HEADLIGHT SYSTEMS
CORRECT AIMING
MADE EASY
Since asymmetric light distribution appeared on the market in 1957, there have also been statutory provisions for aiming headlights.

Headlights were first aimed at the so-called “10-metre wall”. That means a vehicle is driven to a distance of 10 m in front of a light-coloured wall, which has certain markings on it. The headlights are then checked or adjusted on the basis of these markings.

This has remained the statutory test method until today and is still used particularly for checking agricultural or specialist vehicles. One of the disadvantages of this method is that you need a relatively, large, light-coloured and free wall, and a corresponding amount of space to go with it. Neither of these were, or are, exactly easy to find in a garage.

These circumstances were also ultimately among the factors responsible for the development of beam setters. Such devices enable the light distribution to be checked quicker and more flexibly.

The following pages describe the measuring methods, the legal basis and the most important stages involved in headlamp aiming.
AIMING WITH A 10-METRE WALL

General

As already mentioned, this method is still mainly used today for vehicles where the upper edge of the headlights is higher than 140 cm above the ground. The vehicle is driven on to a level surface, which does not have to be horizontal, to a distance of 10 metres from a vertical, light-coloured wall.

The following lines have to be marked on the wall.

Line A

Extend the longitudinal axis of the vehicle to the test wall and mark it with a vertical line.

Line B and C

Measure the distance X of the vehicle headlight (centre to centre) and mark it on the wall symmetrically to Line A.

Line D

Draw this line at a distance ‘e’ below Line H.

For headlights

\[ e = \frac{H}{3} \text{ cm} \]

For fog lights

\[ e = \frac{H}{3} + 7 \text{ cm} \]

Line H

Measure the height of the centre of the headlights above the ground draw the line on the test wall parallel to the ground.

Please ensure that specific national regulations are always observed.
AIMING WITH A 10-METRE WALL

Adjusting the headlights

Cover the right headlight and align the left headlight so that the horizontal part of the cut-off line touches Line D. Then align the headlight laterally. The bend between the horizontal and the sloping (asymmetrical) part of the cut-off line must lie on Line B. Then align the right headlight in the same way. In this case, the bend of the cut-off line lies on Line C.
Beam setters generally simulate the 10 m wall. The lens installed in the beam setter box shortens the prescribed 10 m distance to 50 cm (Fig. 2 - lens to test screen).

The disadvantages, such as storage space and a suitable wall, are omitted. A beam setter can also be flexibly used at different places within the garage, provided the garage floor adheres to the required tolerances.

The composition and condition of the floor are of primary importance to enable exact headlight aiming. That is why, it also has its own standard (DIN ISO 10604) in which the “test surface” is specified precisely and the permissible tolerances listed. The graphics listed in diagram 3 clearly illustrate the requirements.

Please ensure that specific national regulations are always observed.
AIMING WITH THE BEAM SETTER

Sample calculation

If these tolerances are not adhered to, even minor deviations have a large impact on light distribution.

A sample calculation makes it clear:

As already mentioned, a lens is installed in the beam setter which shortens the prescribed 10 m measuring distance to the wall to only 50 cm. A mere 5 mm error in the measurement on the test screen of the beam setter thus corresponds to a 10 cm difference over 10 m (ratio 10 m to 50 cm is factor 20). A vehicle with headlights installed at a height of 60 cm has a dipped headlight with a range of 60 metres (at 1% forward tilt = 10 cm inclination to 10 m range).

This means the light projected by the headlight would deviate by 60 cm! This example clearly illustrates the decisive effect that a precise test surface has on light distribution, as the difference between glare or driving in semi-darkness is measured in millimetres!
AIMING WITH THE BEAM SETTER

Vehicle test

Not only the floor conditions are important. The vehicle must also have been prepared for the test. The following points must be observed.

- Test the headlight function.
- Check the cover lenses for damage from stones, scratches and for dullness.
- The tyres must have the prescribed air pressure.
- Check the vehicle with a person on the driver’s seat or a weight of 75 kg, which is otherwise not loaded.
- No load is required for trucks and other multi-lane vehicles.
- Single-lane vehicles and single-axle traction or working machines (with seat cart or trailer) should be checked with a person on the driver’s seat or a 75 kg load.
- In the case of vehicles with hydraulic or air suspension, manufacturers’ instructions must be heeded.
- If automatic correction of the headlights or an infinite or multi-stage setting fixture is available, follow the manufacturer’s instructions. In this case, various function tests, depending on the manufacturer, must be carried out.
- A diagnosis tester is required for adjusting various vehicles with automatic headlight range adjustment, since the control unit has to be in “basic mode” during adjustment. If the cut-off line is set correctly, this value is set as the new control value, Fig. 4.

Please ensure that specific national regulations are always observed
If the floor conditions are acceptable and the vehicle has been checked, the beam setter still has to be aligned to enable exact adjustment.

The beam setter is moved in front of the headlight to be checked. The beam setter box must be aligned to the middle of the headlight or to the light source. Vertical and horizontal deviations may not exceed 3 cm. The distance between the beam setter box and the headlight varies depending on the manufacturer. In the case of HELLA devices, the distance from the front edge of the beam setter box to the headlight should be between 30 and 70 cm, Fig. 5.

The beam setter box is then aligned to the vehicle. Devices with a wheel-mounted base must be individually aligned for each headlight to be checked. Beam setter devices on rails only need to be aligned once. Using the broad-band, laser or mirror sight, align the beam setter box in such a way that the sight line touches two points situated at the same height, symmetrically to the vehicle’s longitudinal axis, Fig. 5, dashed lines.
Finally, set the ‘forward inclination’ on the device. This corresponds to the angle of inclination of the headlight cut-off line. The forward inclination is given in % and can normally be found on the headlight, Fig. 6.

For example, 1% means that the dipped headlight is at an angle of 10 cm at a range of 10 m. The test screen is set to the correct percentage using the scaled wheel, Fig. 7.
### Vehicle Types

**Vehicle type:**

**Multi-lane vehicles with the exception of agricultural or forestry tractors and working machines**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Headlights for low beam</th>
<th>Fog light</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Setting indicated on the</td>
<td>2.0%</td>
</tr>
<tr>
<td>1.1.1</td>
<td>vehicle</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Cars (and combination</td>
<td>1.2%</td>
</tr>
<tr>
<td></td>
<td>motor vehicles)</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Motor vehicles with level-</td>
<td>1.2%</td>
</tr>
<tr>
<td></td>
<td>regulating suspension or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>automatic tilt compensation of the light beam</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Trucks with loading area</td>
<td>1.0%</td>
</tr>
<tr>
<td></td>
<td>at the front</td>
<td></td>
</tr>
<tr>
<td>d)</td>
<td>Trucks with loading area</td>
<td>1.0%</td>
</tr>
<tr>
<td></td>
<td>at the back</td>
<td></td>
</tr>
<tr>
<td>e)</td>
<td>Semi-trailer truck</td>
<td>3.0%</td>
</tr>
<tr>
<td></td>
<td>except for vehicles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>according to 1.2.2 b)</td>
<td></td>
</tr>
<tr>
<td>f)</td>
<td>Buses and coaches</td>
<td>2.0%</td>
</tr>
<tr>
<td>1.2.3</td>
<td>Motor vehicles with</td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td>headlights H ≥ 1400 mm</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>93 / 92 / EEC as a basis</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>for testing</td>
<td>requirements</td>
</tr>
<tr>
<td>a)</td>
<td>2-wheel small capacity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vehicles</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>3-wheel small capacity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vehicles and 4-wheel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>light vehicles</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Motorcycles without/with</td>
<td>0.5 to 2.5%</td>
</tr>
<tr>
<td></td>
<td>sidecar</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>ECE-R 53 as a basis for</td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td>testing</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>StVZO (Road Traffic Act)</td>
<td>1.0%</td>
</tr>
<tr>
<td></td>
<td>as a basis for testing</td>
<td>2.0%</td>
</tr>
<tr>
<td>3.</td>
<td>Agricultural or forestry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tractors or similar motor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vehicles</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>EEC / ECE as a basis for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>testing</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Headlight height: 500 mm</td>
<td>0.5 to 4.0%</td>
</tr>
<tr>
<td></td>
<td>&lt; h ≤ 1200 mm</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Headlight height: 1200 mm</td>
<td>0.5 to 6.0%</td>
</tr>
<tr>
<td></td>
<td>&lt; h ≤ 1500 mm</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Additional headlights</td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td>(on tractors equipped for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>front loading) H ≤ 2800 mm</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>StVZO (Road Traffic Act)</td>
<td>1.0%</td>
</tr>
<tr>
<td></td>
<td>as a basis for testing</td>
<td>2.0%</td>
</tr>
<tr>
<td>a)</td>
<td>Single-axle tractors or</td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td>working machines with</td>
<td></td>
</tr>
<tr>
<td></td>
<td>permanently dipped</td>
<td></td>
</tr>
<tr>
<td></td>
<td>headlights which indicate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the required</td>
<td></td>
</tr>
<tr>
<td></td>
<td>inclination of the light</td>
<td></td>
</tr>
<tr>
<td></td>
<td>beam centre</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Multi-axle tractors or</td>
<td>1.0%</td>
</tr>
<tr>
<td></td>
<td>working machines</td>
<td></td>
</tr>
</tbody>
</table>

### Notes

1) Up to the highest point of the beamed area.
2) Special features of these facilities must be observed in accordance with the manufacturer’s instructions.
### Checking headlamp aiming

The device now has an optimal setting and the different light distributions can be set.

<table>
<thead>
<tr>
<th>a) Headlights with symmetrically dipped headlight</th>
<th>b) Headlights with asymmetrically dipped headlight</th>
<th>c) Fog light</th>
<th>d) Special headlights for high beam (e.g. auxiliary driving lamps)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Dipped headlight" /></td>
<td><img src="image2" alt="Dipped headlight" /></td>
<td><img src="image3" alt="Fog light" /></td>
<td><img src="image4" alt="High beam" /></td>
</tr>
<tr>
<td><img src="image5" alt="High beam" /></td>
<td><img src="image6" alt="Bi-Xenon dipped headlight" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Align SEG according to point 4.0. Set the scaled wheel according to the adjustment table.</td>
<td>Align device according to point 4.0. Set the scaled wheel according to the adjustment table (observe point 4).</td>
<td>Turn on the fog lamp: The cut-off line must run as horizontally as possible along the dividing line over the whole width of the screen. Correct the headlight aiming if necessary using the adjustment options.</td>
<td>Turn on the main beam: The light beam centre of the main beam must be on the central marking, correct if necessary using the adjustment option. In the case of separate main beam modules (e.g. in combination with Bi-Xenon headlights), the main beam should be aimed according to manufacturers' instructions, since different settings are possible in this case.</td>
</tr>
</tbody>
</table>

#### Turn on the dipped headlight:

The cut-off line must run as horizontally as possible along the dividing line over the whole width of the screen. Correct the headlamp aiming if necessary using adjustment screws.

#### Turn on the main beam:

The light beam centre of the main beam must lie on the central marking, correct if necessary with the adjustment screws.

---

Please ensure that specific national regulations are always observed.
Some manufacturers have also been offering so-called "main beam assistants" for some time now as an optional feature. A camera installed in the windscreen recognises when a vehicle is approaching or driving in front of your car and automatically switches the main beam to low. In addition, there is also the so-called "glare-free high beam cut-off line". This high beam system produces a very special light distribution on the road. Detailed information about this system can be found in the HELLA Online Portal "TECH WORLD".

In contrast to a normal high beam that is displayed on the test screen as an oval spot of light, the shape of the glare-free high beam cut-off line tends to be square, Fig. 9.

In order to adjust the main beam function, a menu needs to be called up using a diagnosis tester. The headlights are moved into a certain position and the glare-free high beam cut-off line is activated. Now the vertical line of the light distribution (red circle) must be adjusted exactly to the central marking of the test screen. In the case of the glare-free high beam cut-off line, correct adjustment is absolutely essential as otherwise other road users may be exposed to extreme glare.

After adjusting the headlights, the incident light meter can be used to check whether the highest permissible glare value of the dipped headlight has been exceeded. Today’s beam setters are generally equipped with a digital incident light meter, Fig. 10.
If the glare has been clearly exceeded, the headlight must be replaced so as not to blind other road users.

As already mentioned, the condition of the floor is of primary importance to enable exact headlight aiming. That is also the reason for the low tolerance values. But what should be done if the aiming device and the vehicle are standing on surfaces which are not on the same level? An example to make this clear.

In many garages, the first two metres, measured from the outside wall to the middle of the interior, form a horizontal surface. After that, there is a second, slightly sloped area which extends to the water drain channel in the middle of the garage. This area is where the lifting ramp or work-position is situated. If, therefore, a vehicle is driven on to the work-position and the headlight aiming device is situated on the afore-mentioned horizontal surface, the longitudinal axes of the aiming device and the vehicle are not parallel to each other. That inevitably leads to wrong measurements.

On the following pages, we will show you two ways of solving this problem step by step. However, this requires an aiming device on which the inclination of the longitudinal axis of the beam setter box can be adjusted, e.g. by an eccentric axis, Fig. 11.
AIMING WITH THE BEAM SETTER

1. A laser pointer and a tripod with adjustable inclination is used for this aiming option, Fig 12. The laser pointer should still be able to generate a small dot at a distance of 5 m.

2. Set up the tripod just behind the back wheel and parallel to the body, Fig 13. The assembly height of the laser is determined by the position of the beam setter box. It should be as low as possible.
AIMING WITH THE BEAM SETTER

3. Switch on the laser. Hold a folding yardstick vertically, exactly over the middle of the back wheel rim to the wheel contact area so that the laser dot can be seen. In this case, the value is at 42 cm, Fig 14.

4. Repeat the procedure for the front axle. If the values differ from each other, the height of the stand must be changed using the adjusting screws until the same value (42 cm) is attained on both axles. The laser now simulates the longitudinal axis of the vehicle.

5. Set up the beam setter so that the laser dot can be seen in the middle of the lens, Fig 15.
Levelling with a point laser on the rear axle

6. Turn the scaled wheel to ‘0’, Fig. 16.

7. Depending on the inclination of the ground, the laser dot can be seen above or below the dashed cut-off line. Using the eccentric axis (Fig. 17) change the inclination of the beam setter box until the laser dot is situated exactly on the cut-off line, Fig. 18.
AIMING WITH THE BEAM SETTER

8. The longitudinal axes of the vehicle and the beam setter are now situated on the same level (Fig 19). When this requirement is met, an exact measurement of the right headlight can be made. This procedure must also be carried out on the other side of the vehicle for the left headlight.

9. With this aiming method, a line laser is attached to the beam setter, Fig 20. With this laser, the magnetic plate is firmly attached to the beam setter box. The actual laser is held to the plate by means of a magnet and is therefore movable. The laser must be equipped with a spirit level to enable adjustment of the inclination.

Please ensure that specific national regulations are always observed.
AIMING WITH THE BEAM SETTER

10. The longitudinal axes of the line laser must now be aligned parallel to the longitudinal axes of the beam setter box. This occurs using the fitted spirit levels of the laser and the beam setter box, Fig. 21 and 22.

11. The laser beam should be on the same level as the middle of the lens (arrow marking at the front of the beam setter box). As the picture clearly shows, the laser beam runs through the arrow point, Fig. 23.
12. Similar to levelling with the point laser, the aiming device is now set to the vehicle. Using a yardstick, the values are then read at the front and rear axle, Fig. 24.

13. If the values differ, the same value has to be set on both axles by adjusting the eccentric axis. In Fig. 25, it is 42 cm.
14. The longitudinal axes of the vehicle and the beam setter are now situated on the same level. When this requirement is met, an exact measurement can then be made. This procedure must also be carried out on the other side of the vehicle for the left headlight.

The two methods for aligning the aiming device to the vehicle show that with relatively little effort, different levels on the ground can be balanced out.
**Test spectrum headlamp aiming**

**Visual + technical inspection**

**Visual inspection**
- Cover lens
- Reflector
- Scratches
- Coating
- Milky glass effect
- Britleness

**Technical inspection**
- Mechanics
- Lights / electronics
- Loose fitting
- Faulty bulb
- Broken bracket
- Corroded contacts
- Faulty adjustment mechanism
- Faulty lamp holding fixture

**Test with SEG**

**Headlight adjustment**
- Low beam: cut-off line
- High beam: centre of light focus
  - Prescribed range is not reached/
glare from oncoming traffic/road ahead not well illuminated
  - High beam function is not used optimally/poor illumination of
  the road

**Light measurement**
- Glare low beam: halogen ≤ 1.2 lux/
  Xenon ≤ 1.3 lux
- Luminous intensity high beam: halogen 48–240 lux/
  Xenon 70–180 lux
  - Higher value dazzles oncoming traffic
  - Difference between right + left headlight: no
  homogeneous illumination of the road

**Additional turnover: Show your customers the drastic effects the faults can have on their road safety and how you can eliminate the faults.**

Please ensure that specific national regulations are always observed.
HELLA KGaA Hueck & Co.
Rixbecker Straße 75
59552 Lippstadt, Germany
Tel.: +49 2941 38-0
Fax: +49 2941 38-7133
Internet: www.hella.com

HELLA Limited
Wildmere Industrial Estate
Banbury, Oxon OX16 3JU
Tel.: (01295) 225600
Fax: 0800 7832571
E-mail: hella.sales@hella.com
Website: www.hella.co.uk

© HELLA KGaA Hueck & Co., Lippstadt
9Z2 999 134-308 J00679/AA/07.13/1.0
Printed in Germany

Subject to technical and price modifications.