

**GTB**

# **Introduction into Regulation 128 of LED Substitute Light Sources**

# Introduction

“**LED substitute light source**” means a LED light source of a category which has a counterpart light source category producing light by another light generating technology.”

## Application:

Original Manufacturer installation on vehicles approved for use of these light sources:

a) Either initial approval

*or*

b) after approval extension for device and/or for vehicle

# Path to LED Substitute Light Sources

- Public is stimulated by governments to use energy efficient LED light sources that fit in existing holders for general illumination (LED retrofit light sources)
  - Lack of public awareness about LED retrofits for automotive exterior lighting:
    - Lamps may be out of compliance
    - Prohibitions by many jurisdictions
  - GTB feasibility study into LED Retrofits
    - Outcome:
      - photometry aspects OK
      - electrical and software configurations of vehicles in use are not standardized
      - Installation is subject to national law
      - Progress reports to GRE (GRE-69-41, GRE-70-47, GRE-72-27 and GRE-73-24)
    - Consequence: GTB abandoned LED retrofit light sources
- New approach: LED substitute light sources, intended for use in lamps on vehicles **approved** for using such light sources.

# LED Substitute Light Source Approach

## Principle

### Approval:

- lamps may be approved with a filament light source and its **corresponding** LED substitute light source, fitting in the **same** holder, and providing **equivalent** photometric performance

### Testing:

- Lamps equipped with LED substitute light sources shall be tested with **both** the filament lamp and the LED substitute light source

### Installation:

- Vehicles equipped with these lamps shall be declared ready for installation of such lamps, in particular in view of failure detection systems

# Proposed Changes to Regulations

## Regulation 128

- Add LED Substitute light sources

## Consolidated Resolution R.E.5 :

- Add LED Substitute light source category sheets

Need to guarantee correct operation of both lamp and vehicle in cases where use of LED substitute light sources was not foreseen during the original design

- Amendments to device regulation
- Amendments to installation regulations

# Related Documents

Document	Topic
GRE/2017/02	Proposal for Supplement 7 to the original version of Regulation No. 128 (Light emitting diodes light sources)
GRE/2017/03	Proposal for amendments to the original version of the Consolidated Resolution on the common specification of light source categories
GRE/2017/04	Proposal for a collective amendment to Regulations Nos. 48 (Installation of lighting and light-signalling devices), 53 (Installation of lighting and light-signalling devices for L3 vehicles), 74 (Installation of lighting and light-signalling devices (mopeds)) and 86 (Installation of lighting and light signalling devices for agricultural vehicles)
GRE-77-02	Equivalence criteria for LED substitute light source categories as equivalents for corresponding filament light source categories
GRE-77-03	Substitute light sources: equivalence reports for C5W, PY21W, and R5W
GRE-77-07	Request for guidance
GRE-77-15	Draft Proposal to introduce requirements for the use of LED substitute light sources in the new Regulation for "Light signalling devices"

# Document Package with [3] Parts

## Part 1

### Light Source Requirements

R128 body text

➤ GRE/2017/02

R.E.5 Category Sheets:

- C5W/LED
- PY21W/LED
- R5W/LED

➤ GRE/2017/03

➤ GRE-77-02

➤ GRE-77-03

## Part 2

### Device Requirements

GTB Request for Guidance

➤ GRE-77-07

Amendments to new Regulation for "Light signalling devices"

➤ GRE-77-15

## Part 3

### Installation Requirements

Collective Amendment to

- Reg 48
- Reg 53
- Reg 74
- Reg 86

➤ GRE/2017/04

# Part 1

## Light Source Requirements



# Regulation 128 + Consolidated Resolution Changes

- Regulation 128: ([GRE/2017/02](#))
  - Allowance of LED substitute light source and related provisions
- Resolution R.E.5.: ([GRE/2017/03](#))
  - Definition of LED substitute light source
  - 3 new category sheets C5W/LED, PY21W/LED and R5W/LED based on LED technology
- Equivalence criteria as guidance for specifying sheets for LED substitute light source categories. ([GRE-77-02](#)).
- Equivalence reports for new categories C5W/LED, PY21W/LED and R5W/LED ([GRE-77-03](#))

# LED Substitute: Technical Characteristics

## Compared to filament “original”

- Same cap
- Same luminous flux
- Same colour
- Same external dimensions
- Equivalent near-field distribution
- Equivalent far-field distribution
- Lower power consumption (about 1/3)

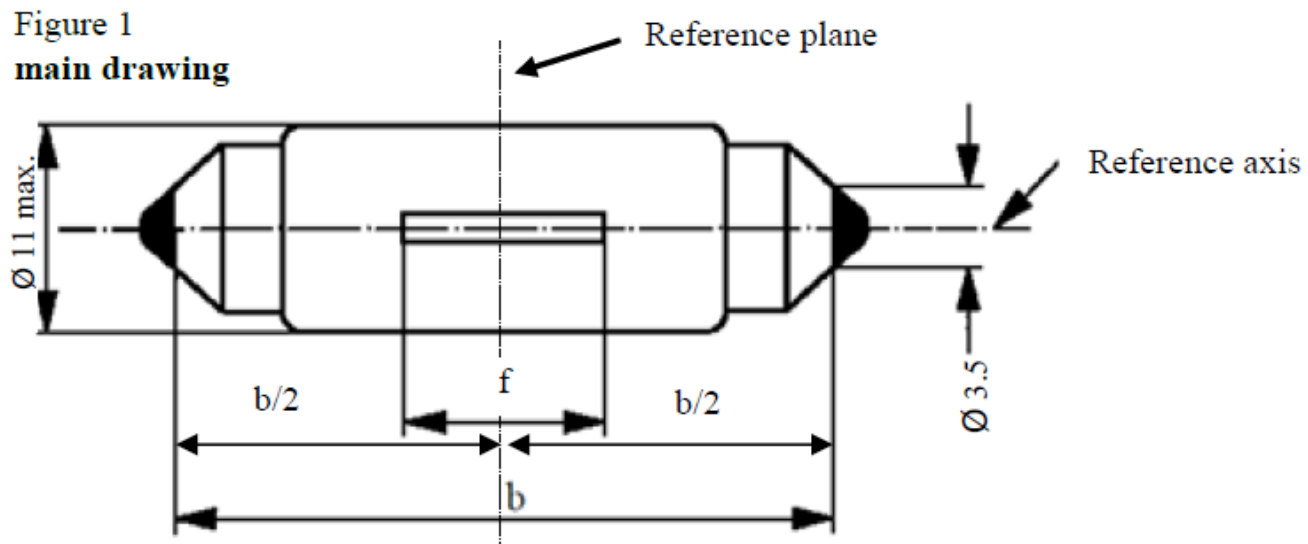
## In addition:

- Voltage range: 12 to 14V
- Flux at 9V
- Flux at 80°C
- 1min/30min ratio
- Min and max electrical current
- Max 50mA in case of failure
- No light during 2 ms pulse
- R10 compliant (EMC)
- For white light sources:
  - < 3000K for universal use
  - > 3000K for white functions only

# Amendment to Resolution

## For inclusion in Resolution R.E.5

➤ C5W/LED shown:



# Amendment to Resolution

For inclusion in Resolution R.E.5

➤ C5W/LED shown:

Table 1

Essential electrical and photometrical characteristics of the LED light source

Dimensions in mm		LED light sources of normal production			Standard LED light source
		min.	nom.	max.	
b	<sup>1/</sup>	34.0	35.0	36.0	35±0.5
e	<sup>2/</sup>		0.0		0.0
f	<sup>2/</sup>		9.0		9.0
Cap SV8.5 in accordance with IEC Publication 60061 (sheet 7004-81-4)					
Electrical <sup>5/</sup> and photometric characteristics					
Rated values	Volts	12			12
	Watts	2			2
Test voltage	Volts	13.5			13.5
Objective values	Watts	2 max.			2 max.
	Electrical current (in mA at 9-16V DC)	75 min. 170 max.			
	Luminous flux <sup>3/</sup> (in lm at 13.5 V DC)	45 ± 20 % <sup>4/</sup>			45 ± 10 % <sup>4/</sup>
	Luminous flux <sup>3/</sup> (in lm at 9 V DC)	9 min.			9 min.

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

<sup>2/</sup> to be checked by a "box system", see Figure 2

<sup>3/</sup> The light emitted from LED light source shall be white

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

<sup>5/</sup> 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 25 mA

# LED-technology Specific Requirements

Requirements specific to LED substitute light sources:

- “G” marking of white LED substitute light sources of a correlated colour temperature up to 3000 K to maintain colour quality and luminous intensity in lamps with colour filters (e.g. direction indicator lamps, stop lamps)
- Electrical current specification for failure detection and on-board diagnostics (OBD) systems, to allow clear interface definition
- Compliance with the technical requirements to an electrical/electronic sub-assembly (ESA) as specified by Regulation No. 10
- Delay in light-up (2 ms) after activation to avoid visible signals on vehicles that feature cold life testing
- Additional higher ambient temperatures for testing (specified in Category sheet) to satisfy the difference in thermal behavior, between LEDs and filament light sources

# Part 2

## Device Requirements

# Device Regulation

## Main Changes

- Use of LED substitute light source(s) is allowed and no change of the lamp type
  - Device approval with LED substitute under same approval number
- Device approval with LED substitute only possible if device approval with filament exists
- Device CoP testing with (étalon) filament light source only (because of equivalent photometrical lamp performance)
- Use of LED substitute light sources is at the discretion of the applicant:
  - to be declared to Approval Authorities
  - documented in communication form (both filament and LED substitute)
- Marking of both light source category names (original + substitute) on device
- Installation allowance is checked using the device marking at type approval and CoP verification
- “G” marking (LED substitute light source and device) in case of LED substitute in device with colour filter(s) to ensure correct colour and luminous intensity
- Usage restrictions of R128 already referenced in device regulations, existing text

# Lamp Approval

## R7 as Example with P21W and P21W/LED

### STEP 1: filament “original”

- Etalon (standard) P21W
  - 23C ambient temperature around the lamp
  - 13.5V to the filament light source
  - Measure photometry
  - Apply correction factor (or adjust voltage/current)
  - R7 Photometry fulfilled
- > approval valid for P21W

### STEP 2: LED substitute

- Etalon (standard) P21W/LED
  - 23C ambient temperature around the headlamp
  - 13.5V to the LED light source
  - Measure photometry
  - Apply correction factor
  - R7 Photometry fulfilled (1min and 30min)
- > approval valid for P21W/LED



Marking:  
P21W and P21W/LED



Filament original  
R37



LED substitute  
R128



# Device Regulation Amendments

- Informal document **GRE-77-15**:
  - Illustration of LED substitute related amendments in draft LSD regulation

Subject to discussion of “GTB Request for Guidance” (**GRE-77-07**)

# Part 3

## Installation Requirements

# Proposal for a collective amendment to Regulations Nos. 48, 53, 74 and 86

## Same changes (except for paragraph numbering) to:

- Regulation 48 (all series of amendments 03, 04, 05 and 06)
- Regulation 53
- Regulation 74
- Regulation 86\*\*

\*\* update definition for “Light source” in accordance with one present in the Consolidated Resolution R.E.5.

# Regulations Nos. 48, 53, 74 and 86

## Main Changes

A. The **definition** of “LED substitute light source”

# Regulations Nos. 48, 53, 74 and 86

## Main Changes

### A. Definition for LED substitute light source:

**“2.7.1.1.8. *“LED substitute light source”* means a LED light source of a category which has a counterpart light source category producing light by another light generating technology.”**

***Example shown for Reg. 48 (06 series)***

# Regulations Nos. 48, 53, 74 and 86

## Main Changes

- A. The **definition** of “LED substitute light source”
  
- B. The **allowance** to use LED substitute light sources
  - Statement in description and communication form of the vehicle
  - When not present need to either:
    - extend vehicle approval
  - Or*
  - specifically forbid the use

# Regulations Nos. 48, 53, 74 and 86

## Main Changes

### B. The allowance to use LED substitute light sources

*Paragraph 3.2.5., amend to read:*

“3.2.5.            ~~The application shall include a~~ statements:

3.2.5.1.        of the method used for the definition of the apparent surface (see paragraph 2.10.);

3.2.5.2.        **whether lamps approved for [and equipped with] LED substitute light sources are allowed to be installed on the vehicle or not and, if this is allowed, which lamps.”**

*Annex 1, insert a new item 9.30., to read:*

“9.30.            **Lamps approved for [and equipped with] LED substitute light source(s) are allowed to be installed on this vehicle type: yes/no<sup>2,3</sup>**

.....  
<sup>3</sup>    **If yes, list the applicable lamps.”**

***Example shown for Reg. 48 (06 series)***

# Regulations Nos. 48, 53, 74 and 86

## Main Changes

- A. The **definition** of “LED substitute light source”
  
- B. The **allowance** to use LED substitute light sources
  - Statement in description and communication form of the vehicle
  - When not present need to either
    - extend vehicle approval
  - Or*
  - specifically forbid the use
  
- C. Compliance **verification**:
  - For type approval and for Conformity of Production (CoP)
  - Check LED substitute light source marking on device



# Regulations Nos. 48, 53, 74 and 86

## Main Changes

### C. Compliance verification:

*Insert a new paragraph 5.30., to read:*

**“5.30. The use of lamps approved for [and equipped with] LED substitute light source(s), is allowed exclusively in the case where the statement indicated in paragraph 3.2.5.2. is present and positive.**

**To verify that this statement is respected, both at the type approval and in the conformity of production verification, the [presence of the marking on the lamps related to the use of LED substitute light source(s)] shall be checked.”**

***Example shown for Reg. 48 (06 series)***

# Sequence to approve a lamp with a LED substitute light source and to allow its installation on a vehicle

Lamp originally approved for filament light source(s) only	Installation in case of:	Vehicle approved without any statement on allowance of light source(s).	OK			No statement on light source(s).			
		Vehicle approved allowing installation of lamps with filament light source(s) only.	OK				Filament light source(s) only.		
		Vehicle approved allowing installation of lamps with both filament and LED substitute light source(s).	OK				Extended for LED substitute light		
Lamp approval extended for LED substitute light source(s)	Installation in case of:	Vehicle approved allowing installation of lamps with both filament and LED substitute light source(s).	OK			Both light source(s)			
		Vehicle approved without any statement on allowance of light source(s).	NOT OK				Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approval <b>extended</b> allowing installation of lamps with both filament and LED substitute light source(s).	OK
		Vehicle approved allowing installation of lamps with filament light source(s) only.	NOT OK				Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approved <b>extended</b> allowing installation of lamps with filament light sources only.	NOT OK
Lamp originally approved for both filament and LED substitute light source(s)	Installation in case of:	Vehicle approved allowing installation of lamps with both filament and LED substitute light source(s).	OK						
		Vehicle approved without any statement on allowance of light source(s).	NOT OK				Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approval <b>extended</b> allowing installation of lamps with both filament and LED substitute light source(s).	OK
		Vehicle approved allowing installation of lamps with filament light source(s) only.	NOT OK				Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approved <b>extended</b> allowing installation of lamps with filament light sources only.	NOT OK
	Installation in case of:	Vehicle approved allowing installation of lamps with both filament and LED substitute light source(s).	OK						
		Vehicle approved without any statement on allowance of light source(s).	NOT OK				Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approval <b>extended</b> allowing installation of lamps with both filament and LED substitute light source(s).	OK
		Vehicle approved allowing installation of lamps with filament light source(s) only.	NOT OK				Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approved <b>extended</b> allowing installation of lamps with filament light sources only.	NOT OK
	Installation in case of:	Vehicle approved allowing installation of lamps with both filament and LED substitute light source(s).	OK						
		Vehicle approved without any statement on allowance of light source(s).	NOT OK				Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approval <b>extended</b> allowing installation of lamps with both filament and LED substitute light source(s).	OK
		Vehicle approved allowing installation of lamps with filament light source(s) only.	NOT OK				Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approved <b>extended</b> allowing installation of lamps with filament light sources only.	NOT OK

We would appreciate your valuable input and guidance

THANK YOU

END

# Back Up LED Substitute Light Sources

# Sequence to approve a lamp with a LED substitute light source and to allow its installation on a vehicle

Lamp originally approved for filament light source(s) only	Installation in case of:	Vehicle approved without any statement on allowance of light source(s).	OK
		Vehicle approved allowing installation of lamps with filament light source(s) only.	OK
		Vehicle approved allowing installation of lamps with both filament and LED substitute light source(s).	OK

No statement on light source(s).
Filament light source(s) only.
Extended for LED substitute light
Both light source(s)

# Sequence to approve a lamp with a LED substitute light source and to allow its installation on a vehicle

Lamp approval <b>extended</b> for LED substitute light source(s)	Installation in case of:	Vehicle approved allowing installation of lamps with both filament and LED substitute light source(s).	<b>OK</b>			
		Vehicle approved without any statement on allowance of light source(s).	<b>NOT OK</b>	Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approval <b>extended</b> allowing installation of lamps with both filament and LED substitute light source(s).	<b>OK</b>
					Vehicle approved <b>extended</b> allowing installation of lamps with filament light sources only.	<b>NOT OK</b>
		Vehicle approved allowing installation of lamps with filament light source(s) only.	<b>NOT OK</b>	Installation <b>after extension</b> of vehicle approval in case of:	Vehicle approval <b>extended</b> allowing installation of lamps with both filament and LED substitute light source(s).	<b>OK</b>

No statement on light source(s).
Filament light source(s) only.
<b>Extended</b> for LED substitute light
Both light source(s)

# Sequence to approve a lamp with a LED substitute light source and to allow its installation on a vehicle

Lamp originally approved for both filament and LED substitute light source(s)	Installation in case of:	Vehicle approved allowing installation of lamps with both filament and LED substitute light source(s).	OK			
		Vehicle approved without any statement on allowance of light source(s).	NOT OK	Installation <u>after extension</u> of vehicle approval in case of:	Vehicle approval <b>extended</b> allowing installation of lamps with both filament and LED substitute light source(s).	OK
					Vehicle approved <b>extended</b> allowing installation of lamps with filament light sources only.	NOT OK
		Vehicle approved allowing installation of lamps with filament light source(s) only.	NOT OK	Installation <u>after extension</u> of vehicle approval in case of:	Vehicle approval <b>extended</b> allowing installation of lamps with both filament and LED substitute light source(s).	OK

No statement on light source(s).
Filament light source(s) only.
<b>Extended</b> for LED substitute light
<b>Both</b> light source(s)