Light Source
Requirements

- In general for UN approved light sources
- OEM situation and AFTM situation

- Requirements clustered in
  - Safety
  - Performance
  - Consumer / Customer

SAFETY REQUIREMENTS (UN ECE)
- Technical
  - Luminous flux incl. tolerances
  - Maximum power
  - “Geometry”
  - ...
- Information / Communication
  - Rated voltage (and wattage)
  - Category name

PERFORMANCE REQUIREMENTS and TEST METHODS (IEC 60810)
- Technical
  - Minimum lifetime
  - Minimum vibration resistance
- Information / Communication
  - Restricted white
  - ...

CONSUMER / CUSTOMER REQUIREMENTS
- E.g. higher lifetime specifications
- E.g. heavy duty performance
- E.g. limited color coordinates
LED Replacement Light Source (LEDr) acc. to R37

- Photometric parameters
  - Same as for LED Substitutes

- Electrical parameters
  - Voltage range
  - FailureDetectionSystem-compatibility
  - PWM operation
  - EMC

- Mechanical parameters
  - Size
  - Mass

- Thermal parameters
  - Behavior under high ambient T.

Task for TFSR

CONSUMER / CUSTOMER REQUIREMENTS
- ...

PERFORMANCE REQUIREMENTS (IEC 60810)
- Technical
  - ...
  - ...
- Information / Communication
  - ...
  - ...

SAFETY REQUIREMENTS (UN ECE R37 / RE5)
- Technical
  - ...
  - ...
- Information / Communication
  - ...
  - ...
Collecting the topics / questions
# Electrical

<table>
<thead>
<tr>
<th>Nr</th>
<th>Topic</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Voltage range</td>
<td>Does the LEDr have the same voltage - flux behavior as the filament light source?</td>
</tr>
<tr>
<td>#2</td>
<td>PWM operation</td>
<td>Does the LEDr flicker in case of pulse-width modulation (PWM) operation? Also covering PWM dimming for dual-function operation</td>
</tr>
<tr>
<td>#3</td>
<td>Power / electr current</td>
<td>Does the LEDr cause a wrong failure message in the dashboard when it is working correctly? Does the LEDr cause a correct failure message in the dashboard when it has failed? Incl presence detection (Kaltüberwachung)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Possible interaction with other electronics</td>
</tr>
<tr>
<td>#4</td>
<td>EMC / EMI</td>
<td>Does the LEDr cause EMC problems in the vehicle?</td>
</tr>
<tr>
<td>#5</td>
<td>Electrical robustness</td>
<td>Is the LEDr as robust against electrical disturbance as the filament lamp?</td>
</tr>
</tbody>
</table>
## Mechanical

<table>
<thead>
<tr>
<th>Nr</th>
<th>Topic</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Vibration / Mass</td>
<td>Does the LEDr have the same mass as the filament lamp and is it as robust against vibration as the filament lamp?</td>
</tr>
<tr>
<td>#2</td>
<td>Maximum geometry</td>
<td>Does the LEDr have the same geometry / maximum outline as the filament lamp? Is the sealing affected by the geometry of the heat-sink</td>
</tr>
</tbody>
</table>

Status after TFSR-08: Discussed and agreed
# Thermal

<table>
<thead>
<tr>
<th>Nr</th>
<th>Topic</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1min / 30 min ratio</td>
<td>Could it happen that the LEDr has higher intensity in the beginning (when switched on) and will reduce its intensity significantly as it reaches steady-state temperature?</td>
</tr>
<tr>
<td>#2</td>
<td>High ambient temperature</td>
<td>Could it happen that the LEDr has significantly reduced intensity when it is operated at high ambient temperature?</td>
</tr>
<tr>
<td>#3</td>
<td>Low ambient temperature</td>
<td>Could the de-icing / de-fogging behaviour of a luminaire be different when an LEDr is used?</td>
</tr>
<tr>
<td>#4</td>
<td>Cap temperature</td>
<td>Could the lamp cap get hotter with an LEDr compared with a filament lamp and could this lead to damage of the material of the luminaire?</td>
</tr>
</tbody>
</table>
Colorimetric

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<tr>
<th>Nr</th>
<th>Topic</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Spectral content</td>
<td>In signalling applications with coloured lenses, is the spectral content of the LEDr sufficiently like the spectral content of the incandescent lamp? e.g.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Red lens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Amber lens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Green+red = white</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Green+red=amber</td>
</tr>
<tr>
<td>#2</td>
<td>Minimum red content</td>
<td>Is the minimum red content fulfilled? (for RID applications).</td>
</tr>
</tbody>
</table>
Question:
Does the LEDr have the same voltage - flux behavior as the filament light source?

Answer:
The electronics of the LEDr is designed so that the voltage – flux behavior is equivalent, or more stable, than the filament light source.

Status after TFSR-08: Discussed and agreed
Question:
Does the LEDr flicker in case of pulse-width modulation (PWM) operation? Also covering PWM dimming for dual-function operation

Answer:
There are two application cases:

1. PWM for dual function dimming (tail / stop and FrontPos / DRL)
2. PWM for stabilisation (reduce voltage peaks)

→ 1) Dual function is only used for a limited number of categories: e.g., P21W, but not e.g. H7
→ 2) all LEDr are tested for “no visible flicker”
Question:
Does the LEDr cause a wrong failure message in the dashboard when it is working correctly?

Does the LEDr cause a correct failure message in the dashboard when it has failed?

Incl presence detection (Kaltüberwachung)

Answer:
Failure detection is mandatory for direction indicators (DI)

→ 1) LEDr for DI – The electronics of the LEDr is designed to ensure compatibility.

→ 2) user information for non-DI application (optional failure detection)
Electrical #3

- Failure detection system compatibility

**Question:**

Does the LEDr cause a wrong failure message when it is working correctly?

Does the LEDr cause a correct failure message when it has failed?

Is the LEDr compatible with presence detection (“Kaltüberwachung”)?

**Answer:**

For all LEDr the electronics of the LEDr is designed to ensure compatibility.

There shall be no light in the first 2ms.

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**Discussion during TFSR-08:**

Solution B “high power option”

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**SAFETY REQUIREMENTS (UN ECE R37/RE5)**

- Technical requirements for minimum current/power: in case LEDr is working correctly. The limit should be >[50]% of the filament current; use of optional external electronics allowed

- Technical requirements for maximum current/power: in case LEDr is failed (no light emitting)

- Information/Communication
  - The consumer is informed about the possible impact of the LEDr on the failure detection system and is given additional information/advice

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**CONSUMER / CUSTOMER REQUIREMENTS**

**PERFORMANCE REQUIREMENTS (IEC 60810)**

**Discussion during TFSR-08:**

Solution B “high power option”
Failure detection system compatibility (non-DI) – two options

Solution A- “high power AND lower power” versions

- “High power” version for vehicles with failure detection (~[20]% of vehicles for low beam)
- “Low power” version for vehicles without failure detection and for vehicles with low threshold (~[80]% of vehicles for low beam)
- User information

Benefit:
- reduction of electronic waste by avoiding additional electronics
- optimized energy efficiency
- reduced CO2 emission, reduced waste

Disadvantage:
- Increased complexity for the consumer
  “mis-use”:
  Wrong failure message in case of using a “low power” version where a “high power” version is needed (but the light source is working correctly)

Solution B- only a “high power” version

- Only high power version

Benefit:
- Less complexity for the consumer

Disadvantage:
- Increase of electronic waste by adding additional components where they are not necessary
- Artificially increased power consumption where low power consumption could be enabled
- increased CO2 emissions, increased waste

Discussion during TFSR-08
End of TFSR-08 meeting on 2019-12-10
Electrical #4
- EMC

**Question:**
Does the LEDr cause EMC problems in the vehicle?

**Answer:**
No, the electronics design of the LEDr is made in such a way that no disturbance occurs; this is regulated in ECE R10 for all ESA in vehicles.

**Initial proposal:**
Same as for substitutes

**SAFETY REQUIREMENTS (UN ECE R37 /RE5)**
- LEDr shall comply with the technical requirements of an Electronic Sub Assembly (ESA) as specified in UNECE R10
Electrical #5
- Electrical robustness

Question:
Is the LEDr as robust against electrical disturbance as the filament lamp?

Answer:
Yes, the electronics of the LEDr should be designed so that it can withstand typical electrical overstress, e.g. reverse voltage.
Mechanical #1 - Vibration / Mass

**Question:**
Does the LEDr have the same mass as the filament lamp and is it as robust against vibration as the filament lamp?

**Answer:**
No, LEDr have typically a higher mass than a filament lamp, but the mass of filament lamps is not regulated or standardised. A market survey can give guidance on the typical mass of the different categories.
For each cap-holder system a mass limit can be determined for which the system is designed.
The vibration resistance can be tested on the LEDr directly, using the same test method used to test the vibration resistance of filament lamps.

**Initial proposal:**

same as for all LED light sources

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**CONSUMER / CUSTOMER REQUIREMENTS**

**PERFORMANCE REQUIREMENTS (IEC 60810)**
define for each LEDr category a maximum mass and test the vibration resistance

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**SAFETY REQUIREMENTS (UN ECE R37 /RE5)**
**Mechanical #2**
- **Maximum geometry**

**Question:**
Does the LEDr have the same geometry / maximum outline as the filament lamp?

**Answer:**
Yes, the “burner-side” of the LEDr has the same maximum outline as the filament lamp to allow safe insertion into the luminaire.

For the “cap-side” of the LEDr there may be a somewhat larger specification than the filament lamps (per category); this will be reflected in the installation instructions, which can be vehicle-specific.

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**Initial proposal:**
Burner side - same as for substitutes

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**CONSUMER / CUSTOMER REQUIREMENTS**

**SAFETY REQUIREMENTS (UN ECE R37 /RE5)**
- Define maximum outline: cap-side
- Define maximum outline: burner-side
- Provide to the consumer installation instructions (can be vehicle specific).

**PERFORMANCE REQUIREMENTS (IEC 60810)**
**Question:**
Could it happen that the LEDr has higher intensity in the beginning (when switched on) and will reduce its intensity significantly as it reaches steady-state temperature?

**Answer:**
No, there is no significant effect, as the design of the LEDr is such that such excessive lumen-drop from 1 min to 30 min is be prevented.

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<tr>
<td>SAFETY REQUIREMENTS (UN ECE R37 /RE5)</td>
</tr>
<tr>
<td>• Limit the deviation of the luminous flux values between 1 min and 30 min</td>
</tr>
</tbody>
</table>
Thermal #2
- High ambient temperature

Question:
Could it happen that the LEDr has significantly reduced intensity when it is operated at high ambient temperature?

Answer:
No, there is no significant reduction, as the minimum performance under high ambient temperature is specified.
Thermal #3  
- de-icing / de-fogging

Question:
Could the de-icing / de-fogging behaviour of a luminaire be different when an LEDr is used?

Answer:
Yes, the de-icing / de-fogging behaviour may be different (can become better or worse). It could change due to the different power consumption and energy balance of the LEDr; the consumer is informed about this.
Thermal #4
- cap-temperature

Question:
Could the lamp cap get hotter with an LEDr compared with a filament lamp and could this lead to damage of the material of the luminaire?

Answer:
No, a maximum power or temperature limit for the LEDr avoids this situation. So even though LEDr has less power consumption than the filament lamp, cap temperature is considered relevant.
Summary of the proposal

Initial proposal

**LED replacement light source**

**CONSUMER / CUSTOMER REQUIREMENTS**

**PERFORMANCE REQUIREMENTS (IEC 60810)**
- **Electrical**
  - #5: Electrical robustness
- **Mechanical**
  - #1: Vibration

**SAFETY REQUIREMENTS (UN ECE)**
- **Electrical**
  - #1: voltage range
  - #2: PWM operation
  - #3: failure detection compatibility
  - #4: EMC
- **Mechanical**
  - #2: Geometry
- **Thermal**
  - #1: hot-cold-ratio
  - #2: high ambient temperature
  - #3: de-icing, de-fogging
  - #4: cap temperature