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MAHA Maschinenbau Haldenwang GmbH & Co. KG

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From positioning lights to **Advanced Frontlightning Systems** and ???
History of Automotiv Headlights

1906: 1st. electrical bulb
1992: 1st. Xenon low beam
2008: Full LED headlamp Cadillac
2013: 1st. Full-AFS LED Headlamp (Matrix) Audi A8
2018: Laser High Beam - Audi R 8, BMW I 8

1957: Asymmetric low beam
1999: 1st. Bi-Xenon headlamp
2009: Truck LED Headlamp DAF
2013: Camera based headlamp with adaptive Cut-Off Line
2018: LED Matrix 2nd. Generation - Audi A 8, Mercedes E-Klasse
Function of Advanced Frontlightning Systems

Camera / Radar

CPU Unit
2009 First Generation of Dynamic High Beam

- Mechanical solution of different forms of light

OEM’s are requesting for special measurement function for headlight tester.

Left high beam

Right high beam
Matrix Beam 1 from Audi was the first complete LED AFS beam.

5 Chip each with 5 LED's

Each Matrix spot is individually controlled ON or OFF or in 64 steps dimmable.
2013 First Generation of Matrix Beam

- Totally 50 LED segments in 10 rows manage every traffic situation

- Adjustment only with digital headlight tester
- **Multi Beam** with 84 Spots was 2016 the first Mercedes AFS beam
  In 100 m distance the size of 1,8 x 2,4 m
- **Matrix Beam 2** is with 64 spots since 2018 the second generation from Audi
- **Porsche Dynamic Light System** is with 84 spots since 2018 on the market
- Known brands with AFS function: Audi, BMW, Fiat, Ford, Peugeot, Lexus, Mazda, Mercedes, Opel, Porsche, Skoda, Toyota, VW, ............
AFS time travel

In development or experimental on the road

- LED modul from Osram with 2 x 1024 LED pixel
- DLP from Automotive lightning with 1 million mirrors/pixel on one chip
- One LED or Laser project the light on the mirrors
- Each mirror can switch with 5000 Hz between active and not active
- One pixel has in 100 m distance the size of 4 x 2,5 cm ≈ factor 100 smaller like actual systems

Source: www.computerbase.de/2016-12/
Benefit of LED headlights

- Almost unlimited design options
- Low installation depth is saving space for other parts
- Up to 50000 hours lifetime. According ECE R-48 / 2006, a bulb replacement must be carried out by the driver himself, except Xenon or LED systems
Benefit of LED headlights

- **Price**

  ![Headlamp cost roadmap](source: www.Ledsmagazin.com)

- **Light source color**

<table>
<thead>
<tr>
<th>Light Source</th>
<th>Temperature (Kelvin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daylight</td>
<td>5300 - 6500</td>
</tr>
<tr>
<td>Halogen</td>
<td>3200</td>
</tr>
<tr>
<td>Xenon</td>
<td>4200</td>
</tr>
<tr>
<td>LED</td>
<td>5500</td>
</tr>
</tbody>
</table>
Benefit of LED headlights

Efficiency reasons

Complete LED equipped vehicle compared to incandescent vehicle

Comparison of light source

<table>
<thead>
<tr>
<th>Light Source</th>
<th>Fuel Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halogen/incandescent bulb</td>
<td>0.10 – 0.25 l / 100 km</td>
</tr>
<tr>
<td>Xenon (high beam) LED (low beam)</td>
<td>0.05 – 0.15 l / 100 km</td>
</tr>
<tr>
<td>Full LED configuration (Potential 2015)</td>
<td>0.03 – 0.09 l / 100 km</td>
</tr>
</tbody>
</table>

Source: www.Hella.de
Speed controlled **Advanced Frontlightning Systems**

- City light: 0 – 55 km/h
- Junction light: 0 – 70 km/h
- Country light: 55 – 110 km/h
- Motorway light: 110 – 250 km/h

Speed controlled Advanced Frontlightning Systems

- Active curve light: 0 – 250 km/h

Camera controlled Advanced Frontlightning Systems

- Dynamic light spot:

Source: www.BMW.com
Camera controlled Advanced Frontlightning Systems

- Dynamic high beam
Camera controlled **Advanced Frontlightning Systems**

- Illuminate traffic signs with less intensity to prevent reflections

Source: www.youtube.com/watch?v=XXDrIANCZDw
FACT’s

- AFS headlight systems will replace soon the previously known headlight systems
- Part of the PTI inspection are Low Beam, High Beam and Fog Lights
- Some countries only focus on the pitch angle in the PTI, but with AFS headlamps, the horizontal orientation has the same, if not greater importance

Source: www.Opel-blog.com
Importance of correct headlight adjustment

- Double brightness
  Intensity of a halogen bulb (H7) = 1450 cd / m²
  Intensity of Xenon or LED = 3000 cd / m²

- A human eye need at the age of 40 three times the amount of light compared to a small child

- The resistance of the human eye to glare decreases by about 50 percent every 12 years

- The brain gets 90% of the information's over the eyes. The eyes are the weak link in the night

- Light is an active security element. Unlike the seatbelt or airbag, which helps mitigate the consequences of an accident, **good light can prevent accidents from the onset**
Floor situations

- Uneven test place
- Positive tilt test place
- Negative tilt test place
Influence of the floor on the orientation of the headlights

Theoretical failure calculation:

+/- 7 mm/m uneven or tilt in the vehicle place  +/- 0,7%

+/- 2 mm/m uneven or or tilt in the headlight tester run way  +/- 0,2%

Headlight tester tolerance  +/- 0,1%

Worst case failure:  +/- 1,00%
Influence of the floor on the orientation of the headlights

Pitch correct adjusted \(-1\%\) \(\Rightarrow\) aprox. 65m
Influence of the floor on the orientation of the headlights

Pitch correct adjusted  -1%  \(\Rightarrow\)  approx. 65m

+1% failure place  \(\Rightarrow\)  after adjustment  \(\Rightarrow\)  setting in the vehicle -2% = 32,5m

-1% failure place  \(\Rightarrow\)  after adjustment  \(\Rightarrow\)  setting in the vehicle 0% = \(\infty\)m
Influence of the floor on the orientation of the headlights
German Limits § 29 StVZO
German Limits § 29 StVZO Pitch

Upper Limit ≈ 97 m
Default ≈ 65 m
Lower Limit ≈ 43 m

German Limits

§ 29 StVZO Pitch

N: -1.3%
KP: -0.9%
I: 22.8 lx

Upper Limit ≈ 97 m
Default ≈ 65 m
Lower Limit ≈ 43 m
German Limits § 29 StVZO Horizontal

Straight in vehicle longitudinal axis
Left / Right 0,5m / 100m

Inflection point
PTI statistic light vehicle 2016 / 2017 / 2018 of Germany

- Totally
  - 2017: 32.7%
  - 2016: 32.0%

- Headlight defect
  - Too high: 10.0%
    - 2017: 10.3%
    - 2016: 9.6%
  - Too low: 9.9%
    - 2017: 9.5%
    - 2016: 8.0%

- Rear Lights
  - 2017: 8.6%
  - 2016: 8.3%

- Too left, too right is also here missing
  - 2017: 23.7%
Legislation

- ISO 10604 describe a headlight adjustment place since 1993
- Worldwide, some PTI organizations, OEMs and workshops do not work to ISO 10604
- The German legislator reacted to the discrepancy between the headlight technologies and test methods 2014
Headlight testing requirements

- According to German directive 5/2014 and 14/2016, every PTI station and Workshop where the periodical technical inspection will be done, must have a Headlight Adjustment System.
- This system consists of:
  - A calibrated headlight tester
  - A flatness and tilt tested vehicle standing area
  - A flatness and tilt tested headlight tester area
Basics German directive VK 5/2014, 14/2016

- Max. unevenness of headlight tester area = +/- 1 mm at 1 m except
  - the headlight tester has a system included to compensate higher uneven areas
- Digital headlight tester are on the market with a max. compensation range of +/- 3 %
- Active compensation systems must be calibrated
Basics German directive VK 5/2014, 14/2016

- Headlight checks for cars are possible on lifts when they are within the limits of unevenness
- Axle play detector plates like follow are not allowed to position a wheel
Axle play detector plates with a lifting prism are allowed

Finally
From positioning lights to Advanced Frontlightning Systems and the resulting consequences for a modern PTI inspection
THANKS A LOT!

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