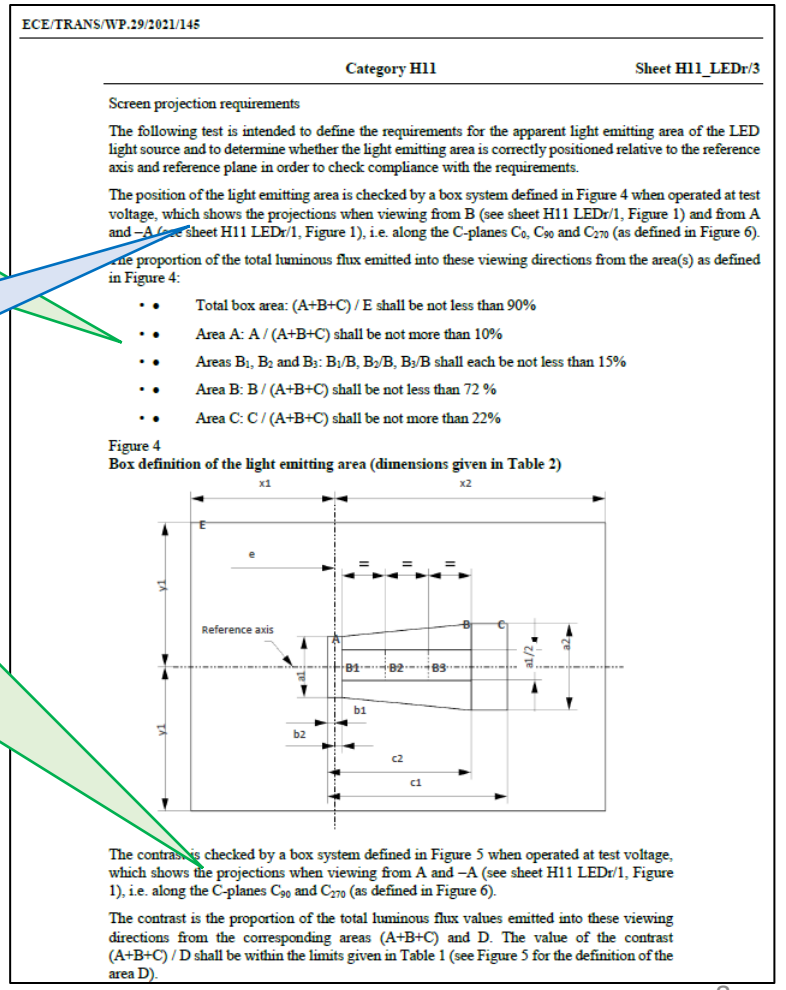
WP.29/2021/145 → Sheet H11_LEDr/3

KEEP all essential characteristics (Table 1) unchanged, especially the box and contrast requirement to avoid glare !

These correspond to the primary (main) directions of emission “A” and “– A”

REMOVE the box requirements
in the secondary (third) direction “B”

In order to maintain relationship between meridional “A” and “–A” emission directions INSERT one new parameter: the spacing parameter “z” describing the “thickness”



ECE/TRANS/WP.29/2021/145

Category H11 **Sheet H11_LEDr/3**

Screen projection requirements

The following test is intended to define the requirements for the apparent light emitting area of the LED light source and to determine whether the light emitting area is correctly positioned relative to the reference axis and reference plane in order to check compliance with the requirements.

The position of the light emitting area is checked by a box system defined in Figure 4 when operated at test voltage, which shows the projections when viewing from B (see sheet H11 LEDr/1, Figure 1) and from A and –A (see sheet H11 LEDr/1, Figure 1), i.e. along the C-planes C_0, C_{90} and C_{270} (as defined in Figure 6).

The proportion of the total luminous flux emitted into these viewing directions from the area(s) as defined in Figure 4:

- Total box area: (A+B+C) / E shall be not less than 90%
- Area A: A / (A+B+C) shall be not more than 10%
- Areas B_1, B_2 and B_3: B_1/B, B_2/B, B_3/B shall each be not less than 15%
- Area B: B / (A+B+C) shall be not less than 72 %
- Area C: C / (A+B+C) shall be not more than 22%

Figure 4
Box definition of the light emitting area (dimensions given in Table 2)

The contrast is checked by a box system defined in Figure 5 when operated at test voltage, which shows the projections when viewing from A and –A (see sheet H11 LEDr/1, Figure 1), i.e. along the C-planes C_{90} and C_{270} (as defined in Figure 6).

The contrast is the proportion of the total luminous flux values emitted into these viewing directions from the corresponding areas (A+B+C) and D. The value of the contrast (A+B+C) / D shall be within the limits given in Table 1 (see Figure 5 for the definition of the area D).

IMPACT on existing H11-LEDr sheet

Under discussion

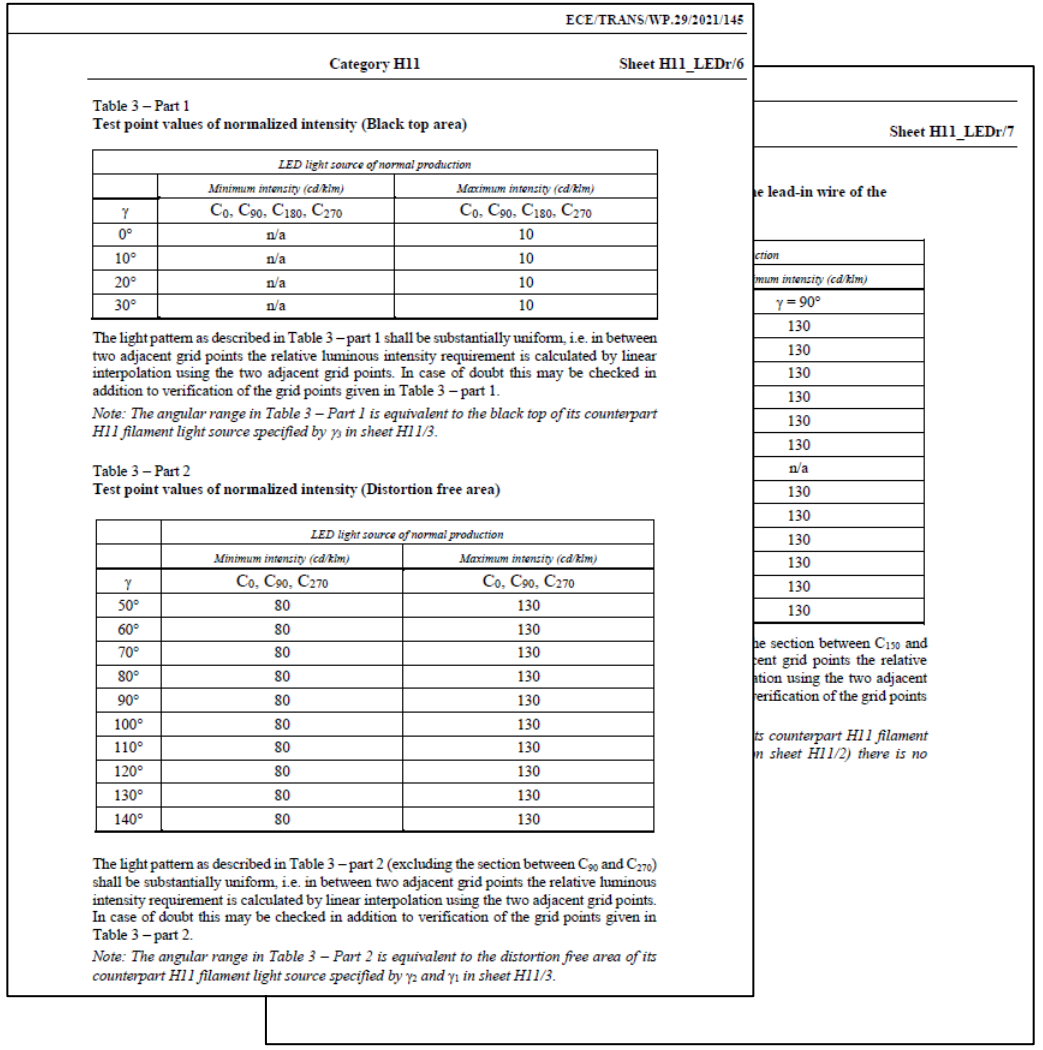
„Far-field“

WP.29/2021/145 → Sheets H11_LEDr/6 and /7

ALLOW more light in the main emission directions (angular range of “A”, “–A” and close-by) and REDUCE intensity requirement for secondary directions (angular range of “B” and close-by)

This would make it possible to take **full advantage of LED technology**

In a nutshell: “shift” some light from less used directions to directions more relevant for beam shaping.



ECE/TRANS/WP.29/2021/145

Category H11 Sheet H11_LEDr/6

Table 3 – Part 1
Test point values of normalized intensity (Black top area)

	LED light source of normal production	
	Minimum intenzity (cd/klm)	*Maximum intenzity (cd/klm)*
γ	C_0, C_{90}, C_{180}, C_{270}	C_0, C_{90}, C_{180}, C_{270}
0°	n/a	10
10°	n/a	10
20°	n/a	10
30°	n/a	10

The light pattern as described in Table 3 – part 1 shall be substantially uniform, i.e. in between two adjacent grid points the relative luminous intensity requirement is calculated by linear interpolation using the two adjacent grid points. In case of doubt this may be checked in addition to verification of the grid points given in Table 3 – part 1.

Note: The angular range in Table 3 – Part 1 is equivalent to the black top of its counterpart H11 filament light source specified by γ_3 in sheet H11/3.

Table 3 – Part 2
Test point values of normalized intensity (Distortion free area)

	LED light source of normal production	
	Minimum intenzity (cd/klm)	*Maximum intenzity (cd/klm)*
γ	C_0, C_{90}, C_{270}	C_0, C_{90}, C_{270}
50°	80	130
60°	80	130
70°	80	130
80°	80	130
90°	80	130
100°	80	130
110°	80	130
120°	80	130
130°	80	130
140°	80	130

The light pattern as described in Table 3 – part 2 (excluding the section between C_{90} and C_{270}) shall be substantially uniform, i.e. in between two adjacent grid points the relative luminous intensity requirement is calculated by linear interpolation using the two adjacent grid points. In case of doubt this may be checked in addition to verification of the grid points given in Table 3 – part 2.

Note: The angular range in Table 3 – Part 2 is equivalent to the distortion free area of its counterpart H11 filament light source specified by γ_2 and γ_1 in sheet H11/3.

Sheet H11_LEDr/7

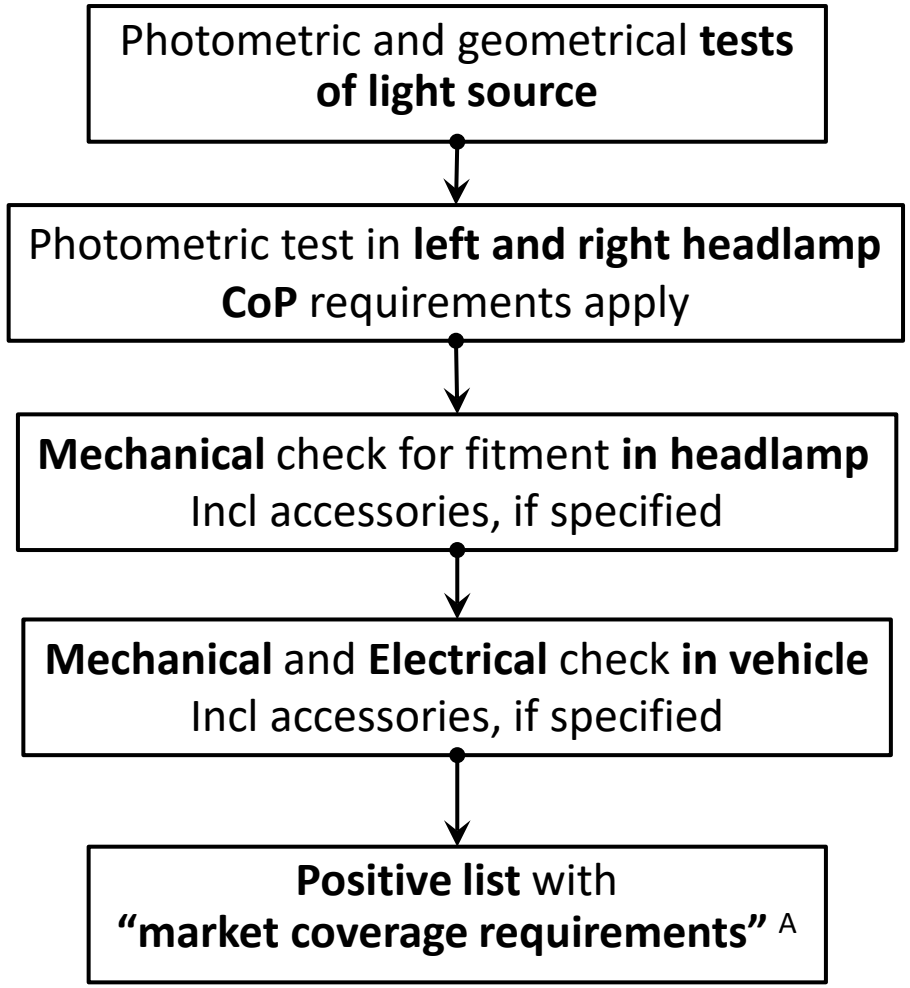
…e lead-in wire of the

…ction	
…mum intenzity (cd/klm)	
γ = 90°	
130	
130	
130	
130	
130	
130	
n/a	
130	
130	
130	
130	
130	
130	

…e section between C_{150} and …ent grid points the relative …ation using the two adjacent …erification of the grid points

…ts counterpart H11 filament …n sheet H11/2) there is no

National Approvals :
TARGET: Aligned between France and German
(and based on German approval: Austria, Czech Republic, Croatia)



[A] French law requires 20% carpark coverage of registered vehicles in between [2013] to [2023] with this light source

French legal text:
« Les véhicules choisis pour les essais doivent être représentatifs et correspondre à au moins 20 % des véhicules immatriculés dans le parc français, sur une plage temporelle de 10 ans précédant la demande de réception. Cette liste est confidentielle entre le demandeur et le ministère et service technique en charge de la réception nationale. »

"The vehicles chosen for the tests must be representative and correspond to at least 20% of the vehicles registered in the French fleet, over a period of 10 years preceding the acceptance request. This list is confidential between the applicant and the ministry and technical service in charge of national reception."

Next steps

- Meeting in June – week of 12 June – exact date to be confirmed by GRE