Transmitted by the expert from GTB

Informal document **GRE-72-27**
(72nd GRE, 20-22 October 2014,
agenda item 4 (j) (ii))

GTB Document No.
CE-5066
Date: 2014-10-08

# GTB Working Group
# Light Sources

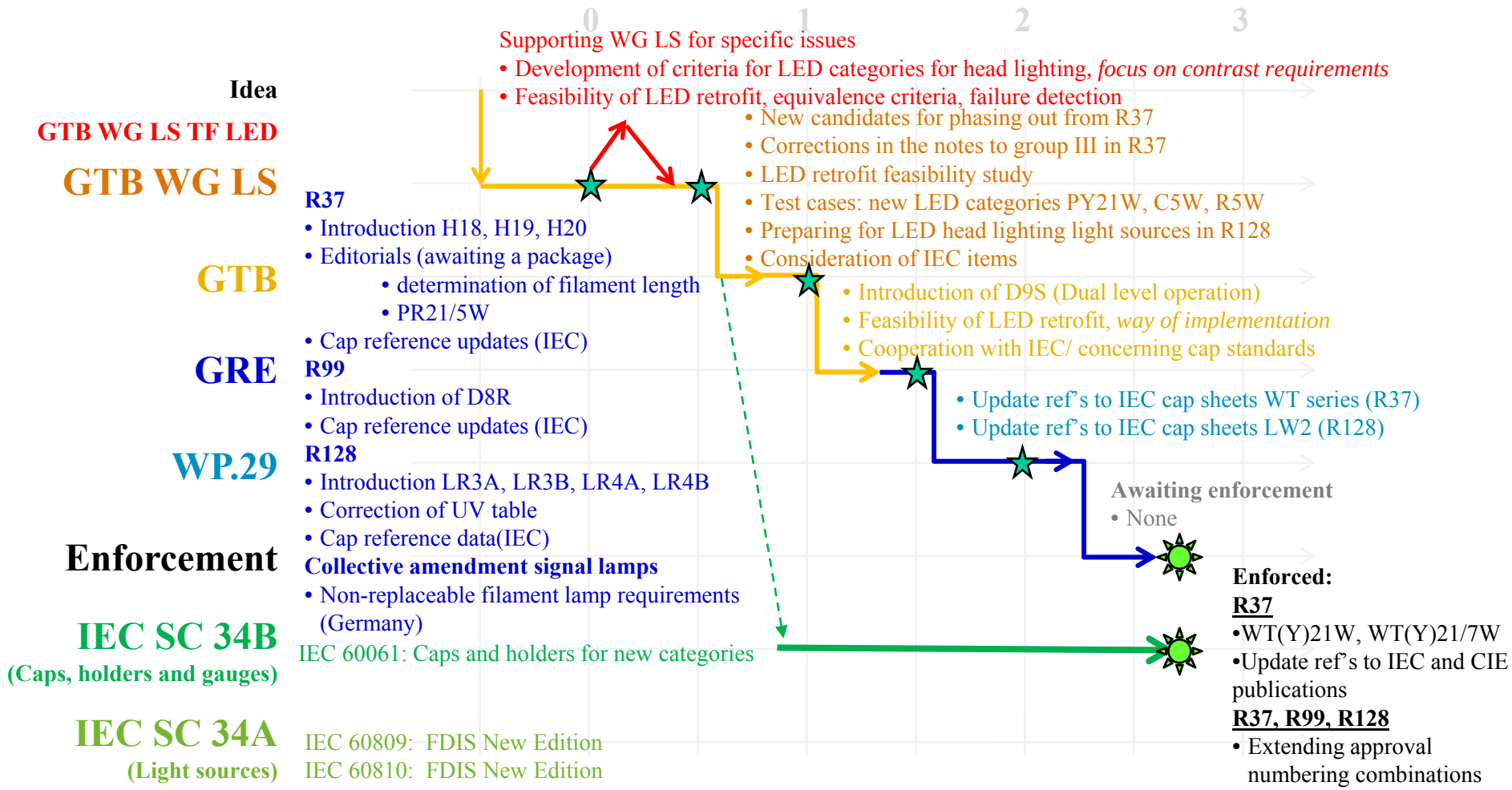
## Status October 2014

# Content

1. Light source work items in the pipeline

2. Progress of the feasibility LED retrofit study

# Light source work items the pipeline



# Progress of the feasibility LED retrofit study

# Reason for the study

## The public

- is stimulated to apply energy saving products in *general* lighting
- is not aware that *automotive* LED retrofits available today are non-approved light sources
- is not aware that many available LED retrofits do not perform and thus compromise traffic safety

There are no legal and approved replaceable LED retrofits as energy saving replacement parts available

GRE-69-41

# LED retrofit in signal lighting

## example

approved filament lamp vs. non-approved LED retrofit

| | | | |
|---|---|---|---|
| ➢ Luminous output: | ok | vs. | not sufficient |
| ➢ Red color: | ok | vs. | ok |
| ➢ Emitter size: | 4mm | vs. | 12mm (too large) |
| ➢ Intensity distribution: | ok | vs. | does not fit to optical system |

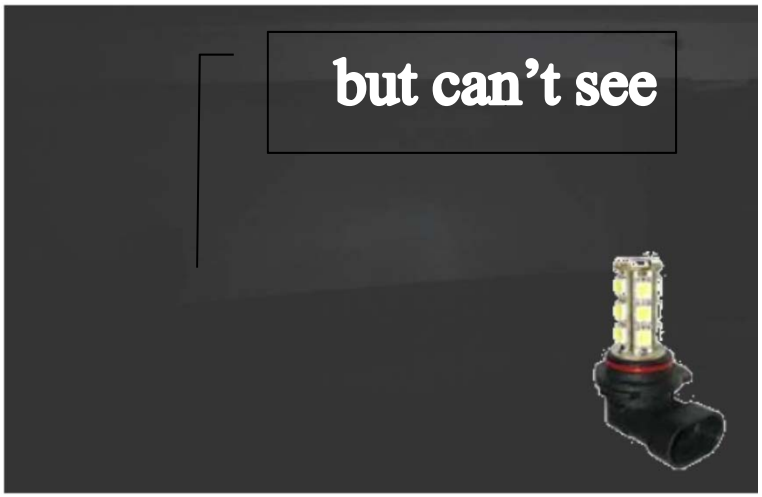
GRE-69-41

# LED retrofit in front lighting

example

approved halogen light source vs. non-approved LED retrofit

looks cool




- Luminous output: 1100lm vs. 67lm
- Color of light: 3200K vs. 9300K (outside boundaries for white)
- Emitter size: 4mm vs. 20mm
- Intensity distribution: circular vs. non-symmetrical

GRE-69-41

# Terms of reference
## work item*

- To investigate feasibility of new LED categories according to R128, as replacement parts for filament light source categories according to R37
- Study should include:
  - The development of equivalence criteria
    - Determine a benchmark of filament lamps to which the LED retrofit should be equivalent within specified tolerances
    - Consider application aspects that are not prescribed by R37, but in other regulations or standards.
    - Select one or two candidate categories to verify such method.
  - An investigation on how to implement retrofit provisions in the relevant UN regulations

*GTB document CE-4792

# Implementation

- An amendment of R128 to allow LED retrofits is in preparation
- LED retrofit categories will need to be defined according to equivalence criteria
- Equivalence criteria may be published as a reference document in the GRE web pages

- Amendment of lamp or installation regulations is considered not necessary

# R128 implementation

*ADMINISTRATIVE PROVISIONS*

"2.3.3. LED retrofit light sources of categories listed in the table for group 4 in annex 1 shall be marked "LED". This mark shall be placed behind the category designation separated by a single blank character, e.g. "P21W LED".

# R128 implementation

*DEFINITIONS*

"3.1.14. LED retrofit light source: LED light source which is an alternative replacement part for a light source of the same light source category but according to another regulation as listed in the table for group 4 in annex 1 to this regulation."

# R128 implementation

*"9. RETROFIT PROVISIONS*

9.1. No LED retrofit light source shall be used for type approval purposes of lamps.

9.2. No LED retrofit light source shall be used for conformity of production control purposes of lamps."

# R128 implementation

## *LED LIGHT SOURCE CATEGORY LISTS*

| | | | |
|---|---|---|---|
| Group 4 | | | |
| LED retrofit light source categories | | | |
| For alternative replacement of light sources of the same category according to Regulation No.37 | | | |
| | | | |
| | Category | | Sheet number(s) |
| | PY21W | | PY21W/1 to 4 |

# R128 implementation

*LED LIGHT SOURCE CATEGORY SHEETS*

Selected test cases

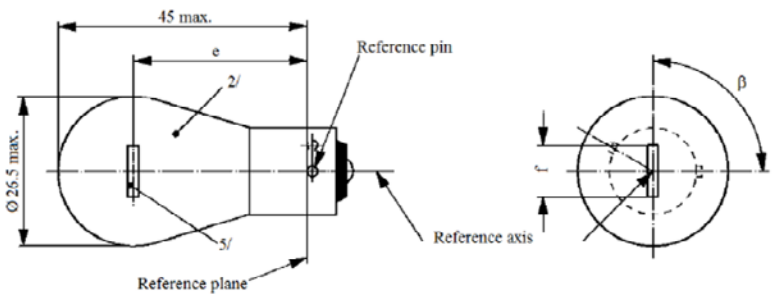
- PY21W LED
- C5W LED
- R5W LED

PY21W
R37

Draft
PY21W
R128

**Category PY21W** **Sheet PY21W/1**

The drawings are intended only to illustrate the essential dimensions (in mm) of the filament lamp




| Dimensions in mm | | Filament lamps of normal production min. | nom. | max. | Standard filament lamp 4/ |
|---|---|---|---|---|---|
| e | 12 V | | 31.8 3/ | | 31.8 ± 0.3 |
| | 24 V | 30.8 | 31.8 | 32.8 | |
| f | 12 V | | | 7.0 | 7.0 +0 / -2 |
| Lateral deviation 1/ | 12 V | | | 3/ | 0.3 max. |
| | 24 V | | | 1.5 | |
| β | | 75° | 90° | 105° | 90° ± 5° |
| Cap BAU15s in accordance with IEC Publication 60061 (sheet 7004-19-2) | | | | | |
| Electrical and photometric characteristics | | | | | |
| Rated values | Volts | 12 | 24 | | 12 |
| | Watts | 21 | | | 21 |
| Test voltage | Volts | 13.5 | 28.0 | | 13.5 |
| Objective values | Watts | 26.5 max. | 29.7 max. | | 26.5 max. |
| | Luminous flux | 280 ± 20 % | | | |
| Reference luminous flux at approximately 13.5 V: | | | | | White: 460 lm<br>Amber: 280 lm |

1/ Maximum lateral deviation of filament centre from two mutually perpendicular planes both containing the reference axis and one containing the axis of the reference pin.
2/ The light emitted from production lamps shall be amber (see also footnote 4/).
3/ To be checked by means of a "Box-System"; sheet P21W/2.
4/ The light emitted from standard filament lamps shall be amber or white.
5/ In this view the filament of the 24 V type may be straight or V-shaped. This shall be indicated in the application of approval. If it is straight, the screen projection requirements, sheet P21W/2, apply. If it is V-shaped, the filament ends shall be at the same distance within ±3 mm from the reference plane.

**Category PY21W** **Sheet PY21W /1**

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

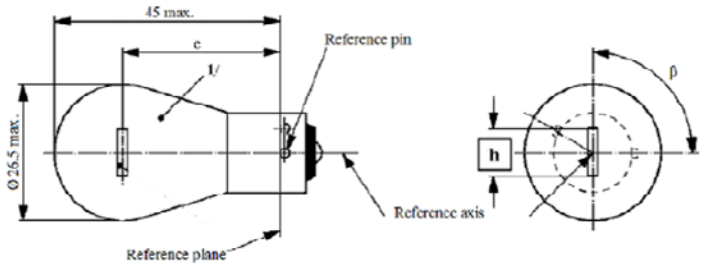



**Figure1: Main drawing**

**Table 1: Essential electrical and photometric characteristics of the LED light source**

| Dimensions in mm | | min. | nom. | max. |
|---|---|---|---|---|
| e | | | 31.8 2/ | |
| h | | | | 9.0 |
| β | | 75° | 90° | 105° |
| Cap BAU15s in accordance with IEC Publication 60061 (sheet 7004-19-2) | | | | |
| Electrical and photometric characteristics | | | | |
| Rated values | Volts | | 12 | 24 |
| | Watts | 7 | | |
| Test voltage | Volts | | 13.5 | 28.0 |
| Objective values | Watts | | 9 max. | 10 max. |
| | Luminous flux | 280 ± 20 % | | |

1/ The light emitted from the lamp shall be amber
2/ To be checked by means of a "Box-System"; sheet PY21W LED/2

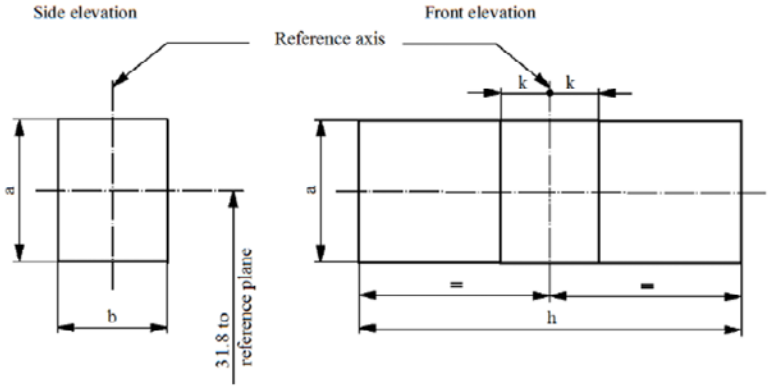
PY21W
R37

Draft
PY21W
R128



Screen projection requirements

This test is used to determine, by checking whether the filament is correctly positioned relative to the reference axis and reference plane and has an axis perpendicular, within ±15°, to the plane through the centre line of the pins (P21W) or of the reference pin (PY21W and PR21W) and the reference axis, whether a filament lamp complies with the requirements.




| *Reference* | *a* | *b* | *h* | *k* |
|---|---|---|---|---|
| Dimension | 3.5 | 3.0 | 9.0 | 1.0 |

Test procedures and requirements

1. The filament lamp is placed in a holder capable of being rotated about its axis and having either a calibrated scale or fixed stops corresponding to the angular displacement tolerance limits. The holder is then so rotated that an end view of the filament is seen on the screen on to which the image of the filament is projected. The end view of the filament shall be obtained within the angular displacements tolerance limits.

2. Side elevation

   The filament lamp placed with the cap down, the reference axis vertical and the filament seen end-on, the projection of the filament shall lie entirely within a rectangle of height "a" and width "b", having its centre at the theoretical position of the centre of the filament.

3. Front elevation

   The filament lamp placed with the cap down and the reference axis vertical, the filament lamp being viewed in a direction at right angles to the filament axis:

3.1. The projection of the filament shall lie entirely within a rectangle of height "a" and width "h", having its centre at the theoretical position of the centre of the filament.

3.2. The centre of the filament shall not be offset by more than distance "k" from the reference axis.



Screen projection requirements

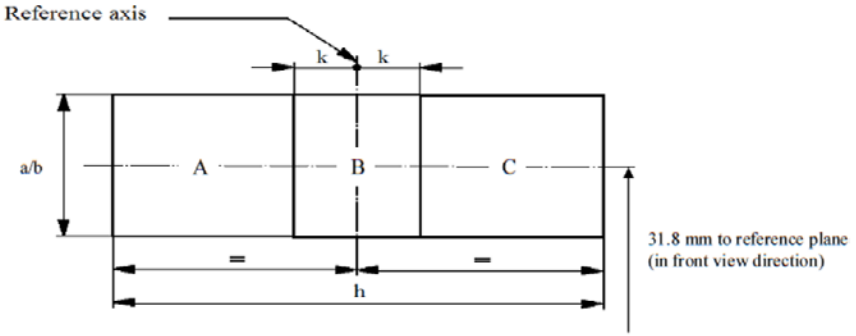
The following test is intended to define the requirements for the apparent light emitting area of the LED retrofit light source and to determine whether the light emitting area is correctly positioned relative to the reference axis and reference plane in order to check compliance with the requirements.

The position of the light emitting area is checked by the box system defined in Figure 2, which shows the projections when viewing along direction $\gamma = 0°$ (top view) and $\gamma = 90°$ (front view) in the plane $C_0$ (C, $\gamma$ as defined in Figure 3).

The proportion of the total luminous flux emitted into the viewing direction from the area(s)

- A, B and C together shall be [80] per cent or more
- B shall be [25] per cent or more
- A and C shall each be [15] per cent or more.

Figure 2: **Box definition of the light emitting area with dimensions as specified in table 2**




The lateral position (in top view direction) of the light emitting area shall be centered in the plane containing the reference axis and being perpendicular to the plane containing the reference axis and the reference pin.

Table 2: **Dimensions of the box system in figure 2**

| *Reference* | *a (front view)* | *b(top view)* | *h* | *k* |
|---|---|---|---|---|
| Dimension | 3.5 | 3.0 | 9.0 | 1.0 |

PY21W
R37

Draft
PY21W
R128



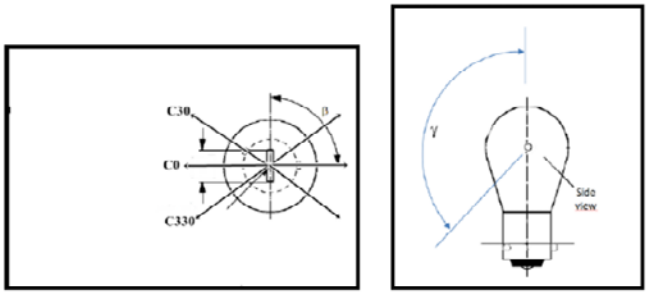
Normalized luminous intensity distribution

The following test is intended to determine the normalized luminous intensity distribution of the light source in the planes containing the reference axis as described in figure 3. The intersection of the reference axis and the edge of the box is used as the coordinate system origin.

The light source is mounted on a flat plate with the corresponding mounting lug features. The plate is mounted to the goniometer table by a bracket, so that the reference axis of the light source lines up with one of the rotating axis of the goniometer.

Luminous intensity data is recorded with a standard photo-goniometer. The measurement distance should be chosen appropriately, to make sure that the detector is located in the far field of the light distribution.

**Figure 3:** Setup to measure the luminous intensity distribution (Definition of C-Planes and angle γ)




The measurements shall be performed in C-planes, which contain the reference axis of the light source. The C-planes shall be $C_0$,$C_{30}$ and $C_{330}$ . The test points for each plane and multiple polar angles γ are specified in Table 3.

After measurement the data shall be normalized to 1000 lm according to paragraph 3.1.11 using the luminous flux of the individual light source under test. The data shall comply with the tolerance band as defined in Table 3.

[C-planes: see CIE publication 70-1987, "The measurement of absolute intensity distributions".]

Table 3: **Test point values of normalized intensity**

| γ | *C0/30/330 Minimum intensity in cd /1000 lm* | *C0/30/330 Maximum intensity in cd/1000 lm* |
|---|---|---|
| 0° | [60] | [120] |
| 25° | [60] | [120] |
| 50° | [60] | [120] |
| 75° | [60] | [120] |
| 100° | [60] | [120] |
| 125° | [60] | [120] |
| 150° | [60] | [120] |

The luminous intensity distributin as described in table 3 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.

# Equivalence options

- In the lamp; list of lamps and/or instructions for use is published for which performance is proven;
- As light source, universally applicable

The feasibility study is aiming for universally applicable LED retrofits

However....

# Equivalence issues

- Technologies are different
- Filament lamps were specified as much as possible performance based *as filament lamp*
- Thus some parameters are not specified because they are implicitly given within the boundaries of the technology and (specified) characteristics necessary for safety and replacement
- In another technology these are different and need specification

# Equivalence parameters

R37

R128

Some Parameters:

- Shall be the same
- Shall be similar within tolerances
- Are unavoidably different due to physical characteristics of the different technologies
- Parameters are necessarily specified for one but not for the other technology

See backup material for details

# Equivalence

## Study status update

- Fully universally applicable LED retrofits are impossible unless major benefits of the LED technology are given up (lower wattage*)
- Approved LED retrofits can be specified in R128 to a high degree of universal application
- For some characteristics (wattage*) a list of lamps and/or instructions for use is unavoidable

  * Due to the lower wattage, failure detection systems may fail to function normally; such systems are not standardized

# Non-fully universally applicable LED retrofits

## Option for a solution

Under consideration is the way as child seats are approved and marked according to Regulation No. 44 with categories:

- Universal
- Restricted
- Semi-universal
- Specific vehicle


This Child Restraint is classified for "(Restricted/Semi-universal)" use and is suitable for fixing into the seat positions of the following cars:

| CAR | FRONT | REAR | |
|---|---|---|---|
| | Outer | Centre | |
| (Model) | Yes | Yes | No |

Seat positions in other cars may also be suitable to accept this child restraint. If in doubt, consult either the child restraint manufacturer or the retailer.

We would appreciate your valuable input and guidance.

THANK YOU

# BACKUP MATERIAL

# Equivalence parameters

# The same parameters

- the cap (IEC 60061)
- maximum outline dimension
- electrical connector
- test voltage
- luminous flux
- colour of the light
- light centre length
- distortion free zone

# Similar parameters

- luminous intensity distribution
- size and position of the light-emitting-area
- homogeneity of the light-emitting-area

# Different parameters

- maximum electrical power consumption
- minimum voltage range
- spectral content

# Additional parameters

- thermal behaviour

END