

LED replacement light sources

Basics

TERMINOLOGY — OVERVIEW

- LED substitute light sources
 - Intended as alternative to incandescent filament light sources in new applications
 - Almost equivalent to the incandescent filament light sources
- LED replacement light sources
 - Intended to replace incandescent filament light sources in existing applications
 - Fully equivalent to incandescent filament light sources
- LED retrofit
 - No longer used for regulated and approved light sources
 - Used in the market for “other” light sources
 - Not standardised
 - Not approved

SITUATION

need for LED replacements

- general lighting
 - energy saving
 - life time
 - consumer have accepted led light sources as replacement
 - sales of incandescent light sources is often forbidden
 - (incandescent) filament technology will be scarcely available
- automotive
 - fewer failure, less exchanges on the vehicle
 - more robust
 - energy saving
 - diverse performance
 - not always permitted
- continued availability of (incandescent) filament technology is driven by general lighting

need for

automotive LED replacement light sources

- capable to replace filament light sources
- approved, permitted for use
- consumers are asking for it
- future availability of spare parts

SOLUTION

replacement parts — insert into R37

- Light source regulations are about
 - approved light sources for
 - new vehicles/lamps to be put on the market
 - vehicles-in-use, replacement parts
- Solution is to develop LED light sources
 - for corresponding filament light sources
 - as replacement part
 - equivalent performance in an approved lamp
technical equivalence
 - same name
 - approved according to the same regulation
legal equivalence

Amend Regulation 37

- (incandescent) filament technology
 - new
 - replacement
- **New: LED technology**
 - **Replacement**

Equivalent counterpart light sources

- **Technical**
 - Equivalent performance
- **Legal (administrative)**
 - Same name
 - Approved according to R37

CATEGORIES

standardized basic design — different technologies

- Category definition by parameters on
 - photometric
 - colorimetric
 - geometric
 - electrical
 - thermal (LED)
- Types: variation within a category
 - manufacturer
 - voltage
 - design of supports (bulb, cap) if changing optical output

New LED replacement categories

- compared to the corresponding category in incandescent filament technology:
 - equivalent technical performance in the lamp
 - with the same name

EQUIVALENCE GRADE SUBSTITUTES ↔ REPLACEMENTS

LED substitutes

- GRE 82-03, Guide supporting the definition of LED substitute categories
- GRE informal documents: equivalence reports for new categories
- R128, requirements
- R.E.5, Annex 3, Group 4, Sheets for LED light sources
 - For additional lamp (luminaire) approval if approved with filament light source
 - Additional keying (interlock)
 - Example H11/LED
- **Lamp and installation regulations**

LED replacements

- GRE 83-15, Guide supporting the definition of LED replacement categories
- GRE informal documents: equivalence reports for new categories
- R37, requirements
- R.E.5, Annex 3, Group 5, Sheets for LED light sources
 - Not for additional lamp (luminaire) approval
 - Standard keying
 - Example H11 (mark: LEDr)

OTHER REQUIREMENTS

To all LED light sources

- Correlated colour temperature
- UV radiation
- EMC/EMI as for an electronic sub assembly (ESA) in R10
- No light from ≤ 2 ms. flashes

EQUIVALENCE CRITERIA

GRE-82-03 vs. GRE 83-15

Parameters, main changes	LED subst.	LED repl.
Photometry		
Objective luminous flux	=	=
Light centre length	=	=
Distortion free zone (if any)	=	=
Normalized luminous intensity distribution	≈	≈
Size and position of the light-emitting-area	≈	≈
Homogeneity of the light-emitting-area	≈	≈
Contrast of the light-emitting area	≈	≈
Colorimetry		
Colour of emitted light	=	=
The spectral content	≠	≠
Geometry		
Maximum lamp outline dimensions	=	=
Cap/holder	= holder	= cap
Functional interlock between light source and application	≠	
Electrical connector	=	=

Parameters, main changes	LED subst.	LED repl.
Electrical		
Test voltage	=	=
Electrical power consumption	≠ max	≠
The minimum voltage range	≠	≠
Dependency of the luminous flux on the applied voltage		≠
Dependency of the luminous flux on elevated ambient temperatures		≠
PWM operation to stabilize the applied voltage		+
PWM operation to dim light sources		+
Voltage polarity		+
Failure detection	+	+
Failure behaviour	+	+
Thermal		
Cap temperature		≠
Thermal behaviour	+	+ run-up

=, ≠, + are compared to filament light sources

All coloured cells for LED replacement are additional to the LED substitutes

EQUIVALENCE CRITERIA

Parameters, main changes	LED subst.	LED repl.
Photometry		
Objective luminous flux	=	=
Light centre length	=	=
Distortion free zone (if any)	=	=
Normalized luminous intensity distribution	≈	≈
Size and position of the light-emitting-area	≈	≈
Homogeneity of the light-emitting-area	≈	≈
Contrast of the light-emitting area	≈	≈
Colorimetry		
Colour of emitted light	=	=
The spectral content	≠	≠
Geometry		
Maximum lamp outline dimensions	=	=
Cap/holder	= holder	= cap
Functional interlock between light source and application	≠	
Electrical connector	=	=

Parameters, main changes	LED subst.	LED repl.
Electrical		
Test voltage	=	=
Electrical power consumption	≠ max	≠
The minimum voltage range	≠	≠
Dependency of the luminous flux on the applied voltage		≠
Dependency of the luminous flux on elevated ambient temperatures		≠
PWM operation to stabilize the applied voltage		+
PWM operation to dim light sources		+
Voltage polarity		+
Failure detection	+	+
Failure behaviour	+	+
Thermal		
Cap temperature		≠
Thermal behaviour	+	+ run-up

Equivalent in all aspects:

Equivalent, practical in production :

default LED replacement light source

- all cells right column above

options at the request of the applicant

- yellow cells right column above

- due to outer dimensions of the cap too small

OPTIONS

practical in production — at request

1: electrical current and monitoring

- LED requires lower electrical current
- Failure detection and monitoring use calculated electrical current from the corresponding incandescent filament lamp
- LED replacement light sources
 - Default: same electrical current
 - High-efficiency: lower current
 - AE device to increase the electrical current where needed for failure detection and monitoring

2: voltage polarity and insertion

- Some incandescent filament light sources can be inserted in more than one way
- LED replacement too, but voltage polarity matters
- Cap size too small:
 - +/- marks on the light source
 - Light source category data sheet (if adopted by GRE) specifies which terminal shall be marked plus or minus

3: cap dimensions and insertion

- Geometric dimensions relevant for interchangeability shall be the same
- When more space in the cap is needed:
 - Light source category data sheet (if adopted by GRE) specifies maximum deviations to the IEC cap sheet
 - Only for part of the cap, irrelevant for interchangeability

OPTIONS

summary

Light source

A. Default – universally applicable

B. Non-default – limited applicable (2.2.2.2.2.)

- Information symbol on the light source

Depending on the option:

- High-efficiency light source

HE mark

- AE device included

AE mark

- Voltage polarity matters

+/- mark

- Larger dimensions

Actual dimensions mark, followed by an exclamation mark 



Package

A. Trade name/mark, rated voltage, approval code, category name and **LEDr mark**

B. Additional to A.:

- Information symbol on the package



- Instructions

 - In the package

 - Display at the point of sales

- Reference to web site

 - Listed applications

 - Info for installation and proper functioning

MORE INFORMATION

[GRE inf. 83](#)

- GRE-83-15e (TF SR) - Equivalence criteria
- GRE-83-16e (TF SR) - Equivalence report for H11 LEDr
- GRE-83-14e (TF SR) - Supporting information for GRE_2020_15, GRE-83-11, GRE-83-12 and GRE-83-13

[TF SR](#)

- TFSR-13-08 - SAE J575 Humidity Test-with-LEDr
- TFSR-11-02rev1 Technical_Requirements_open topics 2020-05-25

How it works

Example: H11

Performance based approach with technology related characterisation and testing

