Submitted by the experts from IEC

Informal document GRE-82-45
(82nd GRE, 22-25 October 2019,
agenda Item 5)

# Supporting document for GRE/2019/21

2019-10-24

W. Schlager, Ph. Plathner

Extract from GRE/2019/21

| | | | | | |
|---|---|---|---|---|---|
| | Power | Watts | 21 max. | 21 max. | 21 max. |
| Objective values | Electrical current | mA | 350 min.<br>1750 max.<br>(at 9-16 V DC) | 175 min.<br>875 max.<br>(at 16-32 V DC) | 350 min.<br>1750 max.<br>(at 9-16 V DC) |
| | Luminous flux [1/ 3/] (at test voltage) | lm | 1,350 ± 10% | 1,350 ± 10% | 1,350 ± 10 % |
| | Luminous flux [1/] | lm | 270 min.<br>(at 9 V DC) | 150 min.<br>(at 16 V DC) | 270 min.<br>(at 9 V DC) |

[1/] The light emitted shall be white without a correlated colour temperature restriction.
[2/] To be checked by means of a "box system", sheet H11/LED/3
[3/] The value measured at elevated ambient air temperature of 60°C shall be at least 70% of this value
[4/] In case of a failure of any of the light emitting elements (open circuit failure), the LED light source shall either still comply to the requirements concerning luminous flux and luminous intensity distribution or stop emitting light whereby, in the latter case, the electrical current draw, when operated between 12 V and 14 V, shall be less than 100 mA
[5/] In case of a failure of any of the light emitting elements (open circuit failure), the LED light source shall either still comply to the requirements concerning luminous flux and luminous intensity distribution or stop emitting light whereby, in the latter case, the electrical current draw, when operated between 24 V and 28 V, shall be less than 50 mA
[6/] The contrast is the proportion of luminous flux originating from two different areas, see details in sheet H11/LED/3

Questions on footnote 3, raised during GRE82:

- #1: Justification for choosing elevated ambient air temperature of 60°C
- #2: Justification for choosing luminous flux limit of at least 70%

# #1: Justification for elevated ambient air temperature of 60°C

- The temperature of 60°C was chosen to make this light source suitable for applications that require an ambient temperature range up to 60°C, e.g. electric cars, motorcycles, …
- During the design-in of an H11 solution, the set-maker and carmaker decide, whether the substitute option with 60°C temperature range is suitable (or not)

  ***Note 1: the use of an LED substitute is optional / voluntary and is subject to dual approval***

- As LED technology is expected to develop further, categories with higher ambient temperature range can be defined in future (using the interlock to prohibit interchangeability)

  ***Note 2: the 60°C proposal reflects current state-of-the-art (given the specified cap size)***

# #2: Justification for 70% luminous flux limit

The choice of the luminous flux limit of at least 70% is supported by:

- Lumen ratio of other LED (substitute) categories in R.E.5 at elevated temperature
- Life-time definition in IEC 60810 for LED light sources
- Luminous flux maintenance in SAE J2560 for halogen light sources

- Real world conditions

# Example for defined temperature ranges in R.E.5 today

| Category in UNECE | Temperature range up to … | Luminous flux limit |
|---|---|---|
| PY21W/LED | 80°C | 65% |
| W5W/LED | 80°C | 70% |
| WY5W/LED | 80°C | 70% |
| C5W/LED | 80°C | 70% |
| R5W/LED | 80°C | 70% |

**Example: C5W/LEDK**

| | | |
|---|---|---|
| Objective values | Watts | 2 max. |
| | Electrical current (in mA at 9-16V DC) | |
| | Luminous flux [3/] (in lm at 13.5 V DC) | 45 ± 20 % [4/] |
| | Luminous flux [3/] (in lm at 9 V DC) | 9 min. |

1 This dimension corresponds to a distance between two apertures of 3.5 mm diameter each bearing against one of the caps.

2 To be checked by a "box system", see Figure 2.

3 The light emitted from LED light source shall be white, without a correlated colour temperature restriction.

4 The value measured at elevated ambient air temperature of 80°C shall be at least 70% of this value.

5 In case of a failure of any of the light emitting elements, the LED light source shall either still comply to the requirements concerning luminous flux and luminous intensity distribution or stop emitting light whereby in the latter case the electrical current draw, when operated between 12 V and 14 V, shall be less than 10 mA.

# IEC 60810 lifetime for LED light sources → L70*

### 7.3 Luminous flux and colour maintenance

The luminous flux maintenance value $L_{70}$ and the colour maintenance shall be measured on a test quantity of at least 20 LED light sources according to the procedure given in Annex I.

For very small production batches, a test quantity less than 20 may be acceptable.

The manufacturer shall declare and determine the $L_{70}B_{10}$ values.

The measured values shall be not less than the value declared by the manufacturer.

For LED light sources which fulfil the requirements of the corresponding category sheet of R.E.5, the $L_{70}B_{10}$ values shall be not less than those specified in Table 5.

*The lifetime of a LED light source is defined as the time it takes until its light output, or lumen maintenance, reaches 70% of the initial output. This is called L70.



**Table 5 – Minimum $L_{70}B_{10}$ values for replaceable LED light sources**

| Category according to R.E.5 | Minimum $L_{70}B_{10}$ h |
|---|---|
| LR1 | 2 200 [ml]<br>1 000 [ma] |
| LW2 | 4 000 |
| LR3A, LR3B | 1 000 |
| LR4A, LR4B | 2 200 [ml]<br>1 000 [ma] |
| LR5A, LR5B | 1 000 |
| LW3A, LW3B | 2 200 |
| LW5A, LW5B | 4 000 |
| LY3A, LY3B | 500 [fl] |
| LY5A, LY5B | 500 [fl] |
| L1/6A, L1/6B | 2 000 |

**Key**

[ml] minor function

[ma] major function

[fl] tested in flashing mode, i.e. ON/OFF ratio of 1:1

NOTE In the case of pulse width modulation (PWM) operation, it can be expected that the $L_{70}B_{10}$ value is higher (depending on duty cycle).

# SAE J2560 Halogen Luminous Flux Maintenance

| SURFACE VEHICLE RECOMMENDED PRACTICE | J2560™ | SEP2019 |
|---|---|---|
| | Issued 2007-07<br>Revised 2019-09<br><br>Superseding J2560 JUL2007 | |
| (R) Halogen Light Source Performance Requirements for Motor Vehicle Forward Lighting | | |

6.5 Luminous Flux Requirement

Measured luminous flux for each filament shall be within the tolerance listed in Table 1.

6.6 Luminous Flux Maintenance Requirement

The luminous flux value for single filament light sources or for each filament of two-filament light sources after burning for 70% of design life shall be no less than 70% of the initial luminous flux value.

# Comparison of minimum luminous flux under real world conditions

## H11 Filament light source

1. Objective luminous flux tolerance: - 10% *(see H11 category sheet, 1350 lm ± 10%)*
2. ~ no dependency on ambient temperature: 0% *(typical halogen bulb property)*
3. Lumen maintenance @350 h: - 30% *(see manufacturer information, resp. SAE J2560)* ← **Irreversible !**

→ Worst case *(= min. flux @350h)*: 0,9 · 1,0 · 0,7 → - 37 % of nominal

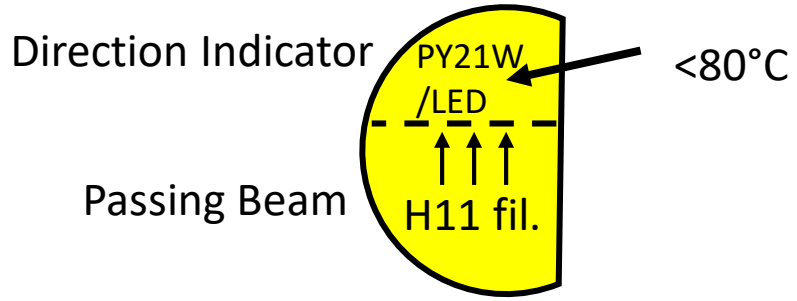
## H11/LED Substitute light source

1. Objective luminous flux tolerance: - 10% *(GRE/2019/21)*
2. Maximum drop at 60°C: -30% *(GRE/2019/21)* ← **Temporarily e.g. when vehicle is stationary**
3. Lumen maintenance @350 h: - 2% *(typical white LED property)*

→ Worst case *(= min. flux @60°C @350h)*: 0,9 · 0,7 · 0,98 → - 38 % of nominal

# Details: why 80°C for LSD application and 60°C for RID application

- For Substitutes like W5W/LEDK or PY21W/LED the “bottom-heating” by a Halogen bulb was taken into account → 80°C




- For H11/LED Substitutes, no “bottom heating”, additionally the significant self-heating of the Halogen bulb removed