Complex light systems require precise measuring equipment – digital headlight checking and adjustment

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“Modern head lights need modern test technology“

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“Modern head lights need modern testing technology“

- Milestones in lighting systems – Changes in Law
- Legal basis for headlight testing
- Guideline for headlight testers and testing areas
- Experience (light/dark boundary, intensity)
- Comparison of optical and digital headlight testers
- Testing of new lighting systems - outlook
**Milestones in lighting systems – Changes in Law**

- **1886**: The first motor-driven vehicles were equipped with candle, petroleum and carbide lamps.

- **1908 – 1913**: Electrical battery-operated head-lights and dynamo machines become popular.

- **1924**: Introduction of a two-thread lamp for a combined high and low beam.

- **1957**: Integration of an asymmetric low beam.

- **1964**: Introduction of halogen light (first H1 and H3, than H4).

- **1967**: First self-directing headlights integrated in Citroen DS.
• Milestones in lighting systems – Changes in Law

1991
Xenon lamps launched in BMW 7 series (initially only as low beam).

1995
Xenon headlamps must be fitted with an automatic light level control.

2003
The active-directing headlights become serial production.

2006
Various manufacturer introduce LED technology for low beam.

2006
Intelligent lighting systems control headlight range and luminosity subject depending on driving conditions.

2009
Full-LED-main headlights become serial production.

1991
2003
2006

1995
2006
2009

www.cita-vehicleinspection.org
• Milestones in lighting systems – Changes in Law

- **2010**

- **2013**
  - Introduction of series production of LED-matrix-beam headlights at AUDI.

- **2015 ?**
  - Dynamic lighting systems are controlled via GPS.

- **2016 ?**
  - As new source of light, laser technology will be used.

- **2020**
• Milestones in lighting systems – Changes in Law

- Development in the headlamp technology
• Milestones in lighting systems – Changes in Law

• Development in the headlamp technology + Changes in European Laws
  
  These laws mainly refer to the admittance of headlights

  Regarding headlight positioning and testing methods, mostly national laws apply!
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• Legal basis for headlight testing
  (such as the German Law §29 and §50 StVZO (road traffic act = RTA))

During the PTI, the test engineer must check the compliance of various regulations and guidelines.

These are:

• State – abnormalities
• Execution – admissibility
• Number – admissibility
• Function
• Headlights‘ adjustment
• Adherence to system data
  (www.fsd-web.de)
• **Legal basis for headlight testing**
  (such as the German Law §29 and §50 StVZO (road traffic act = RTA))

  For checking the **adjustment**, the vehicle needs to be located on a leveled surface.

• **Before 1st July 2012**

  For the testing of headlight adjustment, the legal provisions favour a bright, adjustable and level surface, which can be arranged at a distance of 10 m from the headlights.

• **Since 1st July 2012**

  All test centres must have a headlight tester!
• **Legal basis for headlight testing**

(such as the German Law §29 and §50 StVZO (road traffic act = RTA))

The inclination of the headlamp setting can be described either as a percentage or the setting dimension "e".

![Diagram of headlight testing setup]

Meaning: $\% = \frac{H - h}{1000} \times 100$

- $\%$ = inclination angle in percent
- $H$ = height of the headlight centre in cm
- $h$ = height of light/dark boundary above the surface in cm
- $e$ = adjustment dimension in cm, $e = H - h$
• **Legal basis for headlight testing**  
(such as the German Law §29 and §50 StVZO (road traffic act = RTA))

The required inclination of the headlamp setting is either shown on the headlights or on the vehicle nameplate. Alternatively, it can be looked up in universally valid tables according to §50 StVZO (RTA).

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**fig. inclination angle at headlight body**

**fig. inclination angle on nameplate**

**fig. table according to §50 StVZO (RTA)**
• **Legal basis for headlight testing**
  (such as the German Law §29 and §50 StVZO (road traffic act = RTA))

Before starting the headlight testing and adjusting, the following points need to be checked:

• Check-up of the tire pressure.
• Check-up of the load condition (e. g. trunk).
• The testing area needs to be „leveled“ (according to ISO 10 604).
• Function testing of the headlight level adjustment.
• Passenger vehicles: 75kg-load on driver seat.
• Adherence to system data.
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• **Guidelines for headlight testers and testing areas**

Example Germany:

- The „guidelines for headlight testers“ dated **25th September 1981** consists of:
  - General requirements on the headlight testers
  - Checking of the headlight testers

- The testing area needs to be a „leveled surface“ according to ISO 10 604:
  - Testing area of the vehicle (max. 1 mm/m)
  - Testing area of the headlight tester (max. +/- 0.5 mm/m)
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• Experience (light/dark boundary, intensity)

1. Problematic recognition of the light / dark boundary due to „blue area“.

2. Problematic assessment due to missing inflexion.
3. Intense glare from headlights at testing and adjustments.

The intensity of light sources in comparison:

- halogen = approx. 9 – 18 lux
- xenon = approx. 22- 30 lux
- LED = approx. 40 lux
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• **Comparison of optical and digital headlight testers**

For testing the headlight adjustment, optical or digital headlight testers are used. Basically, with both types, the position of the light / dark boundary is checked.

- **Optical headlight testers:**
  - The assessment of the light / dark boundary is done by the inspector visually.
  - The result is subjective (depending on the individual inspector).
  - The analysis is limited to easy lighting functions, which can be displayed on the „projection screen“ (inside the testing box).
  - There is no possibility of a direct documentation of the measurement data on a PC.
  - Danger of a permanent damage of the eyes due to direct visual assessment of the headlight tester image.
• Comparison of optical and digital headlight testers

  • Digital headlight tester
    o The assessment is done via a camera-based measurement system.
    o Objektive result assessment via electronic analysis.
    o Graphical output of the measurement results on the tester’s display
    o Testing possibility of new lighting systems (e.g. dynamic light assist, motorway light and so on).
    o Transfer and storage of the measurement results to a PC via cable, bluetooth or WLAN.
• **Comparison of optical and digital headlight testers**

<table>
<thead>
<tr>
<th>Advantages of optical testers</th>
<th>Advantages of digital testers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheap acquisition</td>
<td>Objective evaluation of results</td>
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<tr>
<td>Quick operational readiness</td>
<td>Electronic analysis</td>
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<tr>
<td>Easy in handling</td>
<td>Documentable measurements</td>
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<td></td>
<td>Accurate measurements</td>
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<td>Possibility for testing of all lighting systems</td>
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• After the low beam is switched on and the engine is started, the projection modules pivot vertically and horizontally. Afterwards, the headlights return into a standard position, in which an easy test (not adjustment) can be done.

• By selectively controlling the stepper motors via OBD another function testing is possible.

fig. xenon-headlight with projection module, source: VW
• Testing of new lighting systems - outlook

• Functions like „motorway light“ change the light / dark boundary as well as the intensity subject to the driving speed. For function testing, an OBD connection is necessary.

• Some manufacturers use a special adjustment method when checking and adjusting the headlights. This displays a „non typical figure“, which can only be analysed with digital headlight testers. For function testing, an OBD connection is necessary.

fig. optical analysis via the panel to the box back board

fig. electronical analysis via LITE3
• Testing of new lighting systems - outlook

• In order to acquire the testing of headlight adjustment to the required level, the following must be adhered to:
  
  o For an exact and objective analysis, digital headlight testers are necessary.
  
  o Testing areas need to be „leveled“ (according to ISO 10 604).
  
  o The vehicle needs to be prepared in accordance to manufacturer data.
  
  o Headlight tester need to comply with legal minimum requirements.
  
  o An annual check of headlight testers and testing areas needs to be instructed.
Thank you for your attention!