HELLA

LIGHT IS KNOWLEDGE

TECHNOLOGIES,
LIGHTING SYSTEMS,
DIAGNOSTICS

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HELLA TECH WORLD directly here

LIGHT IS KNOWLEDGE

HELLA stands for expertise and experience in automotive lighting – and has done so for more than 100 years. You and your workshop can also benefit from this. No matter whether it is a case of repair or maintenance, whether for vehicles of today or technologies of tomorrow, with HELLA you have a reliable friend at your side that will support you along the entire repair process, getting cars back on the road fast, together with you. A friend that is happy to share their comprehensive knowledge with you.

In this brochure, we provide you with up-to-date knowledge on the topic of lighting technology and engineering, linked with numerous practical instructions and workshop tips.

Do you need an overview of the current legal framework or require a practical checklist for light testing? Then take a look at the technical notes from page 74 onwards.

You can find even more detailed information on lighting technologies, technical background information, up-to-date repair instructions, as well as practical workshop applications round the clock on our HELLA TECH WORLD workshop portal at www.hella.com/techworld.

Have fun reading!

HELLA – the workshop's friend

BRIGHTER, FURTHER, MORE EFFICIENT:
THE KEY MILESTONES IN HELLA'S HEADLAMP DEVELOPMENT

1908:	First electrical headlamp
1971:	First halogen H4 headlamp
1992:	First xenon headlight in series production
2007/2008:	First full LED headlamp in the Cadillac Escalade Platinum
2013:	LED matrix headlamp with glare-free high beam in the Audi A8
2016:	Matrix HD84 in the Mercedes E-Class

HALOGEN

THE CLASSIC MODEL

Since the beginning of the 60s, halogen light sources and halogen headlamps have been used in vehicle lighting – and since the beginning of the 70s also as an H4 version with two filaments. As a further development of the classic bulb, until today, tried-and-tested halogen technology has been standard equipment for many vehicle headlamps. The halogen lamp is comprised of a glass bulb which is filled with a halogen gas. A coiled tungsten filament is heated by applying a current, thus emitting light.

Halogen models include the single-filament H1 bulb, which is hardly used anymore, and its modern development, the H7, as well as the two-filament H4 model mentioned above for a joint source of high beam and low beam light.

In addition to halogen reflection systems, headlamps with a Bi-halogen projector-type system are also used in vehicles. They generate low beam and high beam with just one projection module. Through the use of a moveable cover, the light can be switched mechanically between the two lighting functions. In the raised position, the cover creates the cut-off line which is prescribed for the low beam. Lowered, it enables the path for the high beam.

Halogen variant of the VW Golf VII headlamp

XENON

INCREASED LIGHTING POWER AND SAFETY

At the beginning of the 90s, the next headlamp generation followed with the development of xenon technology. The xenon gas discharge lamp works as follows: A compact combustion chamber made of hardened quartz glass is filled with a xenon gas under high pressure. The light arc in the combustion chamber is generated between two tungsten electrodes. A very high luminous flux is reached due to the xenon gas just a short time after ignition ("powering up of the xenon bulb") – unlike the noble gas argon, for example, which is used in metal-halide lamps and takes considerably longer to provide the full luminous flux.

To ignite the xenon bulb, a high-voltage pulse is required which is generated by an electronic ballast and an ignition unit. The ballast is also responsible for controlling the light output and is therefore absolutely essential for functioning.

Compared to the light of standard halogen bulbs, xenon light has two crucial advantages: A xenon bulb not only provides more than double the light of a modern H7 bulb, it only requires around 2/3 of the electrical power. Xenon light also has a lighter light colour. Due to the increased light, the road is brighter and illuminated more widely. Hazards at the edge of the road in particular, and also those on the road, are detected earlier. The improved illumination of the road and the daylight quality of the xenon light aid the natural way people see – they become tired more slowly and drive in a more relaxed manner.

The xenon variant of the VW Golf VII headlamp

LED

The use of LED technology for modern headlamp systems is one of the greatest innovations in the field of automotive lighting. Since the introduction of the first lighting functions as a centre high-mounted stop lamp at the beginning of the 1990s, LED technology has developed rapidly, culminating in its current use in modern lighting systems such as the matrix HD84 system (→ you can find comprehensive information on modern lighting systems from page 12). LED headlamp solutions are now found in vehicles of almost every vehicle class – from small cars to the premium class.

This development is driven by the many advantages offered by LED technology:

Energy efficiency: Compared to other light sources, LEDs provide significantly improved energy efficiency. This is important, not only for reasons of cost but also consumption. Due to the increasing prevalence of electromobility, in the future we will need solutions which save the resources of the battery. CO2 emissions can also be reduced by the systematic use of LED technology, making an important contribution to protecting the environment!

Small car / VW Polo (2014):
LED front headlamp with reflector system for low beam and high beam

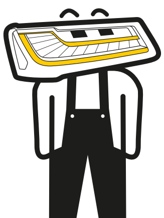
Compact class / Renault Kadjar (2015):
LED front headlamp with HELLA mono-LED modules for low beam and high beam

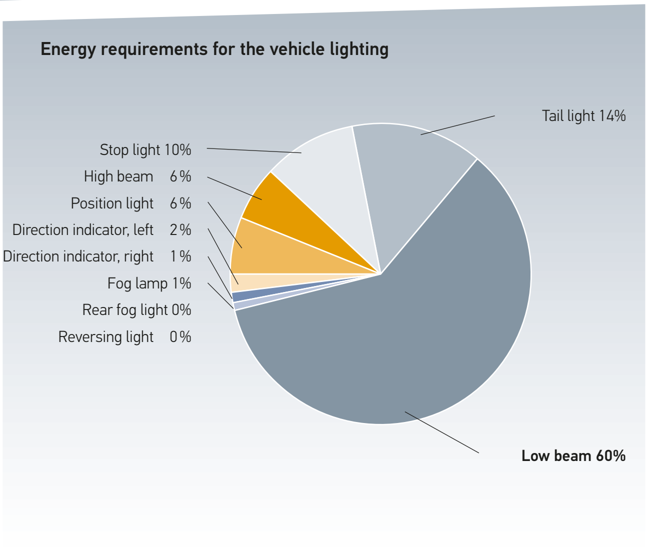
Lower mid-class / Audi A3 (from 2012):
LED front headlamp

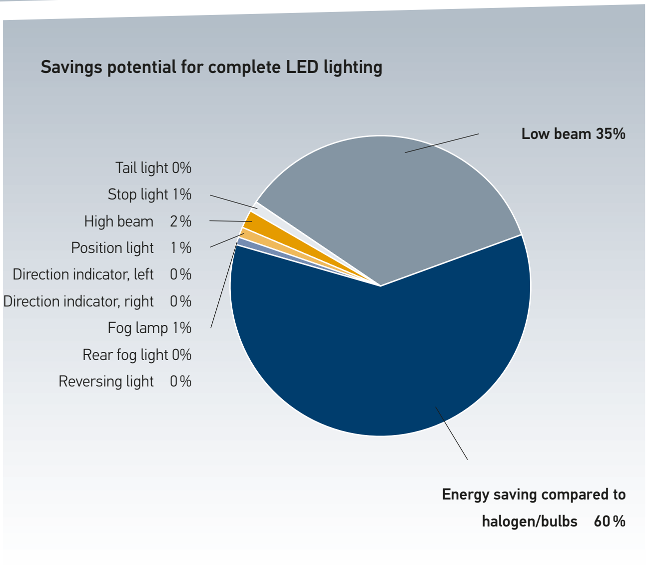
Premium class / Audi A7 (2014):
LED matrix headlamp based on reflectors

Premium class / Mercedes E-Class (2016):
Full LED headlamp with matrix HD84 module

NOTE
You can find further information on halogen, xenon, and LED light sources from page 76 onwards.





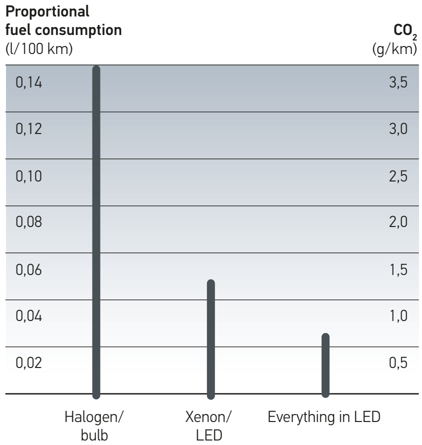


Durability: LEDs are considered to be practically maintenance-free and last considerably longer than standard halogen or xenon light sources. With service lives of several thousand hours, LEDs often last the entire vehicle life. Sophisticated thermal management also contributes to a long service life as no modern LED headlamp can do without this.

Comfort: The light colour, which is similar to daylight, is particularly pleasant for the eyes and can prevent signs of fatigue for the driver.

Safety: Because the light output is strong and the road is well illuminated, the surroundings and obstacles can be detected more easily and quickly – a plus as regards safety for all road users. This applies in particular to state-of-the-art LED lighting systems with advanced lighting functions.

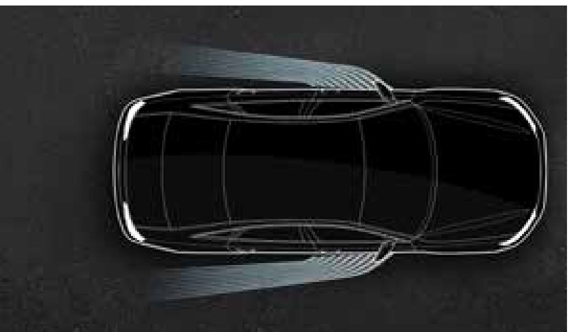
Style: In terms of vehicle development, LED technology provides new, wide-reaching design options – for both headlamps and rear lamps, as well as interior lighting (ambient lighting). Vehicle manufacturers are offered new potential to differentiate themselves – customers benefit from a stylish, unmistakable vehicle and lighting design.



Reduced CO2 emissions due to LED technology

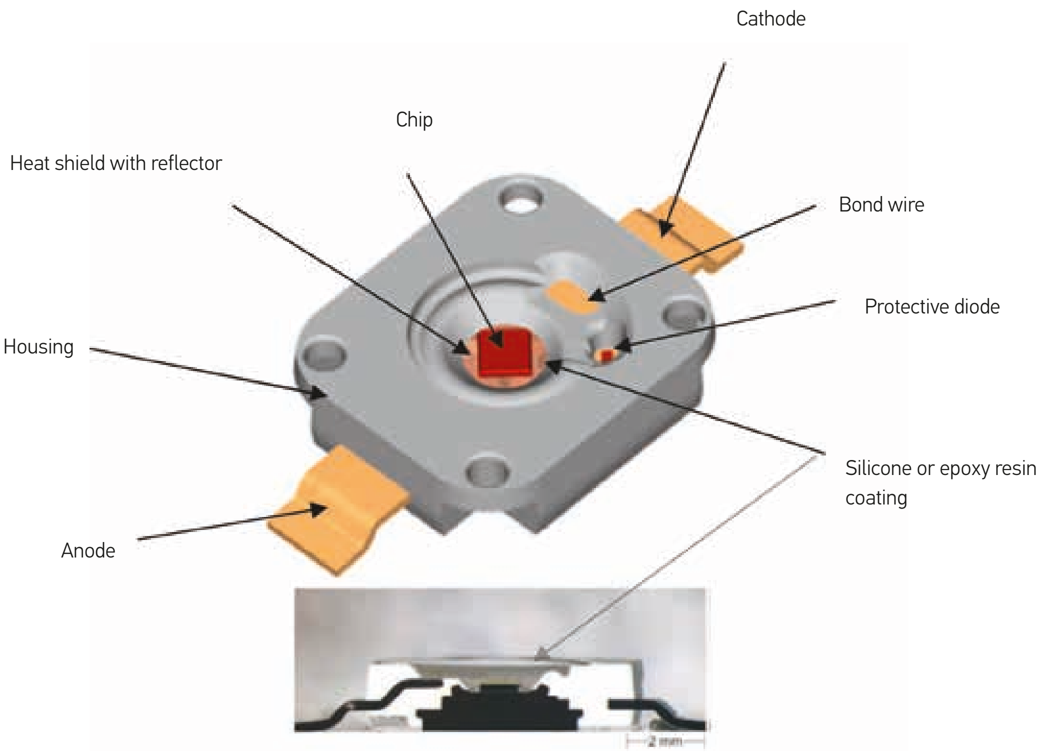
Light carpet ®: New LED technology application options

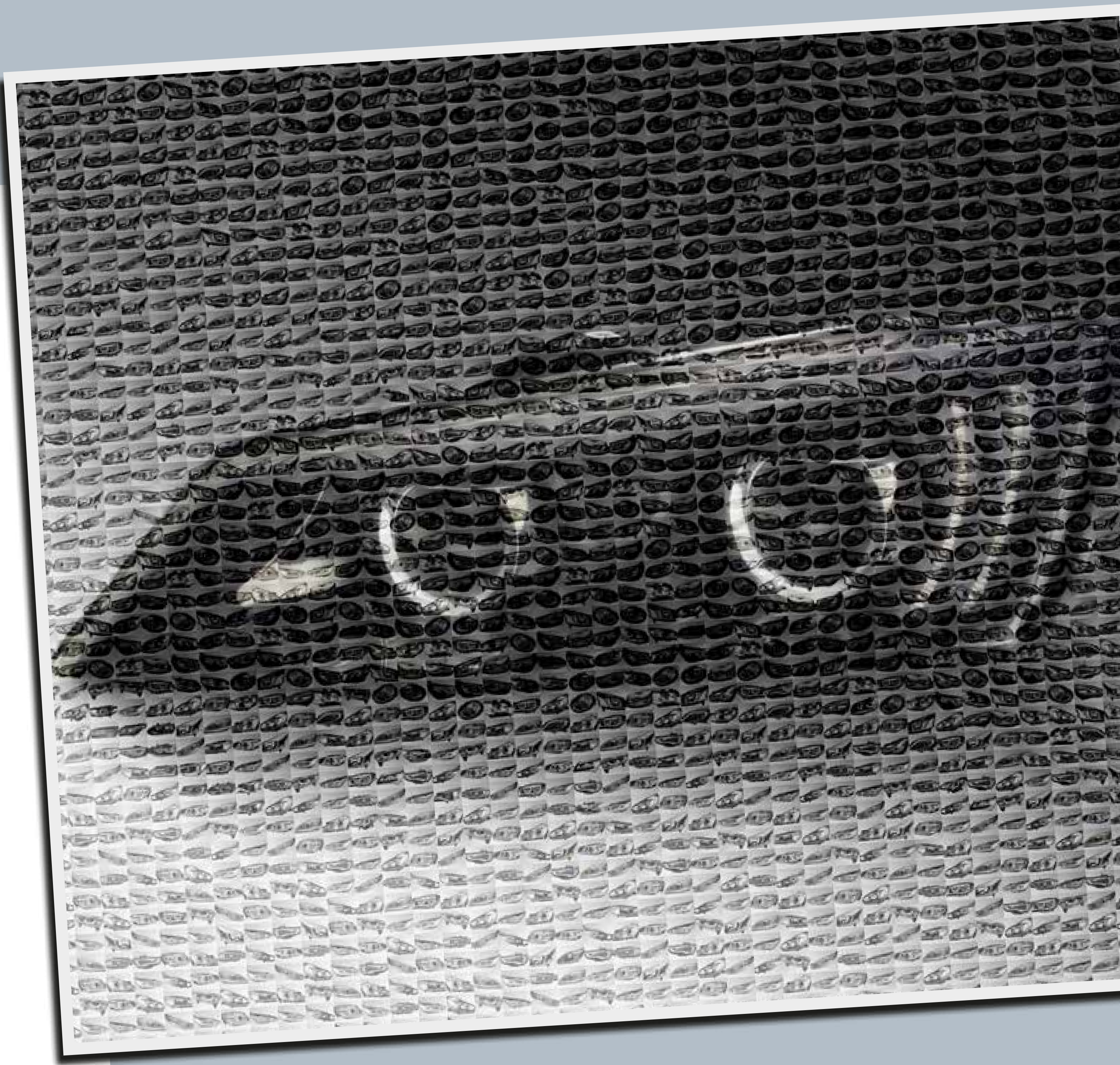
Stylish design and light signature options due to LED technology (example: Audi A8 full LED headlamp)



How does LED technology actually work?

A semiconductor crystal is responsible for light generation in an LED. It emits light when it is excited electrically. As with conventional light sources, in LED headlamps the light can also be distributed by using reflection or projector-type systems. The challenge for both systems is good thermal management, among other things. The power loss of the LEDs must be effectively dissipated from the LED chip and transferred to the surroundings.





GOOD LIGHT
IS MULTIFACETED.

MODERN
LIGHTING SYSTEMS

**Dynamic, adaptive, active:
Development of lighting systems
in the course of time**

2003 2004 2006 2008 2009 2010 2013 2016

Dynamic bend light

LED as a signal function

Adaptive Frontlight System (AFS), VarioX/ VarioLED

First full LED front headlamp

First headlamp with camera-based AFS function in the Mercedes E-Class

Matrix LED / Full LED headlamp with AFS in the Audi A8

First glare-free high beam light with 25 individually controllable LED chips without moving parts

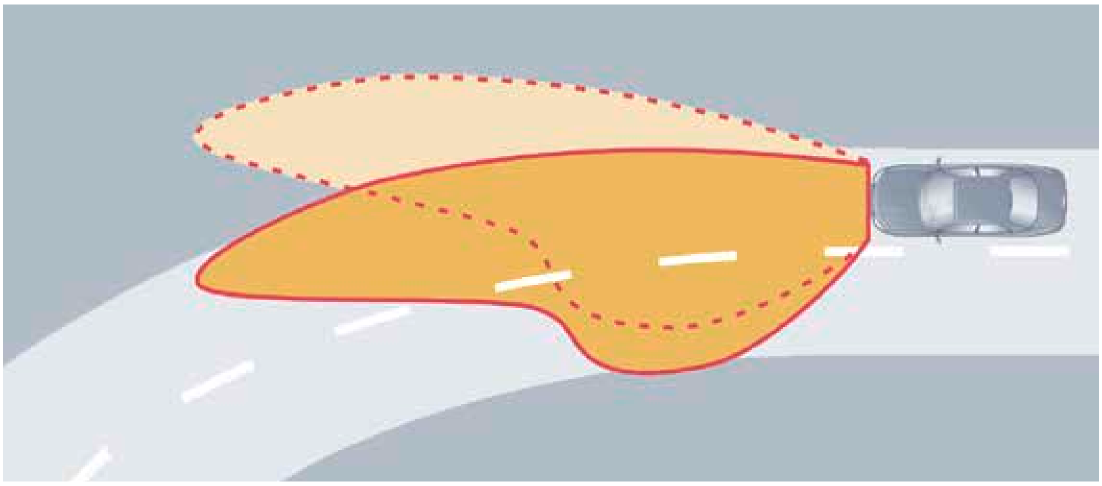
Matrix LED HD84 / Glare-free high beam light and HD84 module in the Mercedes E-Class

With the fast development and increased prevalence of LED technology, there have also been developments in the field of modern lighting systems in recent years. This is because LED technology in particular opens up ever new possibilities in this area.

This is especially true in conjunction with camera and/or radar-based assistance systems and modern vehicle electronics. Due to the perfect interaction of all the components, modern lighting systems provide numerous advantages and comforts – not only for the driver, but also for other road users. Both the levels of driving comfort as well as safety are increased considerably.

In the following, we would like to provide you with an overview of the development and technical background of selected lighting systems – from the first bend lighting to the state-of-the-art matrix HD84 headlamp of today. We also take a look into the future – what technical advances can we expect in the next few years? What systems may we find on our streets in the immediate future? Developments in this area are certainly exciting – and with HELLA you will always have your finger on the pulse!

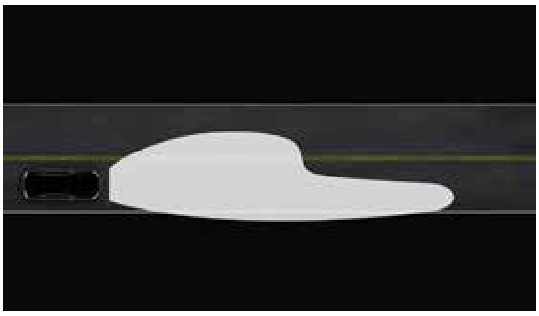
Dynamic development
One of the first light-based assistant systems was the dynamic **bend light**, which was introduced as early as 2003. In this system, the LED modules swivel depending on the steering angle. This means the visual range for bends is almost doubled.

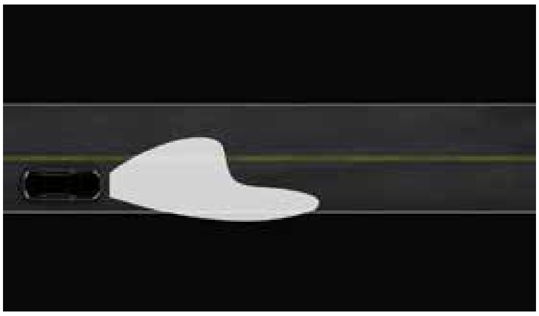


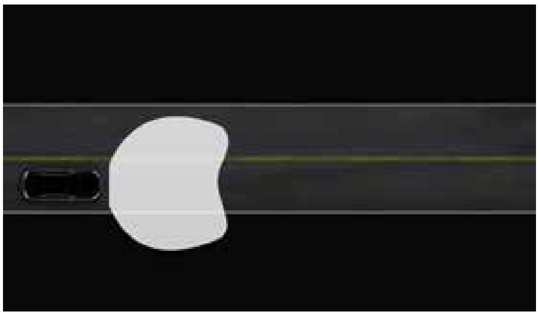
A further development of the dynamic bend light is the **adaptive frontlighting system (AFS)**. Here, in addition to the steering angle, the speed is also used as a parameter for illuminating the road. Based on this internal vehicle data, using the roller of the VarioX module (for xenon headlights) or the VarioLED module (for LED headlamps), different light distributions can be created e.g. for town or country road lights, for adverse weather or highway lights.

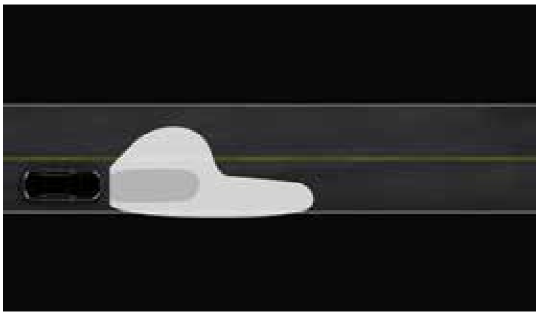
Vario headlamps: The free-form roller enables the widest range of light distributions

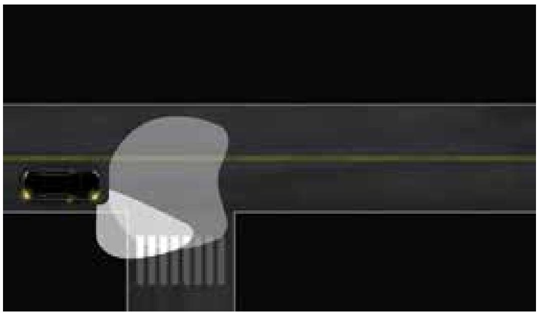
Possible lighting functions of the adaptive frontlighting system (AFS)

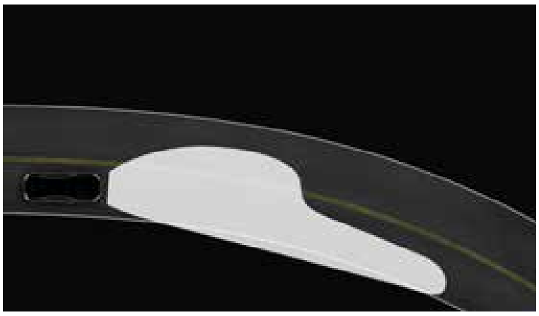

Highway light


Country light

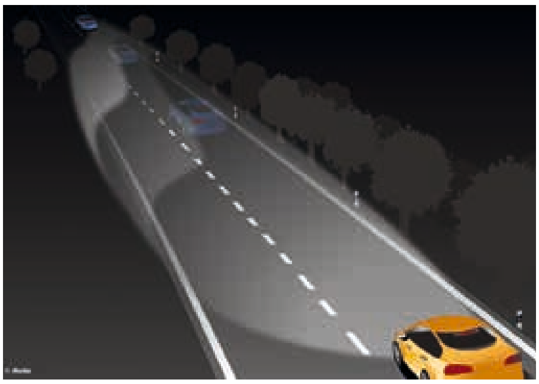

Town light


Adverse weather light

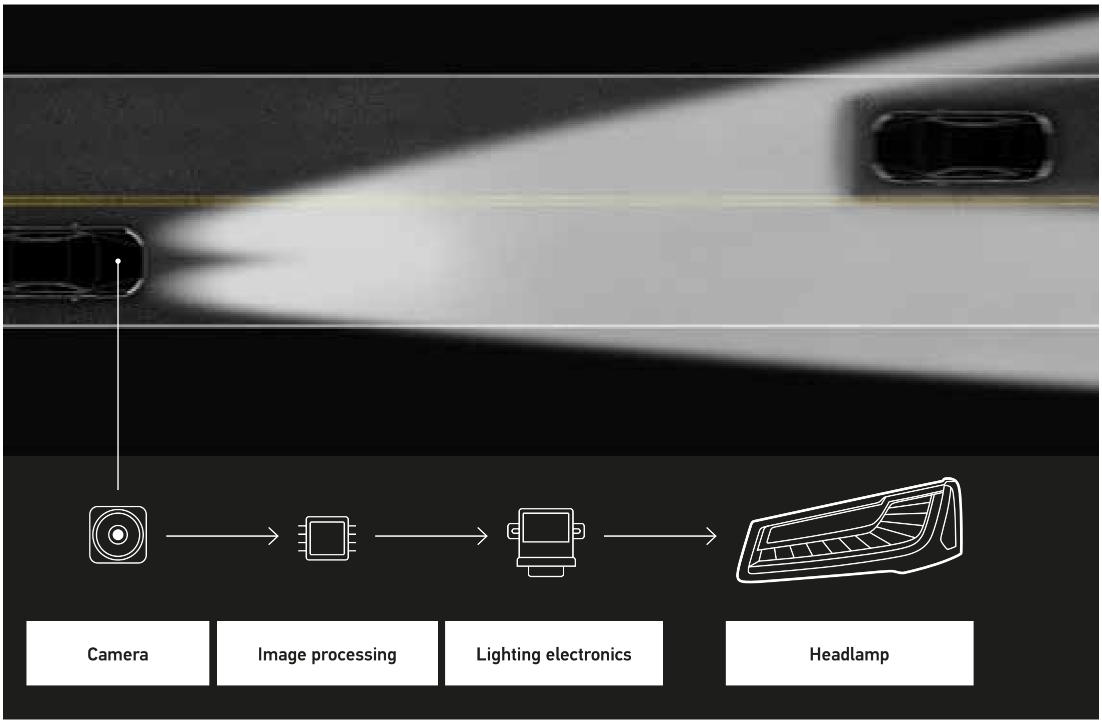

Cornering light


Dynamic bend light

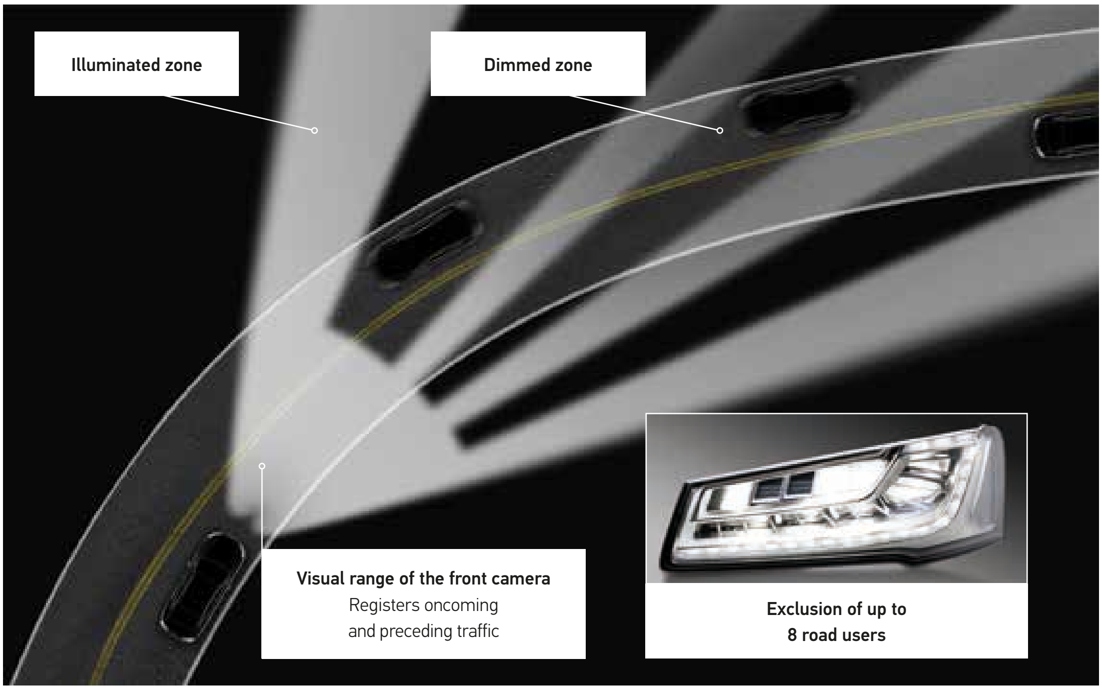
The development of the **adaptive cut-off line** goes one step further. Here, data from the surroundings of the vehicle is used to generate the light distribution. A camera detects oncoming or preceding vehicles, and with the aid of a stepper motor, the roller of the Vario module can be turned to the required position within a few milliseconds. This means the light cone always stops directly in front of the oncoming vehicle or behind the preceding vehicle.



With the **glare-free high beam light** the driver can, however, always drive with high beam lights.
If the camera detects other road users, these are excluded from the field of high beam light distribution. This is the case, for example, with the **matrix LED headlamps** in the Audi A8 (2013).



Function of camera-based lighting systems



Light distribution for the Audi A8 matrix headlamp

Modern camera-based LED lighting systems such as the matrix HD84 system provide an additional option.
As the modules can be addressed individually, objects at the edge of the road, for example, can be purposefully illuminated. The driver's attention is therefore turned to this source of danger in time and they can react earlier.

Honored with the Red Dot design award – the matrix HD84 LED headlamp

Innovative high-end lighting technology: Matrix HD84 LED headlamp

The completely newly developed matrix HD84 LED headlamp combines state-of-the-art illumination technology with award-winning design. The three-line pixel light with a total of 84 individually controllable LEDs per headlamp automatically adapts the light distribution to the traffic, weather, and road conditions within fractions of a second. The integrated adaptive High Beam Assistant Plus also ensures that high beam is used more frequently, therefore offering greater safety and comfort. Developed in cooperation with Daimler AG, this headlamp technology is used for the first time in the Mercedes E-Class (W213).

THE HIGHLIGHTS:

→ Precision module with a total of 84 individually controllable LEDs per headlamp and automatic adaptation of the light distribution to the traffic, weather, and road conditions.

→ The integrated adaptive High Beam Assistant Plus ensures that high beam is used more frequently, therefore offering greater safety and comfort.

→ The "Adaptive Highbeam" lighting function selectively masks the area the other car is in from the light distribution within fractions of a second. This also works even if several vehicles are in the sensing area of the headlamps at the same time.

→ The newly developed adverse weather light reduces reflections on the oncoming lane when it is raining by specifically dimming individual LEDs in the low beam.

→ Glare affecting the driver's own vehicle due to illuminated road signs is also reduced by the system by reducing the brightness of individual LEDs.

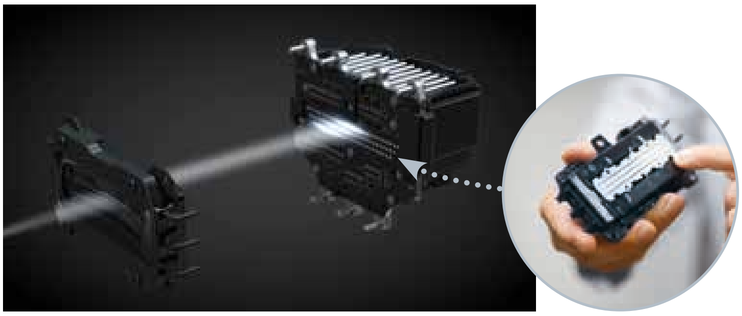
→ In the matrix HD84 LED headlamp, the primary optics – the lens system positioned directly in front of the light source – is made for the first time from a transparent silicone plastic specially developed for this purpose. In contrast to the thermoplastic plastics used up to now, the material is resistant to the high energy radiation of LEDs. In addition to this, in contrast to glass, it can be machined much more precisely and thus meets the high demands made by the minimal tolerances in the manufacturing process.

→ The first purely electronic dynamic bend light in the world. Here, variable dimming of individual pixels adapted to suit each situation allows the light focus in the particular setting to be shifted so that the driver's attention is directed towards the course of the bend.

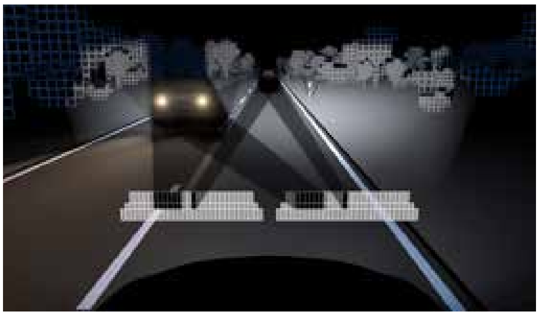
Matrix HD84 from the view of oncoming traffic:
No glare even though the oncoming vehicle with the
matrix HD84 LED headlamp has the high beam switched on

Complex technology: Matrix LED HD84 headlamp

Primary optics made from silicone plastic

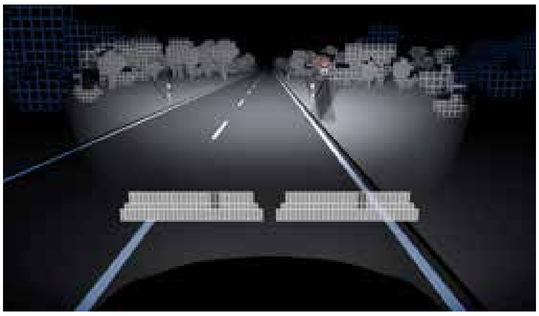


Precision module with 84 individually controllable LEDs



Glare-free high beam light due to targeted masking of individual LED modules

Automatic hazard detection; the world's first purely electronic bend lighting in low-beam function



Traffic sign detection with reduction in glare affecting the driver's own vehicle

Glare reduction on road wet from the rain

Modern lighting systems in the workshop

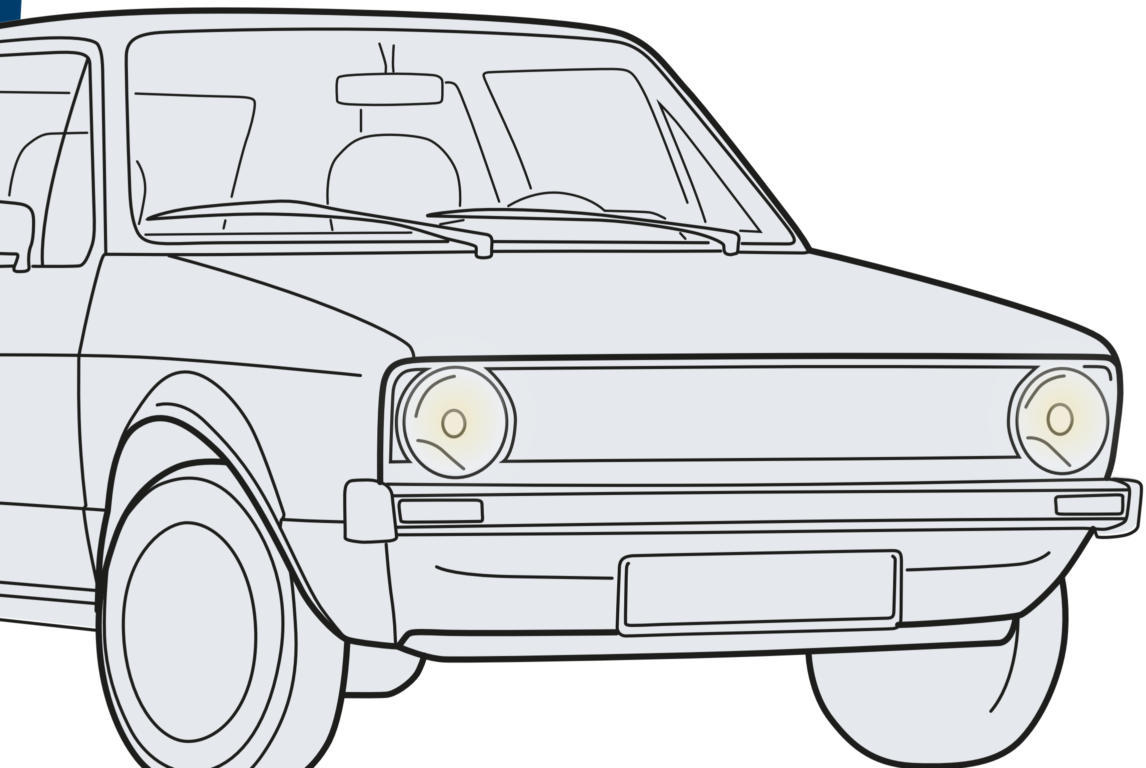
The requirements made of workshops also increase with the fast development of modern lighting systems. This is because only correctly adjusted (radar) sensors and cameras enable technical assistance systems to function smoothly. Modern LED headlamps sometimes require particular steps during measurement or adjustment. You can find an overview of the required garage equipment as well as numerous practical tips from page 22 onwards – and 24/7 online at HELLA TECH WORLD.

HELLA HEADLAMPS IN THE VW GOLF

A SUCCESS STORY

1974. The beginning of an automotive legend – after all, the VW Golf Mk 1 gave the starting signal for an automotive career that remains unparalleled to this day. Now, more than 40 years later, the VW Golf is into its seventh generation – with millions of models on the streets around the globe.

There from the beginning, and a faithful companion ever since to one of the top-selling cars in the world: The HELLA headlamps. Alongside an unmistakable "expression", the headlamps impress above all due to advanced technology which is state of the art and which has always kept pace with developments – from first-generation halogen headlamps up to the highly modern LED headlamps of the present day.



On the independent parts market, HELLA offers both halogen as well as LED headlamps for the VW Golf Mk7.
A clear practical example of headlamp installation using the halogen headlamp can be found on the following pages – the LED variant is installed in the same way.

Following installation, a visual and functional inspection, as well as measurement and adjustment of the new headlamp in accordance with the manufacturer's specifications should be carried out – for this, please also see the comprehensive information from page 22 onwards.

Master at work:
Replacing halogen headlamps on the VW Golf Mk7

HELLA also applies its many years of OE expertise on the independent parts market and provides a wide range of high-quality spare parts in OE quality.

In the following example, we demonstrate the individual steps which should be noted when replacing a headlamp, using the left halogen front headlamp on the VW Golf Mk7. In addition to the halogen headlamp, HELLA also offers a xenon variant for the independent parts market.

1

Preparation: First of all, the hood is opened and the headlamp system is disconnected from the voltage supply.

2

The radiator grille is then removed.
For this, the following steps are required:
Unscrew the fastening screws.

Unlock the locking lug using a screwdriver.

Depending on the vehicle model, unscrew the fastening screws of the bumper to the radiator.

Pull the radiator grille forward and at the same time pull it out of the hood latch locking mechanism.

NOTE: The bumper should be secured against falling! Furthermore, before carrying out the next steps, areas which are at risk of being scratched on the headlamp and the bumper should be masked to prevent this.

3

4

5

Loosen the wheel arch paneling
Next, the fastening screws at the wheel arch liner at the front are unscrewed. Depending on the vehicle, the underbody protection screws are also unscrewed.

Remove the bumper
The bumper is carefully removed. Here, take care that this is not deformed or cracked.

The old headlamp can now be removed.
For this, unscrew the corresponding fastening screws at the sides and on the inside. The electrical plug connection can then be detached and the headlamp can be pulled out.

6

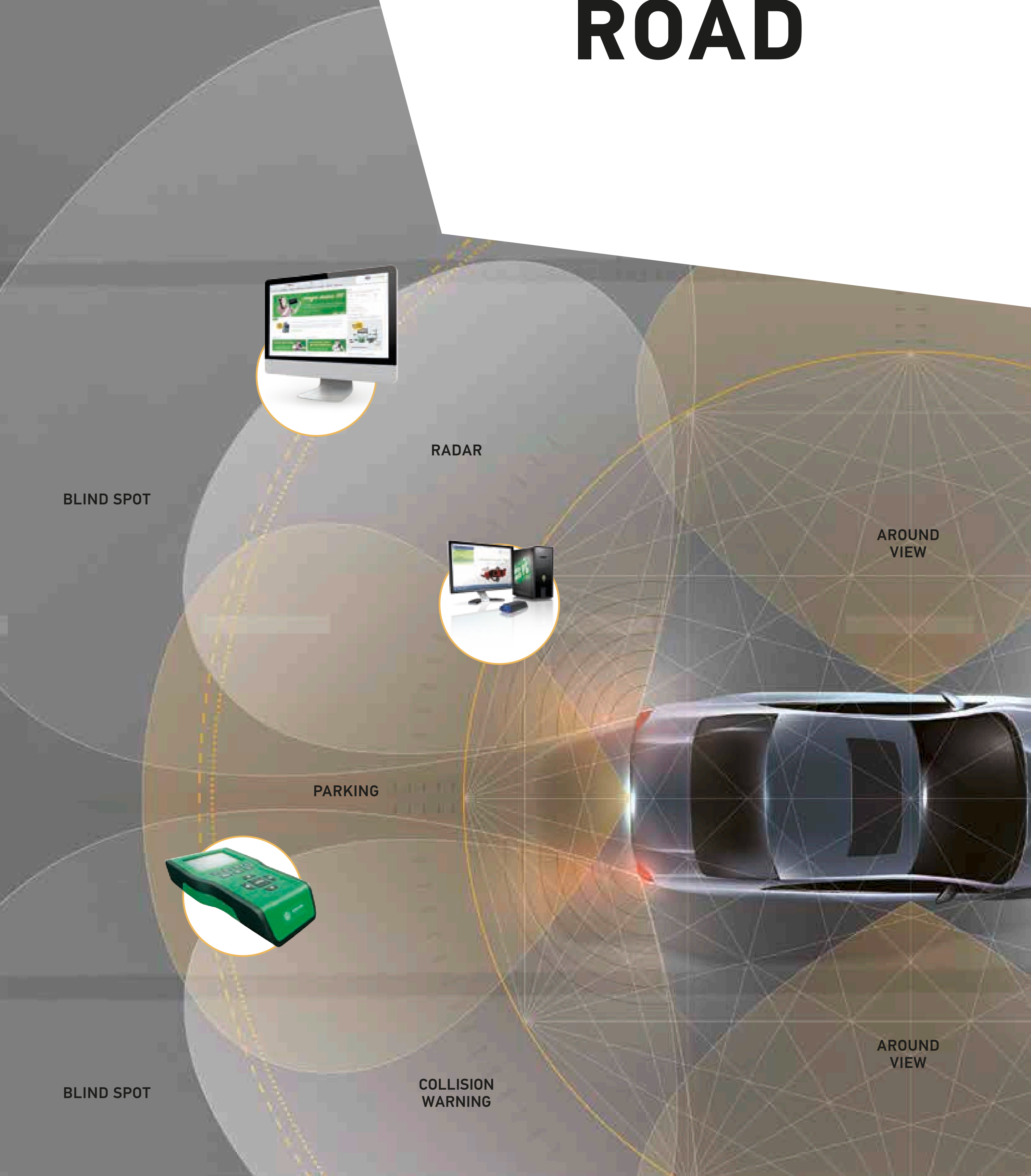
The new headlamp is installed as follows:
Carefully insert the headlamp, fitting it into the guide profile of the bumper; screw the screws in again and connect up the plug connection.

i

The following should also be noted during installation:

- → Keep the gap width between the headlamp and body parts constant
- → Lock in the bumper correctly
- → Correctly attach strain relief for the electrical connection line (depends on the vehicle)
- → Note the correct tightening torques

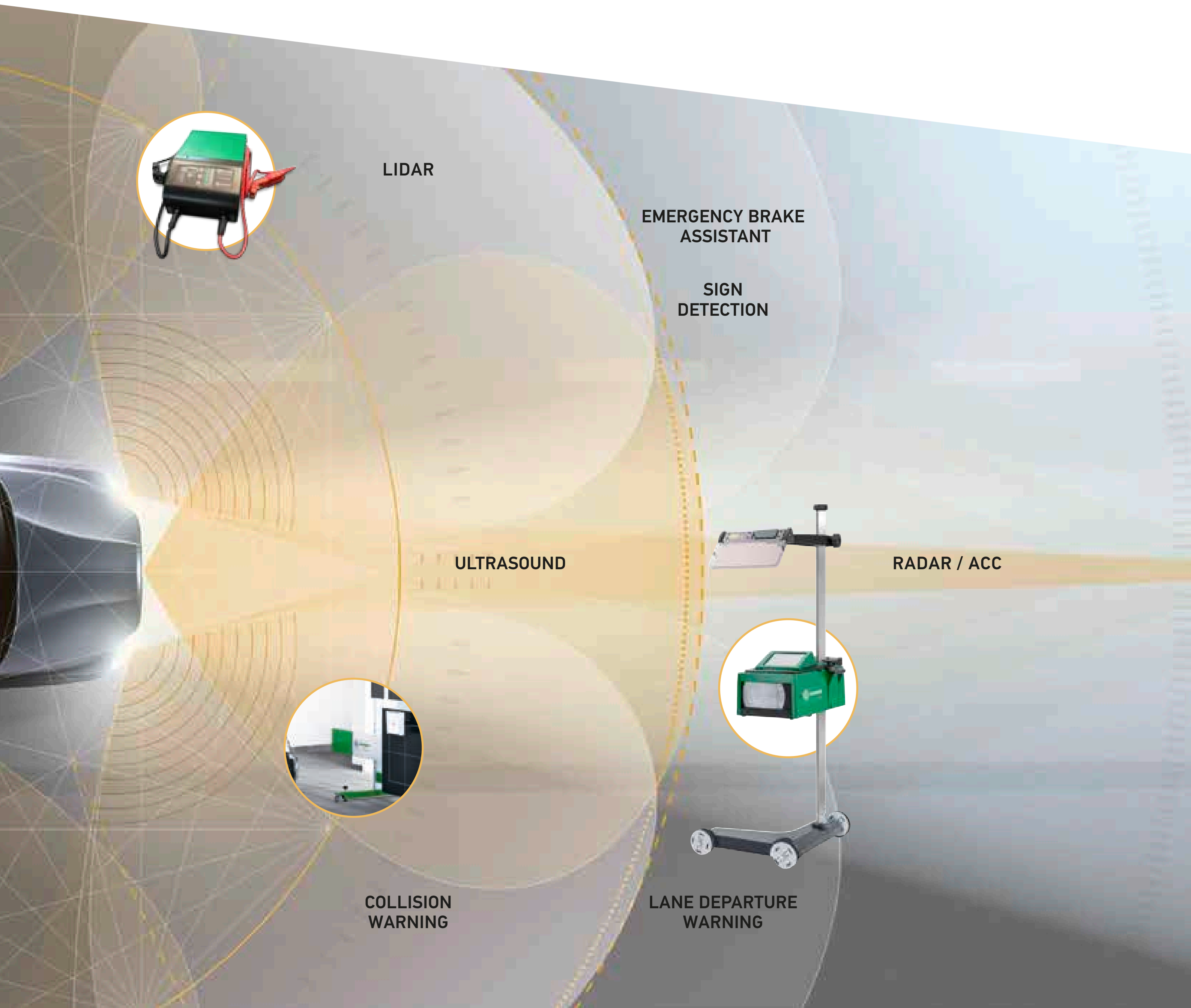
BACK ON THE ROAD



It is the aim of every workshop to get the customer's car back on the road again fast, and to gain high levels of customer satisfaction. But this is not possible without a correct test, diagnostics, and successful repair – and nowadays, these are not possible without professional garage equipment. Especially given the fast technical developments, the vehicles and their components are becoming increasingly complex – and the requirements made of a workshop's technical equipment ever greater. This concerns vehicle lighting in particular, too, and therefore the associated electronics and the sensor systems.

Whether for a light check, headlamp adjustment/calibration, or radar adjustment, on the following pages, we will provide you with an overview of the garage equipment required for successful diagnostics and repair – and also what other requirements must be met as regards a correctly set-up headlamp adjustment station, for example.

Last but not least, using selected simplified practical examples, we show you the basic steps which should be carried out when checking the headlamps and adjusting the radar.



HEADLAMP **ADJUSTMENT** GENERAL INFORMATION

HEADLAMP ADJUSTMENT – PROCESS AND GENERAL INFORMATION

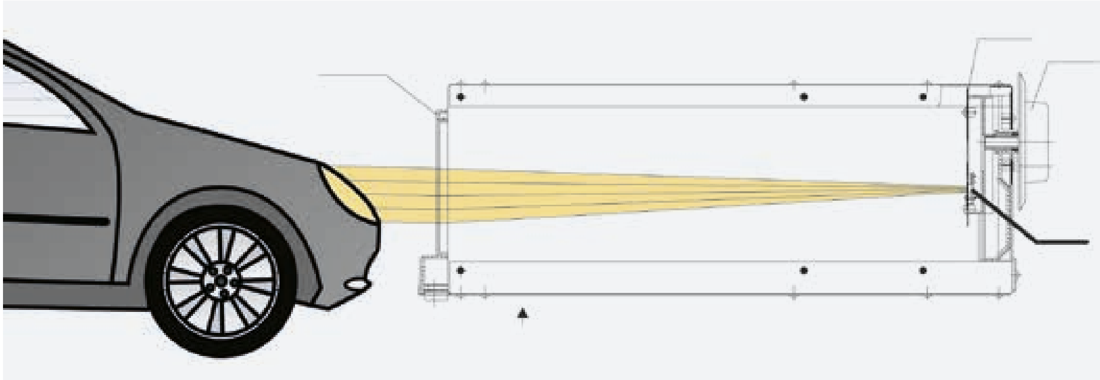
They aid visibility and safety. Correctly adjusted headlamps are an absolute must on the road – and should therefore regularly be measured and re-adjusted as required by a workshop. Until recently, this test was carried out using the so-called "10-metre wall". With this measuring method, a vehicle is placed at a distance of 10 m in front of a light-coloured wall which has certain markings on it. The headlamps are then checked or adjusted on the basis of these markings.

This may still be a statutory test method today, but in the described form, it is at best used for checking the lights on agricultural or special vehicles which have the headlamps installed in a high position. This is because the disadvantages of the "10-metre wall" are obvious: You need a relatively large, light-coloured and free wall and a corresponding amount of space – especially in smaller workshops, both of these are just not available. Furthermore, today's modern lighting systems place significantly higher demands on the measuring process.

Nowadays, the checking of headlamps and their adjustment is almost exclusively carried out using modern beamsetters ("SEG" for short). Such devices enable quicker and more flexible checking of the light distribution.

Shortening the measuring distance using a beamsetter

Beamsetters fundamentally simulate the 10-metre wall described above. Here, the lens installed in the beamsetter box shortens the prescribed 10-metre distance to just 50 cm.

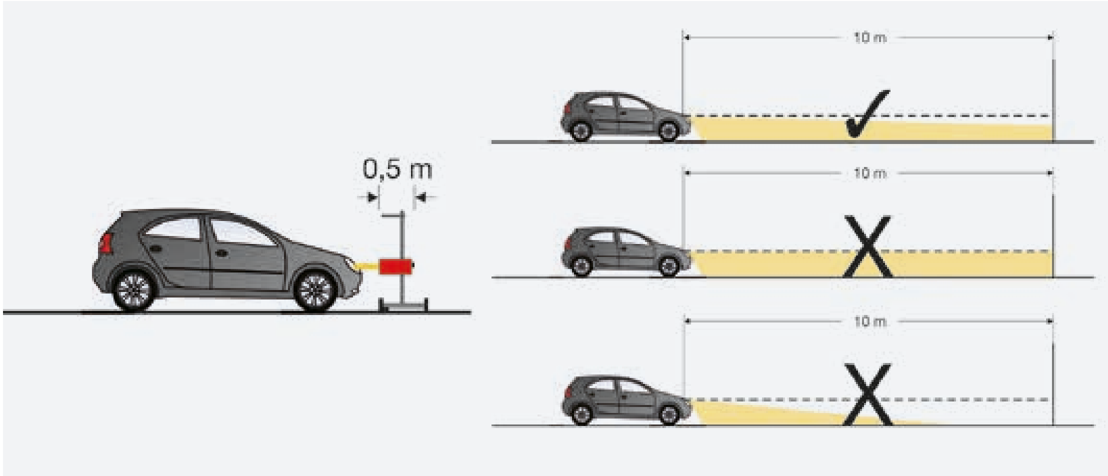


Shortening of the 10 m measuring distance due to a Fresnel lens in a beamsetter (representation of the lens to the aiming screen)

The disadvantages, such as high amount of space and a suitable wall, are thereby omitted. A beamsetter can also be flexibly used at different places, provided the respective workshop floor adheres to the required tolerances.

The composition and condition of the floor are of primary importance to enable exact headlamp adjustment. 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.

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



Effect of tolerance deviations in the condition of the floor on the light distribution

A sample calculation makes this clear:

→ As already mentioned, a lens is installed in the beamsetter which shortens the prescribed 10 m measuring distance to the wall to only 50 cm.
→ A mere 5 mm measured wrongly on the aiming screen of the beamsetter thus corresponds to 10 cm difference over 10 m (ratio 10 m to 50 cm is factor 20).
→ A vehicle with headlamps installed at a height of 60 cm has a low beam with a range of 60 m (at 1% forward tilt = 10 cm inclination to 10 m range).
→ This means that the headlamp light would deviate by 60 cm if incorrectly adjusted.

This shows the decisive effect that a precise test surface has on light distribution, as millimetres can decide between glare for the oncoming traffic or driving in semi-darkness.

For further requirements for the condition of a correctly set-up headlamp adjustment station, please see page 30.

Preparation of the vehicle to be checked

During headlamp adjustment, it is not only the floor conditions which are important. The vehicle must also be prepared for the test.

The following points must be observed:

→ Test the headlamp function.
→ Check the cover lenses for damage from gravel throw, scratches, and for dullness.
→ The tyres must have the prescribed air pressure.
→ Load the vehicle with a person or a weight of 75 kg on the driver's seat. The vehicle is otherwise not loaded. Please observe the specifications of the manufacturer.
→ 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 loaded with a person or 75 kg on the driver's seat.
→ In the case of vehicles with hydraulic or air suspension, the manufacturers' instructions must be heeded.
→ If automatic correction of the headlamps 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 diagnostic tester is required for adjusting various vehicles with automatic headlamp leveling, since the control unit has to be set to "basic mode" during adjustment. Once the cut-off line has been set correctly, this value will be stored as the new standard position.

Setting up the beamsetter

If the floor conditions are alright and the vehicle has been prepared, the beamsetter still has to be aligned to the vehicle to enable exact adjustment:

- → Move the beamsetter in front of the headlamp to be checked.
- → Using the broad-band, laser, or mirror sight, align the beamsetter box to the vehicle in such a way that the sight line touches two points situated at the same height, symmetrically to the vehicle's longitudinal axis, see the figure below. With the dashed lines, the distance from the front edge of the beamsetter box to the headlamp may be between 30 and 70 cm.
- → Align the beamsetter box to the middle of the headlamp or to the light source, using a laser pointer if necessary. Vertical and horizontal deviations may not exceed 3 cm. The distance between the beamsetter box and the headlamp varies depending on the manufacturer.

Please observe the applicable country-specific regulations and information provided by the vehicle manufacturer.

EQUIPPED FOR EVERY EVENTUALITY:
SELECTED BEAMSETTERS FROM HELLA GUTMANN SOLUTIONS

Beamsetters are an indispensable piece of garage equipment. Only by using them can workshops ensure that they cover as many customer requirements as possible as regards the measurement, adjustment, and calibration of modern headlamp systems, as well as ensure that they are technically up-to-date. The beamsetters from Hella Gutmann Solutions are a valuable aid for many workshops here – they are versatile, flexible, and reliable. Here we present two examples in greater detail:

SEG IV – THE RELIABLE ALL-ROUNDER

Due to a new scale on the aiming screen, with the analog Hella Gutmann Solutions SEG IV all current headlamp systems such as halogen headlamps, xenon headlights, LED headlamps, and systems with high-beam assistant (vertical cut-off line) can be tested and adjusted with precision.

→ The adjustment range of the column from 250 mm to 1450 mm enables fast and convenient adjustment for passenger cars, trucks, and motorcycles, as well as for vehicles with a height of over 1.20 m, for example agricultural vehicles and municipal vehicles.
→ Vertical scale on the new aiming screen enables values to be read off in 0.1° increments (scale in 0.2° increments).
→ Aiming screen suitable for all light distributions such as low beam, high beam, and fog lights as well as for light distributions for the different high-beam assistants.
→ Suitable for evaluation and calibration (in conjunction with the mega macs diagnostic unit) of matrix LED high beam light, for example, for the Audi A8.

SEG V –
DIVERSE HEAD-TURNER

The SEG V from Hella Gutmann Solutions is a digital beamsetter of the latest generation.

- 8.4" touch display aimed at the user for clear and intuitive control of all the functions.
- Electronic position sensor to compensate for unevenness of the floor.
- Long battery operating time for mobile work, short charging times.
- Sturdy design.
- Clear vehicle identification using "Car History".
- CMOS camera to record the light distribution and subsequent electronic evaluation.
- Real-time display of the light distribution with specific data on the display.
- Software based on the mega macs diagnostic unit.
- USB interface for transferring the logged measurement data to peripheral devices.

The simplification of work provided by the SEG V is most evident when fine-tuning state-of-the-art high-beam assistance systems, since the traditional cut-off lines are not visible in this case. Having the vehicle information stored on the SEG V lets you select the corresponding headlamp at a moment's notice, including the correct adjustment method.

ON THE PATH TO SUCCESS WITH ACCURATE TESTING

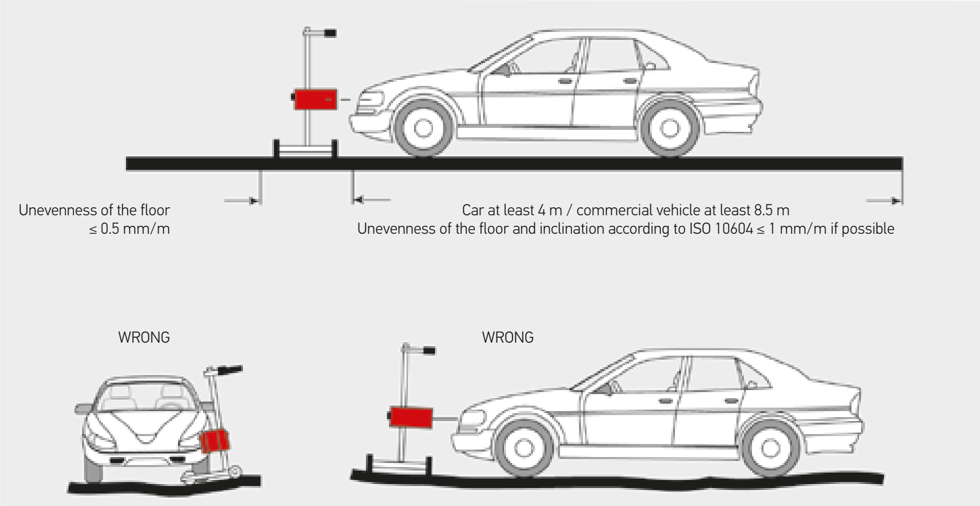
REQUIREMENTS FOR A STANDARDISED HEADLAMP ADJUSTMENT STATION

The increasing prevalence and further development of new headlamp technologies and light assistance systems also leads to greater requirements when it comes to inspecting and adjusting headlamps. This of course not only applies to the beamsetters, but also the measurement environment. In order to ensure greater precision when measuring and adjusting headlamps, a directive was created in Germany which, as it stands, is to be implemented at the start of 2018. It contains precise information for the correct setup of a standardised headlamp adjustment station. On this page, we provide you with an overview of some of the things that workshops should observe.

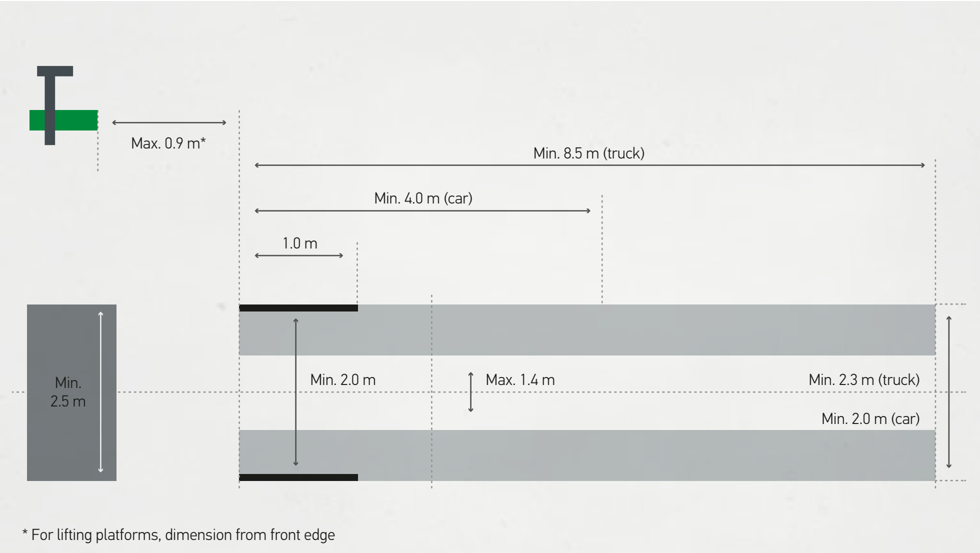
THE REQUIREMENTS

- → The testing area and beamsetter must be an interlinked system and form a measuring unit.
- → The set-up surface for the vehicle and beamsetter must be clearly identified, with floor markings, for example. At least two lines are required which indicate the start and the outer edge of the set-up surface. Marking of the set-up surface which goes beyond this is recommended.
- → For light tests, the inclination of the set-up surface for the vehicle must not exceed 1.5 % and must be aligned.
- → For cars, the length of the testing area must be at least 4 m – for trucks, the minimum length is 8.5 m.
- → The unevenness of the headlamp adjustment station may be a maximum of +/– 1 mm over 1 m.
- → The headlamp adjustment station must be approved every two years by an expert.

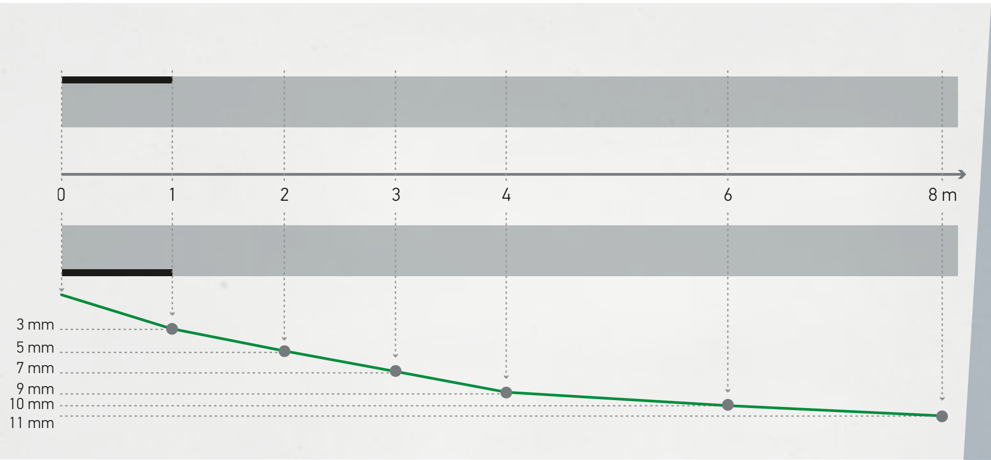
The requirements mentioned here refer to the main inspection (HU) testing guidelines applicable in Germany from 01/2018.
In other countries, the relevant national regulations must be observed.



Requirements for evenness of the vehicle set-up surface



Dimensions which must be complied with for a standardised headlamp adjustment station



Requirements for the vehicle set-up surface as regards permitted unevenness

TIP

With a leveling plate system, for example from Hella Gutmann Solutions, the requirements for evenness and inclination of the headlamp adjustment station in accordance with the directives can often be met even without construction measures.
Using variable adjustment elements, individual heights can be compensated for in each lane.

ILLUMINATING EXAMPLES

PRACTICAL TIPS FOR HEADLAMP ADJUSTMENT

On the previous pages, we presented the principles and tools which are necessary for optimum headlamp adjustment. In addition to a qualified workshop employee and a correctly set-up headlamp adjustment station*, the centrepiece is of course the beamsetter. The adjustment can essentially be made with both an analog beamsetter as well as a digital beamsetter.

In the following practical examples, we demonstrate the typical procedure for headlamp adjustment based on selected vehicles – in each case using the analog SEG IV and the camera-based (digital) SEG V from Hella Gutmann Solutions.

Further information and other tips and tricks on the topic of headlamp adjustment can be found 24/7 online at HELLA Tech World:
www.hella.com/techworld

* YOU CAN FIND THE REQUIREMENTS FOR SETTING UP A
HEADLAMP ADJUSTMENT STATION ON PAGE 30.

BMW 5 SERIES

A CHECKLIST FOR THE VISUAL AND FUNCTIONAL INSPECTION CAN BE FOUND IN THE TECHNICAL NOTES.

1 **Vehicle and work preparation** *(SEG IV & SEG V)*
Irrespective of the beamsetter used, the vehicle must be prepared before the actual measurement or adjustment. This includes correct placement on the headlamp adjustment station, a comprehensive visual inspection, as well as the connection of a battery charger.

2 **Read the forward inclination** *(SEG IV & SEG V)*
The next step involves reading off the required forward inclination of the cut-off line for the headlamp. For the BMW 5 Series, this information is located directly on the headlamp.

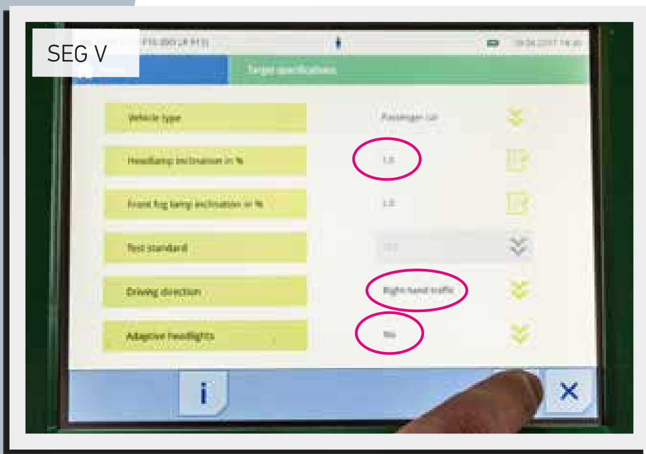
3 **Align the beamsetter** *(SEG IV & SEG V)*
The beamsetter is now aligned to the vehicle with the aid of the laser sight.

4 **Positioning of the beamsetter** *(SEG IV)*
Following alignment to the vehicle, the beamsetter is positioned correctly to the headlamp using the laser pointer.

SEG IV = analog diagnostic unit, SEG V = digital diagnostic unit

5 **Check the low beam** *(SEG IV)*

The test scale shows the measurement of the low beam on the SEG IV. In this example, this is adjusted correctly. In the event of deviations on the scale to the top or bottom, the headlamp must be re-adjusted accordingly.

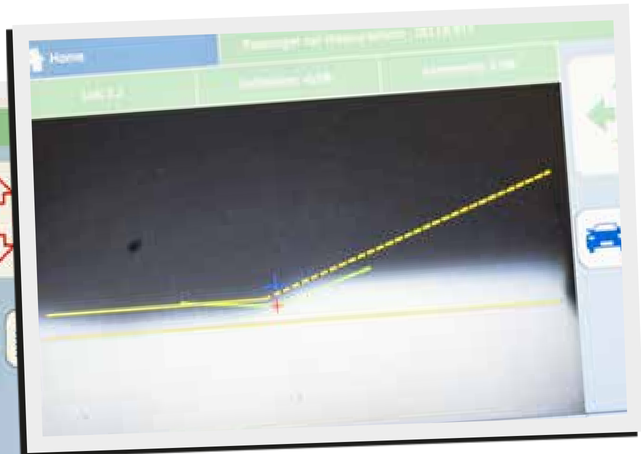


5 **Check the low beam** *(SEG V)*

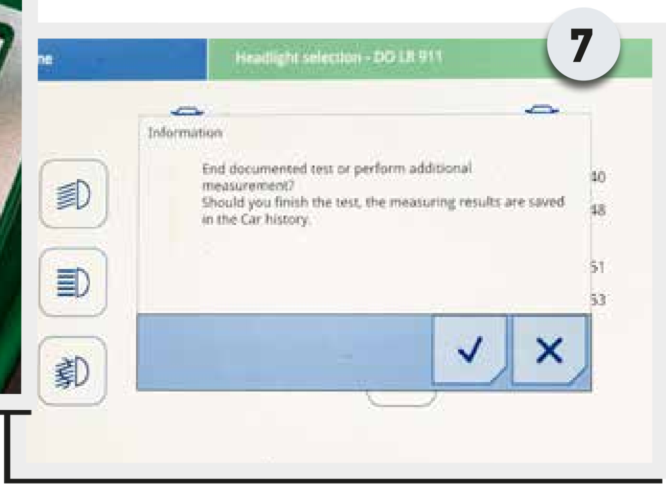
For the SEG V, the test procedure is initiated via the device menu. For this, first of all the vehicle to be checked is selected.
The vehicle can (as in the example) be selected from the vehicle database or created manually. Furthermore, vehicles that have already been tested can be saved in a history and called up at a later point.

The forward inclination angle is also entered via the menu, as well as the selection of whether the vehicle is left-hand drive or right-hand drive, and specification of the adaptive frontlighting system (AFS).

The low beam test for the right side of the vehicle is initiated by tapping on the symbol. Following confirmation of the positioning information, the measurement and direct display of the result follow. In the example, the measurement result is OK.



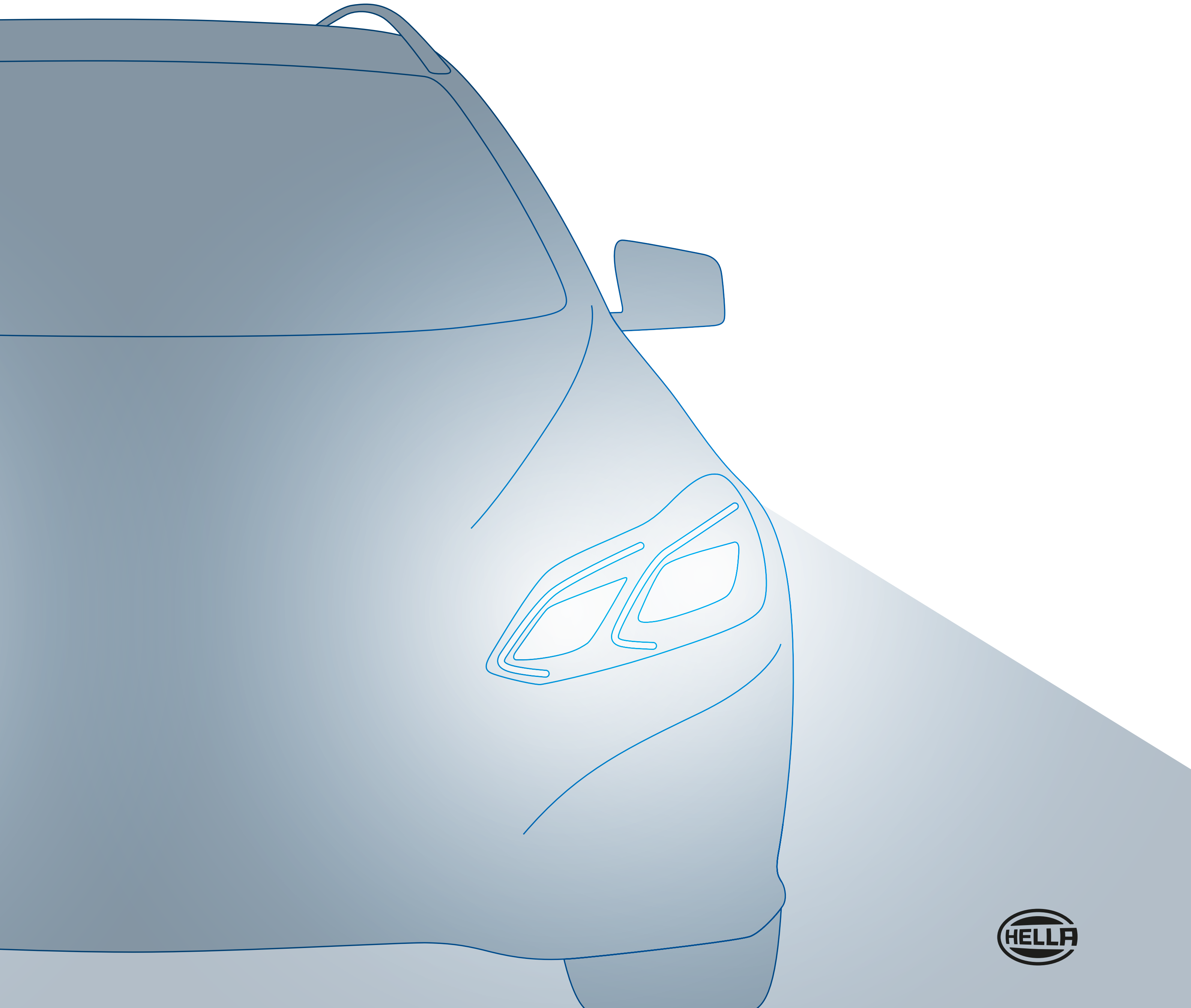
❻ **Check the high beam** *(SEG IV & SEG V)*
Once the measurement of the low beam function has been carried out, the test of the high beam is carried out on both devices.

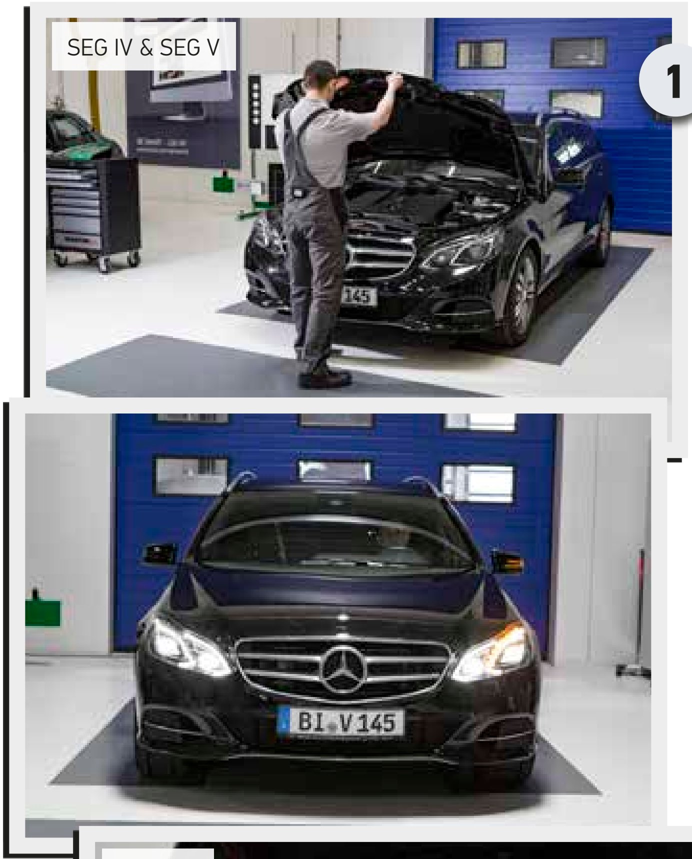


❼ **Conclusion of the testing** *(SEG V)*
For the SEG V, the measurements are displayed with the date and time respectively following the test. The results are automatically saved in the measurement history and can be called up again at any point later.

THE REQUIREMENTS FOR SETTING UP A HEADLAMP ADJUSTMENT STATION CAN BE FOUND IN THE TECHNICAL NOTES.

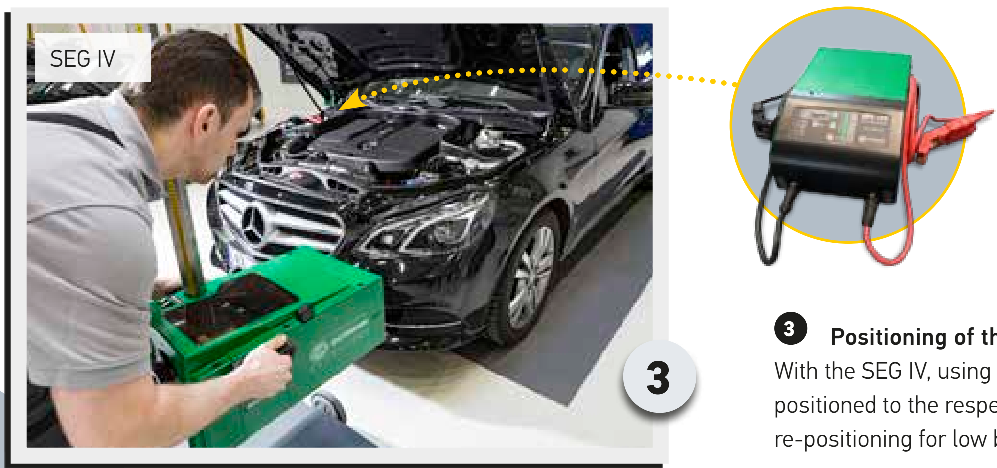
MERCEDES-BENZ
E-CLASS





1 Vehicle and work preparation *(SEG IV & SEG V)*
First of all the vehicle is prepared: This includes placement on the correctly set-up headlamp adjustment station, connection of a battery charger, as well as a visual and functional check.
You can find an overview of the setup of the workplace on page 30.

2 Alignment to the vehicle *(SEG IV & SEG V)*
The beamsetter is then aligned to the vehicle.

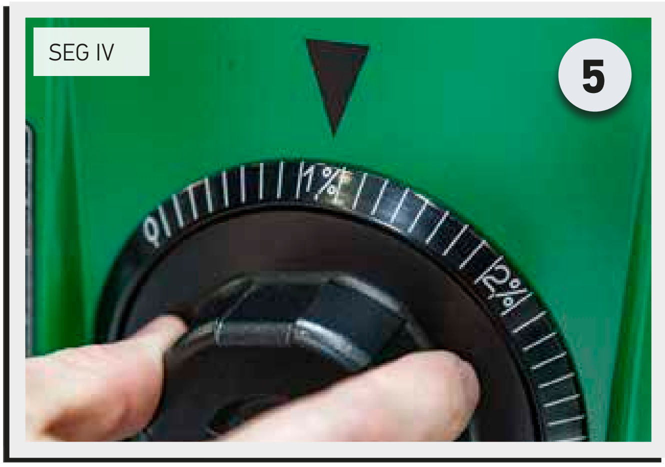


3 Positioning of the beamsetter to the headlamp *SEG IV)*
With the SEG IV, using the laser pointer, the device is optimally positioned to the respective light source (for dual headlamps, re-positioning for low beam/high beam required).

SEG IV = analog diagnostic unit, SEG V = digital diagnostic unit

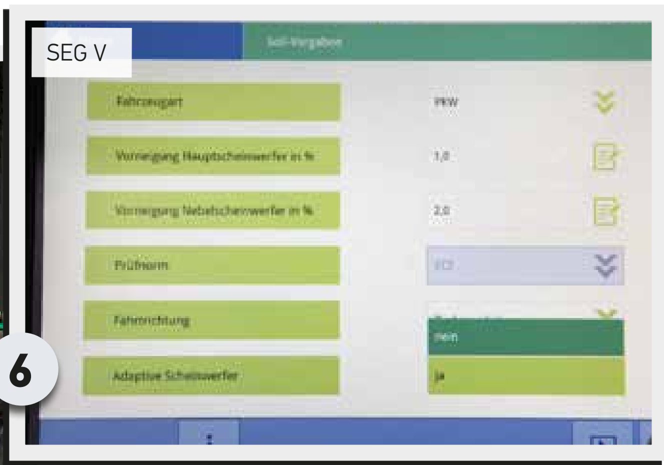
PRACTICAL EXAMPLES OF HEADLAMP ADJUSTMENT
MERCEDES-BENZ W 212 (E-CLASS UP TO MODEL YEAR 2016)

4 Read the forward inclination *(SEG IV & SEG V)*
For the Mercedes W 212 the required forward inclination can be read from the B-pillar. In the example, this is 1 %.



5 Set the forward inclination *(SEG IV)*
With the SEG IV, the forward inclination read from the vehicle is set using the rotary knob.

With the SEG V, the forward inclination is automatically taken over by the device following vehicle selection.

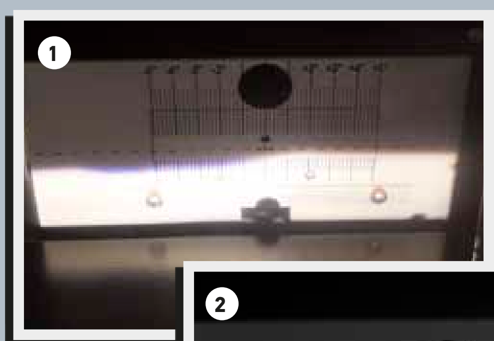


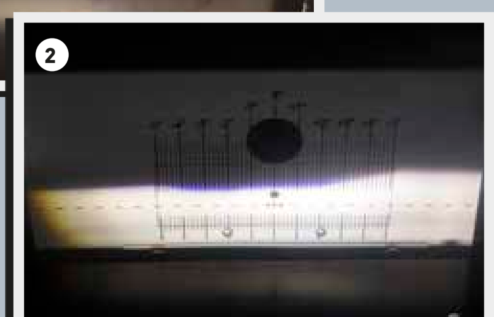
6 Initiation of the light measurement (s) *(SEG IV & SEG V)*
The actual light measurement is then initiated – first of all of the low beam.

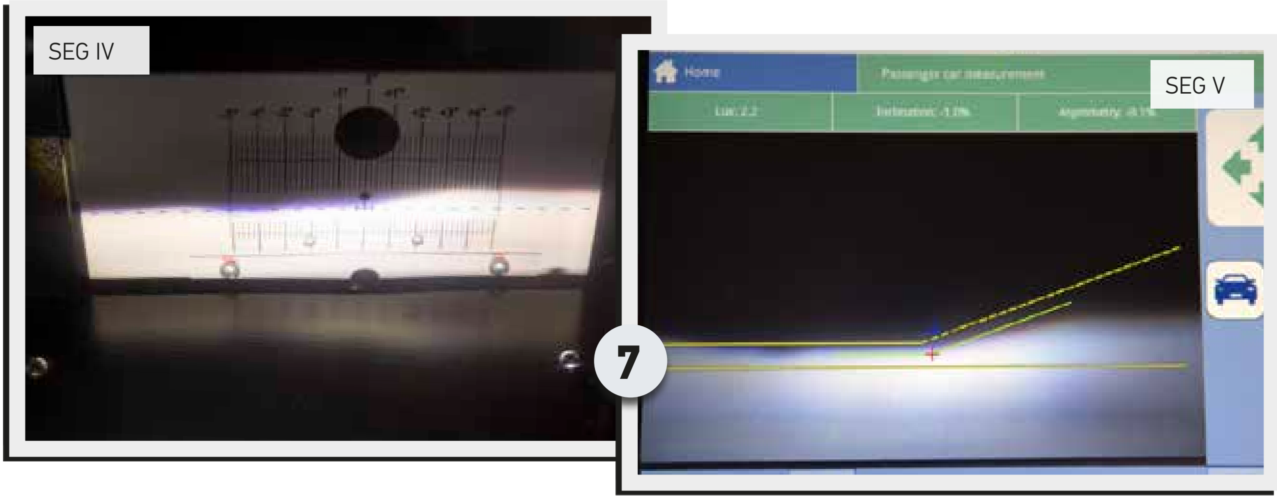
DEVIATIONS

Deviations from the reference specifications
Two examples

In our example measurements above, the results were perfect. But what do results that deviate from the standard value look like? We provide an overview based on low beam measurement using the SEG IV.

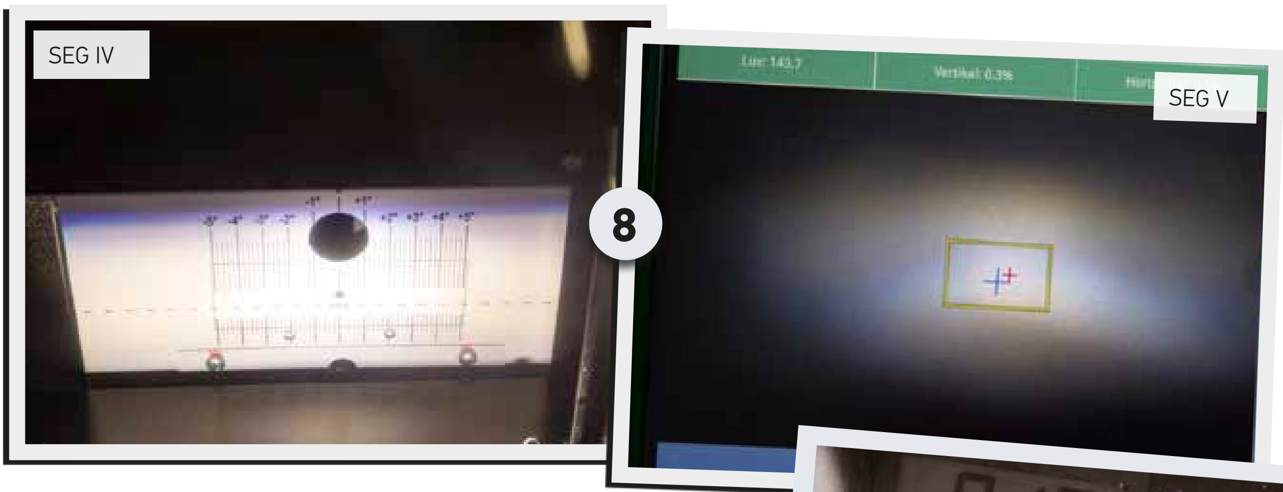






7 **Low beam measurement results** *(SEG IV & SEG V)*
The results of the low beam can be read from the analog scale on the SEG IV.

On the SEG V, the results are displayed digitally. In the example, the light distribution is OK in each case.



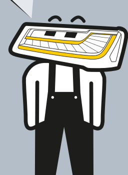
8 **High beam measurement results** *(SEG IV & SEG V)*
The high beam measurement is then carried out. Here the results in the example measurement are also OK in each case.

Practical tip
Alongside the light distribution measurement, both the SEG IV and the SEG V enable you to measure the lux values emitted from the headlamp. This means you can reliably assess whether the highest permitted glare value for the low beam is exceeded and the minimum high beam illuminance is reached or the maximum illuminance is exceeded.

1 In the first example, the headlamp is set too low and too far to the left. This is shown by the fact that the measurement line runs below the reference line and the centre is offset.

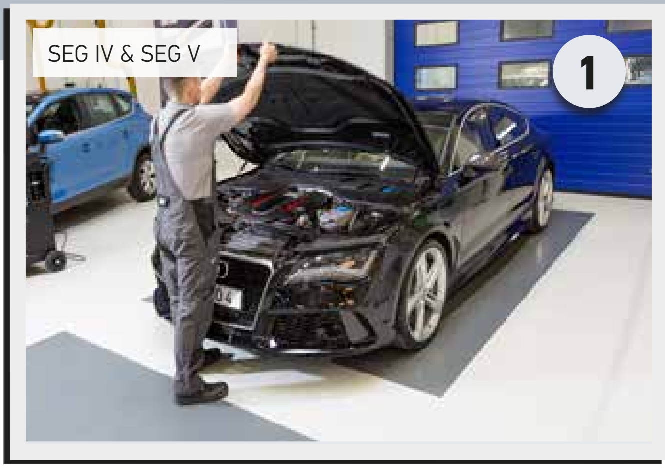
2 In the second example, the headlamp is set too high and too far to the right. The cut-off line runs above the reference line and the centre is also offset.

In both cases, the headlamps would need to be re-adjusted until the reference specifications are met.



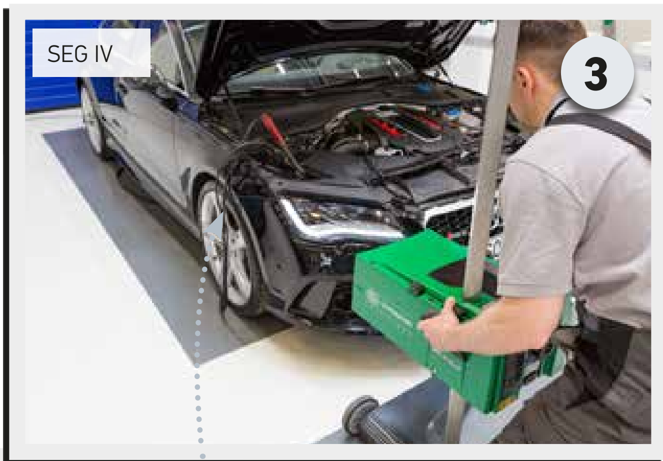
AUDI RS 7

1 **Preparation** *(SEG IV & SEG V)*
The Audi RS 7 must also first of all be prepared. This means: Placement on the headlamp adjustment station which complies with the standards (see page 30), connection of the battery charger, and visual inspection of the headlamps and their function.



2 **Alignment to the vehicle** *(SEG IV & SEG V)*
Using the laser, the beamsetter is then correctly aligned to the vehicle.

3 **Positioning** *(SEG IV & SEG V)*
The beamsetter is placed in the correct position in front of the headlamp – with the SEG IV using the laser pointer.

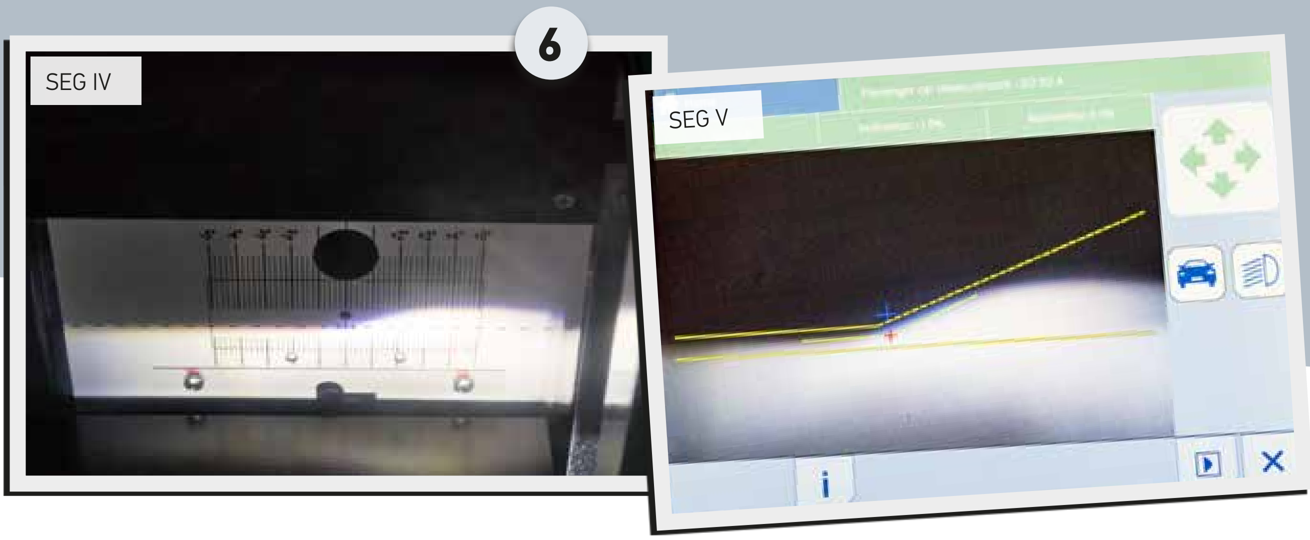


SEG IV = analog diagnostic unit, SEG V = digital diagnostic unit

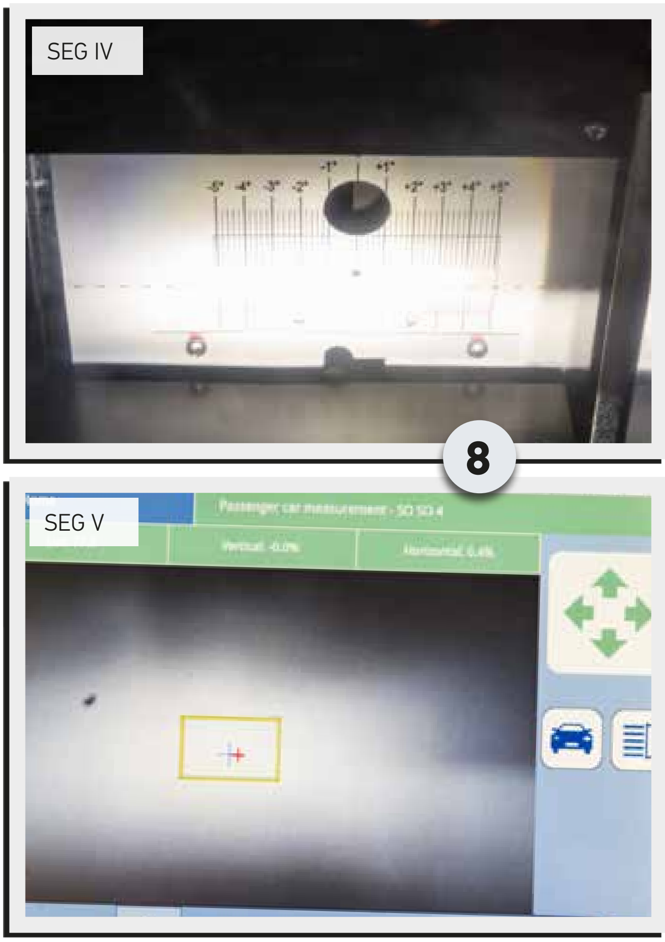
❹ Read and set the forward inclination *(SEG IV & SEG V)*
The required forward inclination is read off the headlamp for the RS 7 and set manually on the SEG IV using the rotary knob on the device. With the SEG V, the setting is automatically taken over following vehicle selection using the menu.

❺ Initiation of the measurement *(SEG IV & SEG V)*
The low beam measurement is then initiated. The result can then be read on the scale of the device (SEG IV) or on the screen (SEG V).

❻ Low beam results *(SEG IV & SEG V)*
The measurement results in our example each confirm correct adjustment, which is then confirmed on the SEG V using the touch screen. Please see our practical example for the Mercedes W 212 on page 38 for information that should be noted for a deviating measurement result.



❼ High beam measurement *(SEG IV & SEG V)*
The high beam is measured accordingly.

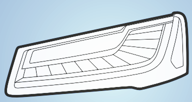


❽ High beam measurement results *(SEG IV & SEG V)*
In this case, the measurement results are also OK.

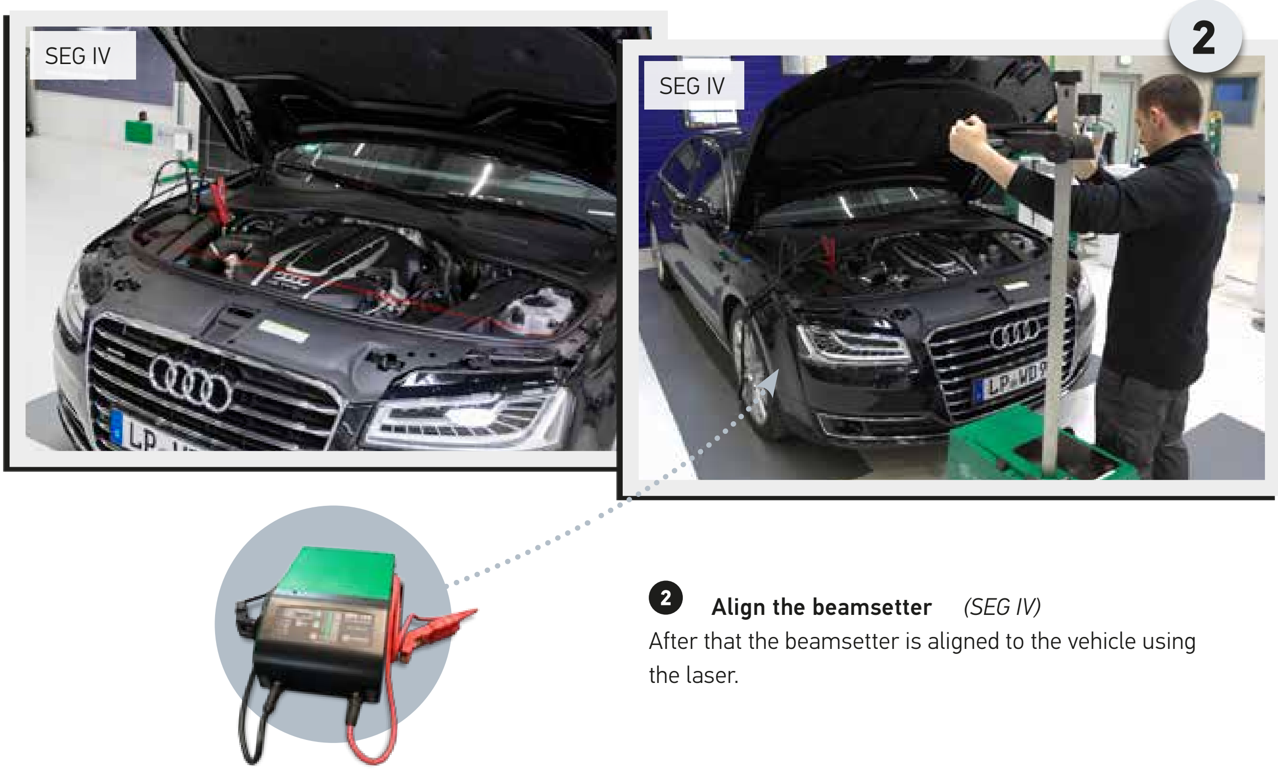
❾ Measurement history *(SEG V)*
The SEG V shows the successfully carried out measurements. The results are automatically saved in the history and can be called up again at any point later.

AUDI A8

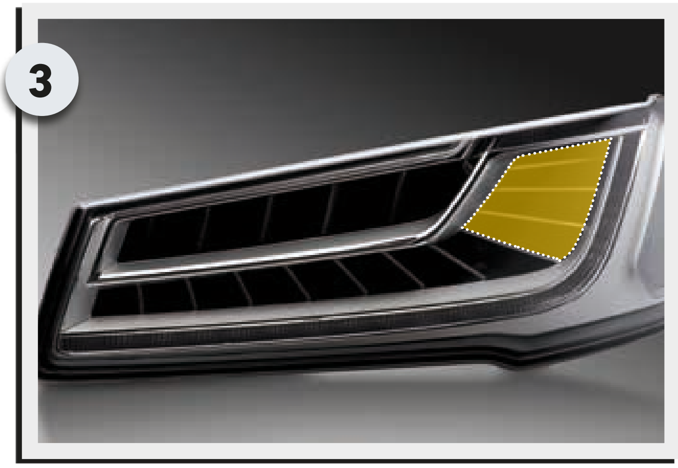
1 Vehicle and work preparation *(SEG IV & SEG V)*
The Audi A8 is first of all placed on the prescribed headlamp adjustment station (see page 30) and prepared. For this, the vehicle undergoes a visual inspection and a battery charger is connected.



YOU CAN FIND AN OVERVIEW FOR CALIBRATING THE MATRIX-LED HIGH-BEAM ASSISTANT ON PAGE 50.



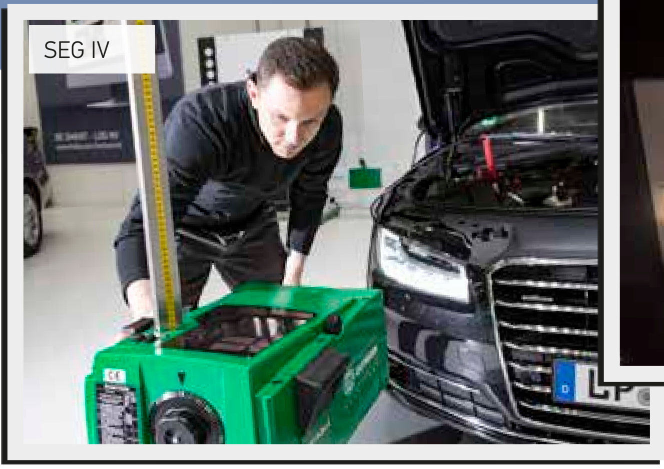
❷ **Align the beamsetter** *(SEG IV)*
After that the beamsetter is aligned to the vehicle using the laser.

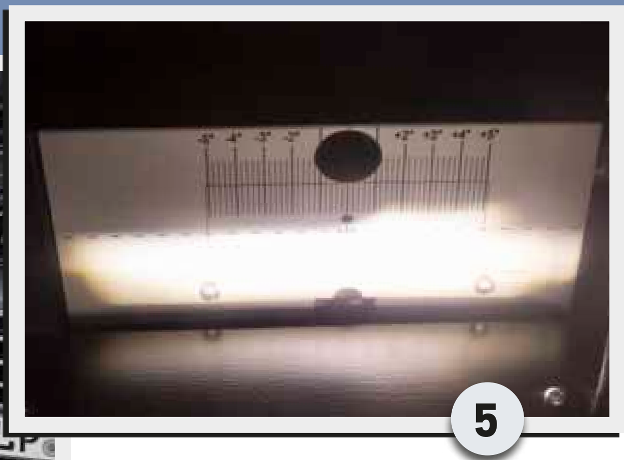


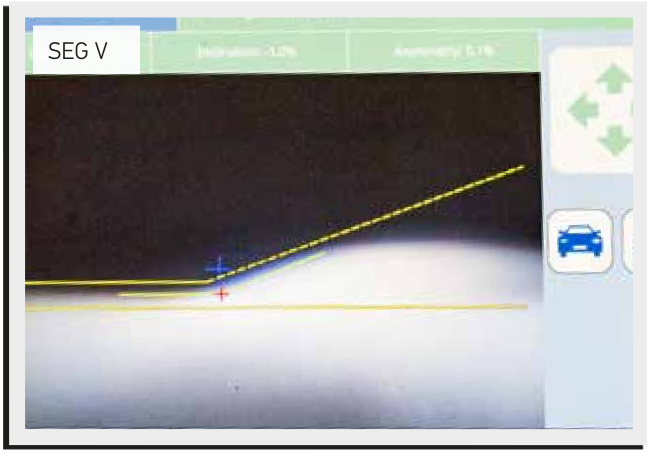
❸ **Positioning of the beamsetter** *(SEG IV & SEG V)*
The beamsetter is then positioned to the headlamp.
Note on the SEG IV: Aiming with the laser pointer on the light source helps positioning.

❹ **Read and set the forward inclination**
(SEG IV & SEG V)
The required forward inclination setting is read off the headlamp for the Audi A8 and set on the SEG IV using the rotary knob.
On the digital SEG V, forward inclination is set during selection of the vehicle model (see here our practical example using the BMW 5 Series on page 34).

SEG IV = analog diagnostic unit, SEG V = digital diagnostic unit



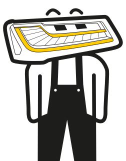


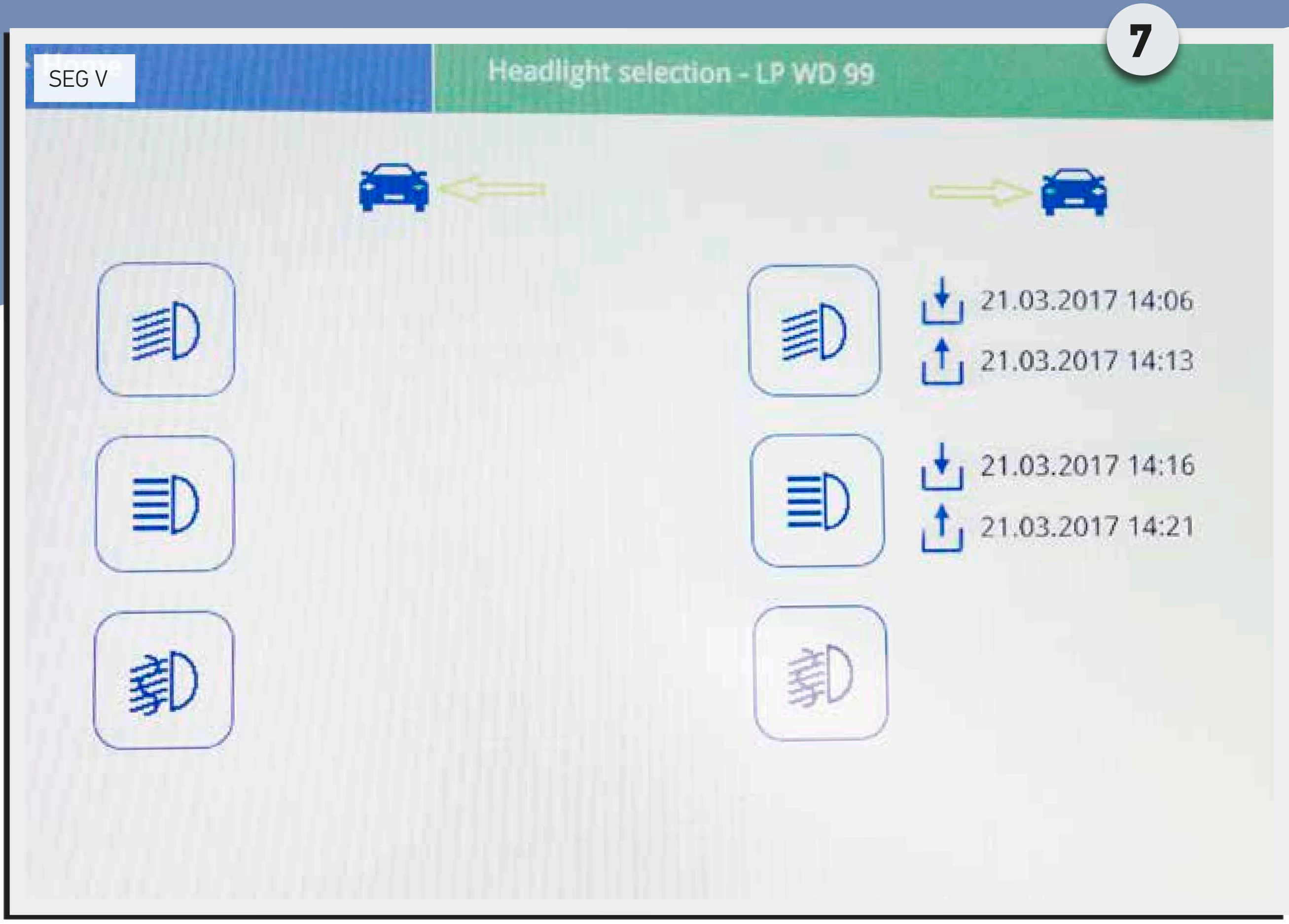


5 Check the low beam *(SEG IV & SEG V)*
First of all the low beam is measured. The result can then be read on the scale (SEG IV) or on the digital display (SEG V).
In the example, each result is OK – please see the information box for a description of deviating results.

6 Check the high beam *(SEG IV & SEG V)*
The high beam is measured accordingly. On the SEG V, this is initiated via the display. The result of the high beam test is also perfect in our practical example.

Practical tip
The SEG IV also enables you to measure lux values so you can therefore check the glare.

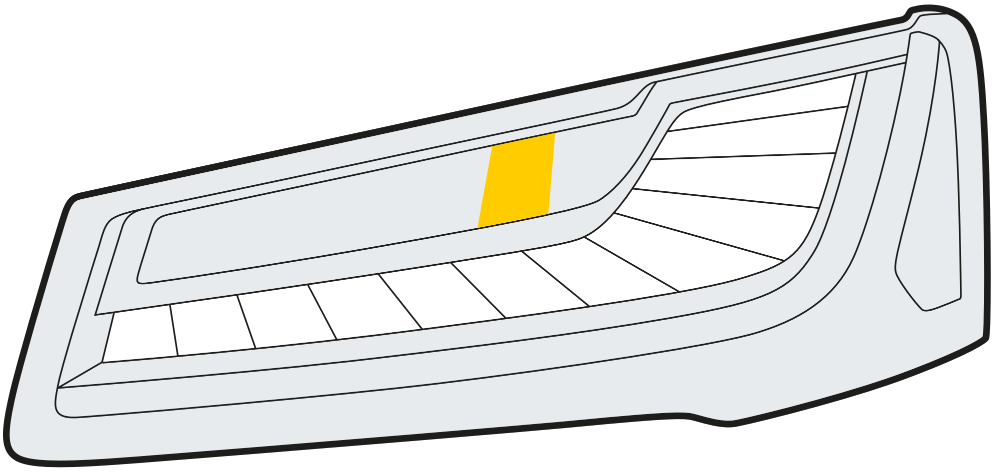




7 Conclusion of the testing *(SEG V)*
Following testing of both main light functions, the measurement is concluded. With the SEG V, the results can be saved to be called up later. The measurement for the other side of the vehicle is carried out in the same way.

WHAT TO DO IN THE EVENT OF DEVIATIONS?

Our example image shows low beam lights that are set too low using the example of the SEG-IV scale. The headlamp adjustment must be corrected accordingly.

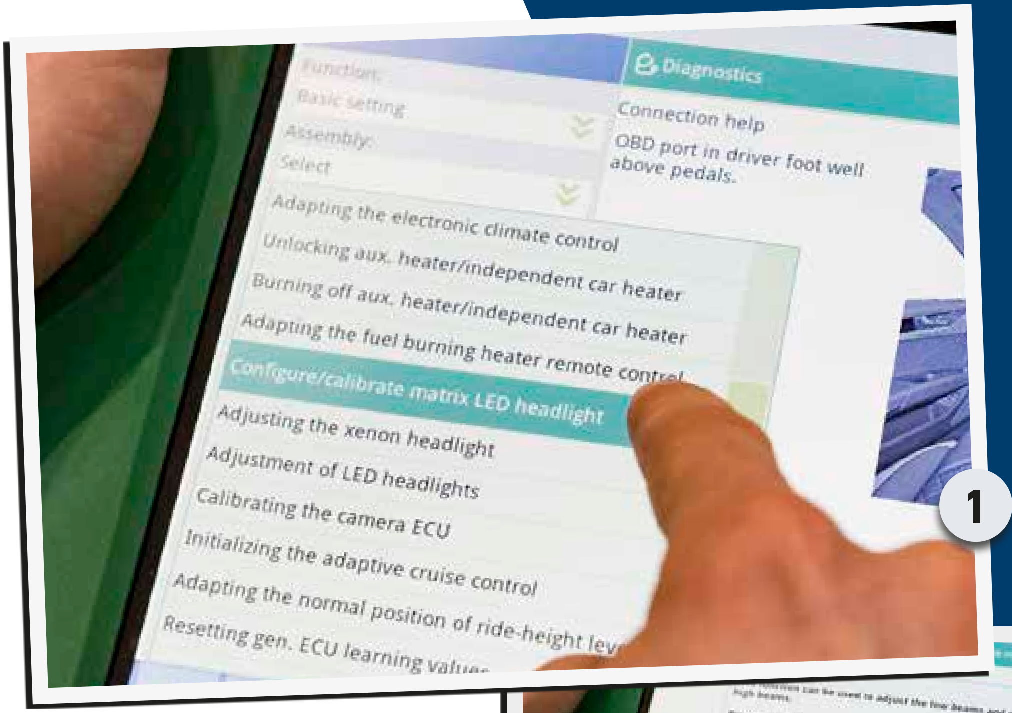


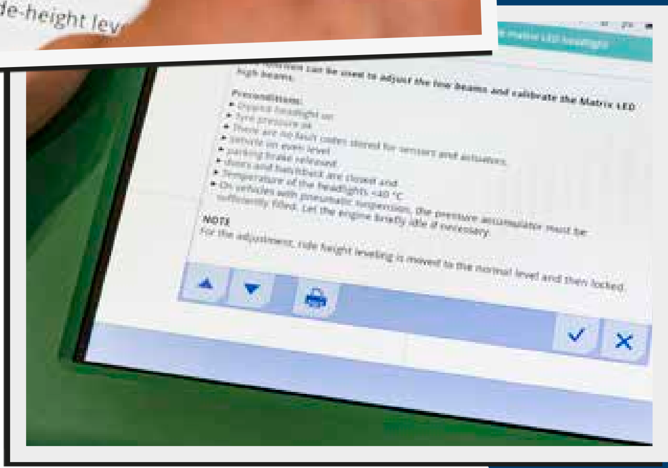
CALIBRATION OF THE MATRIX LED HIGH-BEAM ASSISTANT

The matrix LED high beam must be re-calibrated in certain situations, for example following installation/removal of the headlamp, replacement of the windshield, wheel alignment of the rear axle, or installation/removal of the front camera.

Following adjustment of the low beam, it is also then necessary to re-calibrate the front camera system as the high beam loses its learning values in this case.

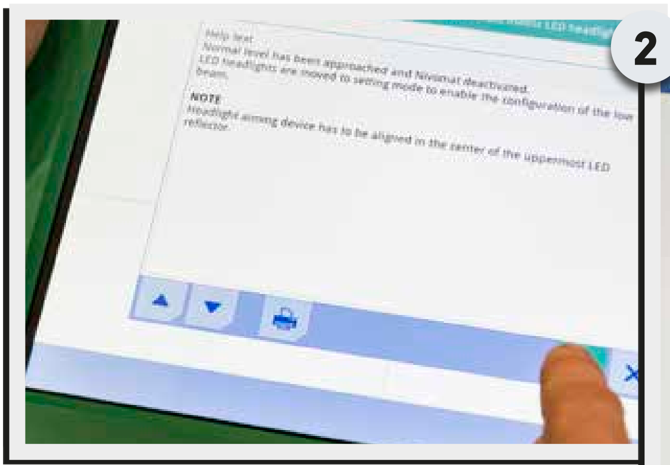
In the following, we show you the main steps to be carried out during calibration. Here a beamsetter is used that is suitable for matrix LED calibration, in conjunction with a mega macs diagnostic unit from Hella Gutmann Solutions.

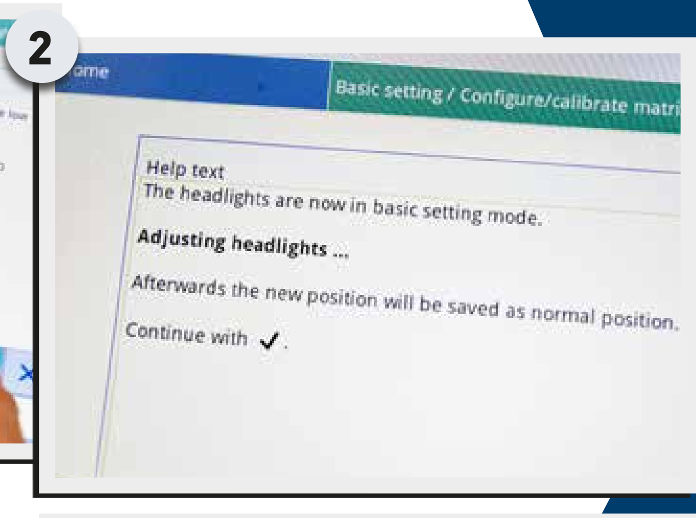


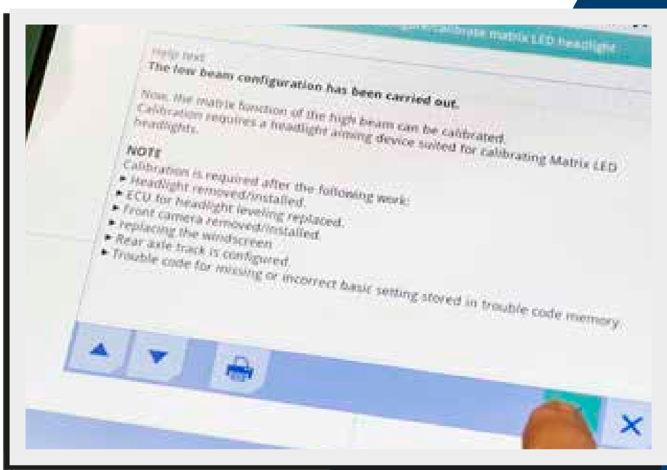


1

In the menu of the diagnostic unit,
the corresponding function is selected in
the basic settings.

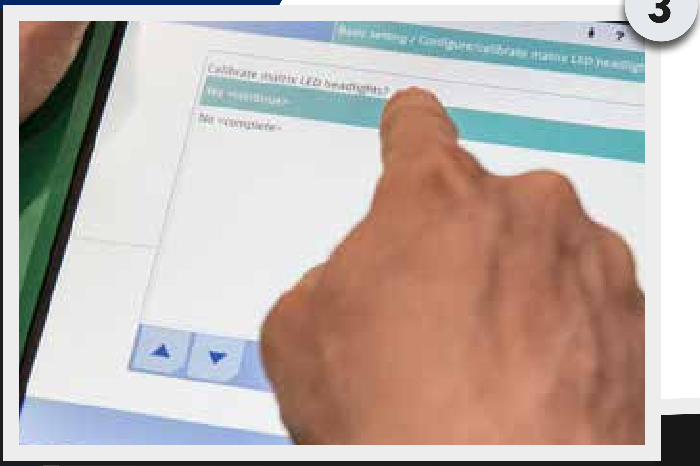






2

First of all, the low beam is set to basic
mode and then adjusted (not elaborated
upon here). Here, the diagnostic unit
provides precise specifications,
for example for the alignment of the
beamsetter.

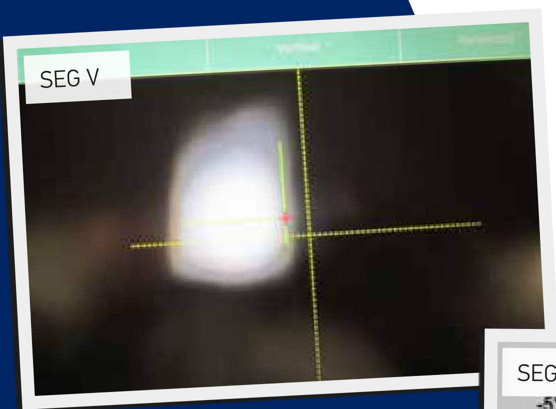


3

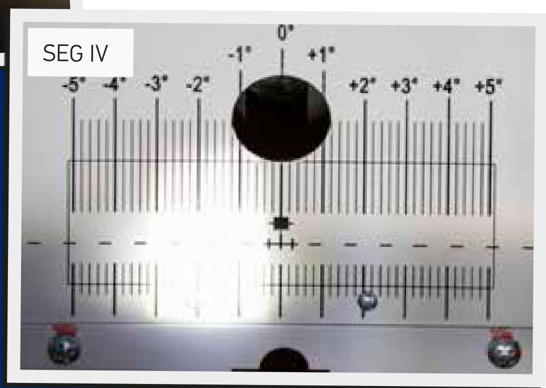
The matrix LED high beam can then be calibrated.

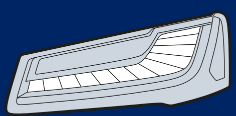
4

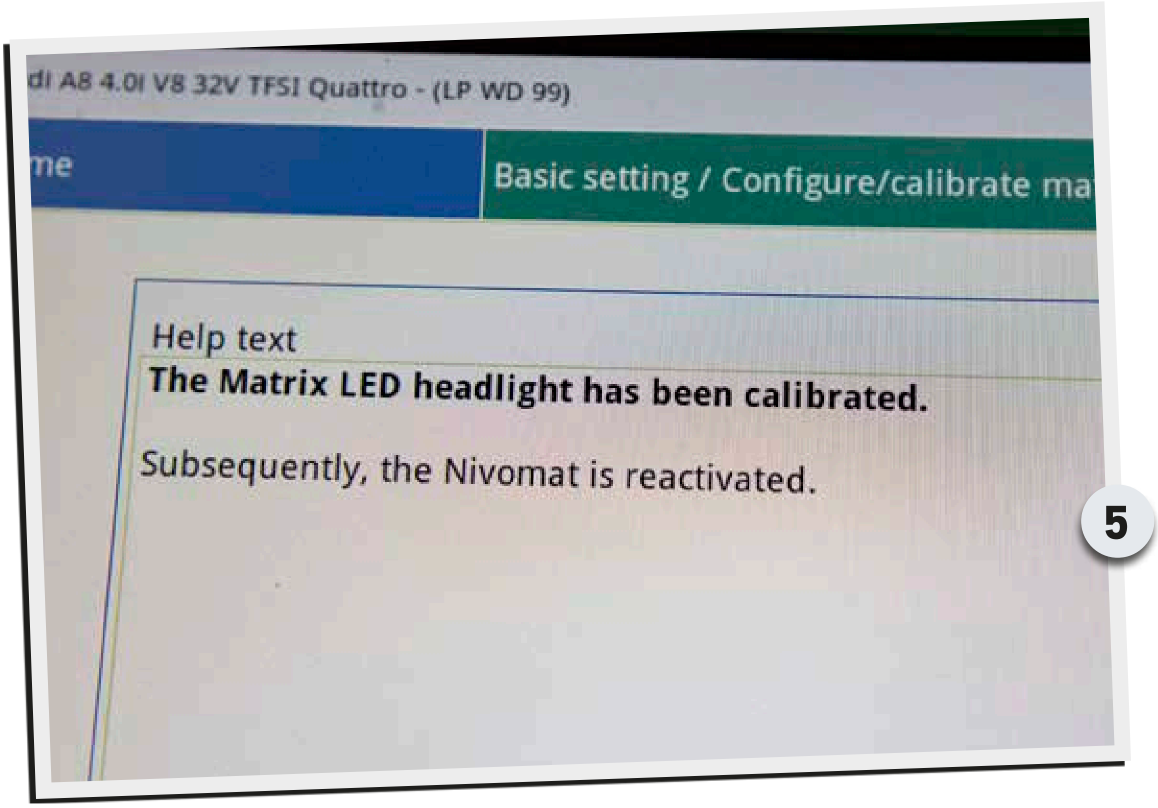
The calibration is carried out using so-called master LEDs on the left and right headlamp. For this, the beamsetter must be positioned correctly in front of the respective master LED, and the angular values/angular minutes determined from this must be entered into the diagnostic unit. The diagnostic unit specifies all the work steps in detail.



The images show, as an example, the measurement results of the master LED for the SEG IV and SEG V.







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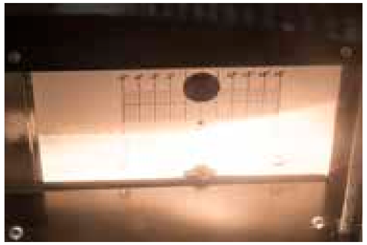
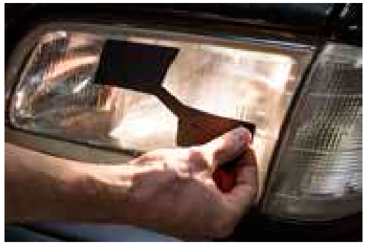
Once the corresponding angular values are correctly entered and confirmed, the diagnostic unit automatically carries out the calibration via the control unit. Once calibration is completed, the level adjustment is activated again. This must be switched off during calibration.

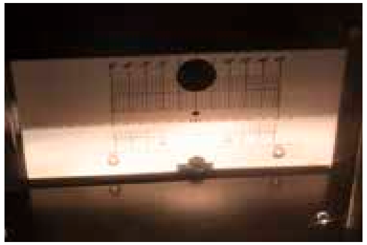
Low beam measurement for the Mercedes W 202 left-hand drive vehicle BEFORE masking: Normal asymmetrical light distribution



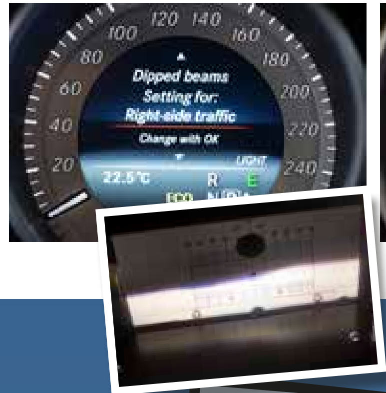
Masking of the asymmetry



Low beam measurement for the Mercedes W 202 left-hand drive vehicle AFTER masking: Light distribution without right asymmetry



Adjustment of the headlamp to right-hand traffic on the MMI of the Mercedes W 212.



Adjustment to left-hand traffic on MMI: The headlamps are adjusted automatically.

IMPORTANT:
The blocking out of the asymmetry described is only suitable for short-term use. The reason: Due to the missing asymmetrical distribution (for the correct side of the road) the visibly illuminated area at the edge of the road is reduced for the driver. Obstacles and information signs are therefore harder to recognise, leading to a potential risk to safety. For a longer period of driving in left-hand traffic it is always recommended that you use headlamps which are designed for this.

WHEN NOTHING GOES RIGHT – GO LEFT!

HEADLAMPS IN RIGHT-HAND OR LEFT-HAND TRAFFIC A QUESTION OF THE RIGHT ADJUSTMENT!

What do Kenya, Great Britain, Japan, and Jamaica all have in common? Yes – in these countries (and many others), they drive on the left! Right-hand and left-hand traffic each have different requirements for the asymmetrical light distribution of headlamps to avoid blinding oncoming traffic and to enable good illumination of the edge of the road. But what steps are necessary when you are driving on the left-hand side of the road with headlamps which are designed for right-hand traffic, for example, when on holiday?
We provide an overview – also of the changes brought about through technical developments.

Older models: Masking of the headlamps
When driving in left-hand traffic with headlamps designed asymmetrically for the right – and the other way round – the asymmetry must be blocked out to ensure the oncoming traffic is not endangered by glare. For the majority of older headlamp models, it is necessary to cover the cover lens accordingly. You can do this using adhesive tape or special cover discs, available on the independent parts market or on car ferries, for example. In our example, you can see the results of headlamp measurement BEFORE and AFTER masking.

Note: Depending on the headlamp model, different areas must be masked.
Please observe the specifications of the manufacturer accordingly.

Newer models: Automatic adjustment via on-board computer
In contrast to the masking of older headlamps described to the left, the headlamps in more modern systems can be adapted very easily for use in left-hand traffic. The required adjustment can generally be selected conveniently using the menu of the on-board computer or the MMI. The asymmetry is then automatically blocked out. For various headlamp models, there is also a kind of "in-between solution": Here, the headlamps can be adjusted manually by moving a lever or switch on the headlamps.

CSC MODULAR SYSTEM & DIAGNOSTICS TOOL

ADDED VALUE FOR WORKSHOPS: THE MODULAR CSC TOOL AND THE MEGA MACS DIAGNOSTIC UNITS

The expanded modular CSC Tool system (CSC = Camera and Sensor Calibration) from Hella Gutmann Solutions allows workshops to professionally calibrate cameras on vehicles from numerous car brands in conjunction with current mega macs diagnostic units. Furthermore, due to additional expansions, all current common radar systems can also be aligned.

Popular driver assistance systems

The CSC tool is also beneficial for workshops due to the increasing importance of driver assistance systems – as these have been particularly popular among drivers for years, and the trend is increasing. Whether intelligent cruise control via radar, lane assistant or automatic parking assist – to name just a few – the driver assistance systems not only provide greater comfort, but also a higher level of safety. Provided they are aligned regularly.
The perfect aid for this is the CSC Tool in conjunction with a mega macs diagnostic unit. Here, the diagnostic unit takes over the communication with the control unit and initiates the calibration. To execute the calibration itself, however, a suitable calibration panel is required and it must be aligned correctly. It is here that the CSC Tool comes into play.

We provide an overview of the main features of the CSC Tool:

→ **Modular principle**
Due to the modular expandability, users are able to calibrate vehicles of many common brands and to also use future functionalities. The basic CSC Tool includes the height-adjustable base with adjustment bar and two mirror units, two laser measuring heads and two calibration panels, which already cover several important brands. Through new modules, in the future, other brands and additional functionalities can also be used.

→ **Simple, fast use**
Operation is extremely easy for workshop employees, as the diagnostic unit guides you through the successive individual work steps, right the way through to the initial click that starts the actual calibration process in the control unit. Matching the image from the vehicle camera to the target image saved in the system only takes a few seconds, and the entire process is completed in just 20-30 minutes.

→ **For radar calibration, too**
The system can also adjust all common radar systems thanks to specially developed radar kits. As with all sensors whose measurements take place at distances of several hundred meters, long-distance radar heads must also be precisely set to the driving axle (rear axle) of the vehicle. However, by contrast to the rigid attachment of a camera to the windshield, a radar sensor can be re-positioned along its X- and Y-axis using screws, thereby also adjusting its measurement field. This is possible using the CSC Tool basic kit. For radar heads without measurement mirror (e.g. Mercedes), a radar adapter kit is available.

The diagnostic unit is an indispensable aid in the workshop!

The increasing complexity of high-tech components in modern vehicles requires flexible diagnostic solutions. Without fast vehicle identification, reliable fault diagnostics, comprehensive provision of data and parts, as well as professional support, successful and – from the point of view of the workshop – worthwhile vehicle repairs are hardly possible.

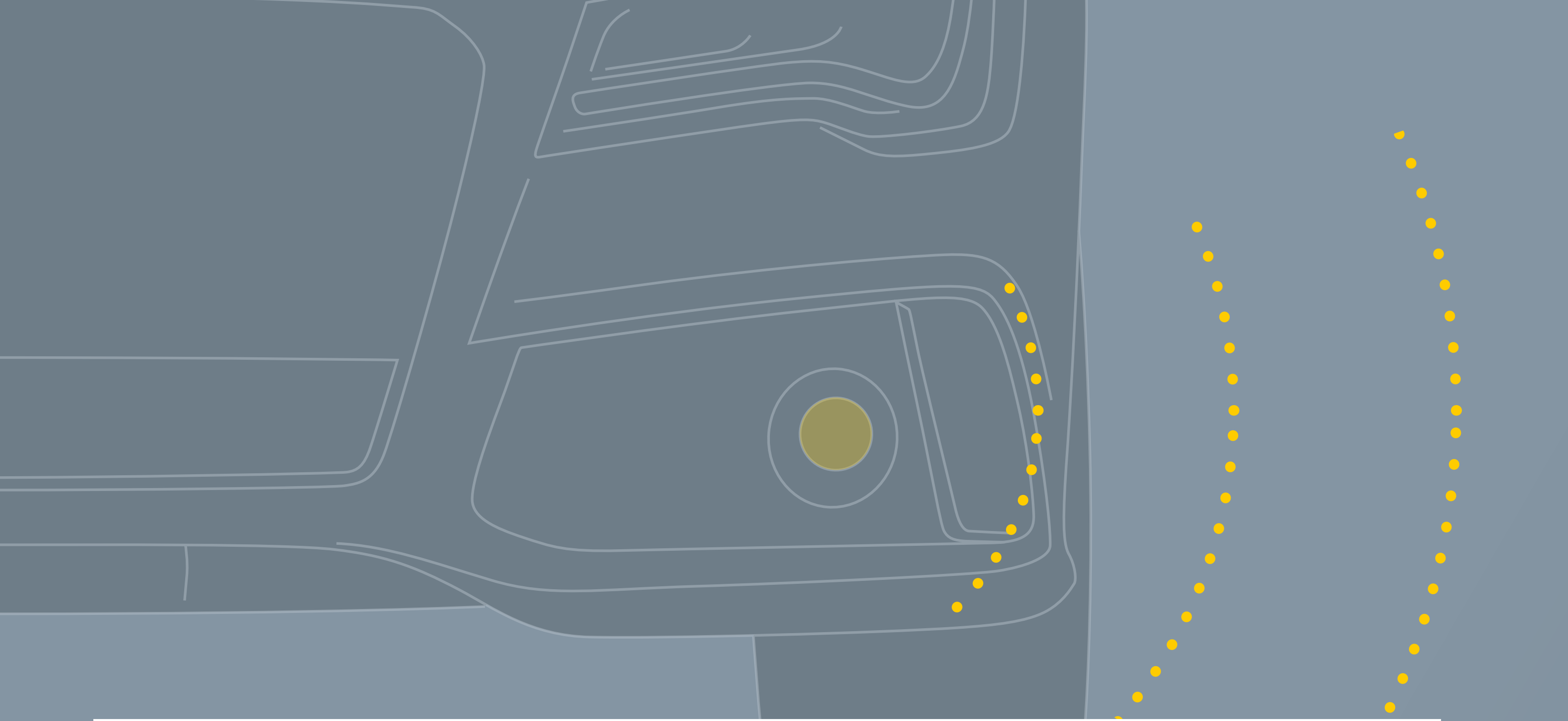
This is where professional diagnostic units, for example the current devices from the Hella Gutmann Solutions mega macs series, come into play. These communicate directly with the vehicle control unit, evaluate fault codes, provide repair information, and guide you step-by-step through camera and matrix headlamp calibration procedures (see here our practical example using the Audi A8 on page 46), and much more.

Using the example of the compact, portable mega macs 56, we illustrate some of the fundamental functionalities:

- → Fault code-based solutions in real time*
- → Access to comprehensive, constantly updated repair database with more than 35 000 vehicle models of all main manufacturers
- → Symptom-based solutions proposed*
- → Read and delete fault codes in all control units
- → Parameter display with explanation (up to 12 parameters simultaneously)
- → Comprehensive technical data (timing belt, fuse relay box layout, etc.)
- → Precise vehicle identification via VIN
- → Wireless transmission via VCI
- → Service reset
- → Actuator test
- → Basic setting
- → Coding
- → Digital compression test**
- → Car history
- → Motorcycle diagnostics***
- → PassThru-capable
- → CSC Tool compatible
- → asanetwork compatible
- → Quick-change battery***

* In conjunction with a Repair-Plus licence (scope of licence may vary depending on country).
** Vehicle-dependent using diagnostics.
*** Available as an accessory.

WHEN SHOULD A FRONT CAMERA BE CALIBRATED?
THE ANSWERS TO THIS CAN BE FOUND IN THE TECHNICAL NOTES.



WARNING, RADAR!

AUDI RS 7 RADAR ADJUSTMENT

The increasing use of modern driver assistance systems continually changes the challenges faced by independent workshops. An example here is the use of radar-based assistance systems. Until recently, their adjustment may have been the concern of the respective brand workshop, but now independent workshops with the right equipment can also easily carry out such work.

The requirements for this are the CSC Tool (familiar from camera calibrations) with optional radar attachment, a mega macs diagnostic unit, as well as a battery charger.

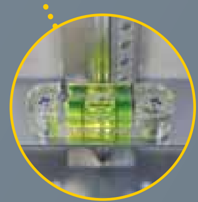
Our simplified practical example, based on an Audi RS 7, shows the main steps which should be noted during radar adjustment for the Adaptive Cruise Control System (ACC).

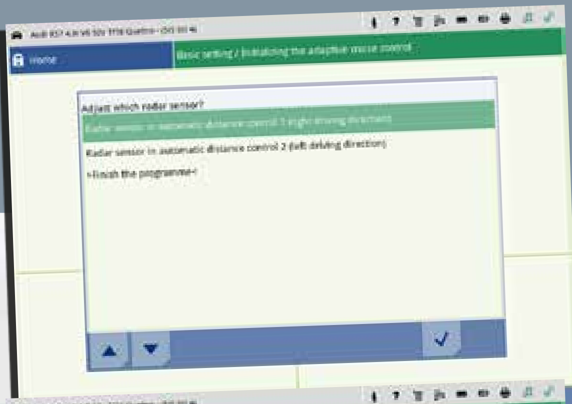
Angle adjustment plate for radar systems

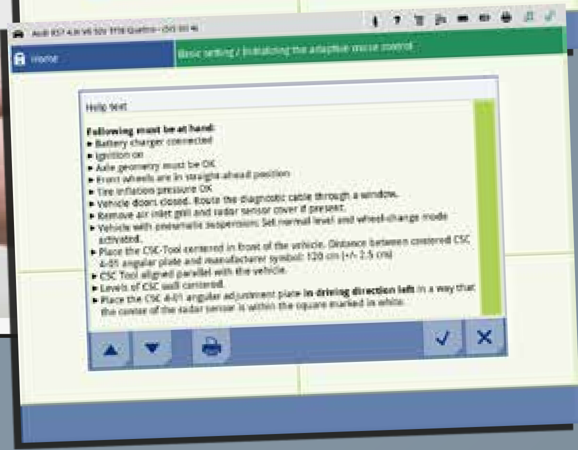
1 **Preparation:** The vehicle is placed on *a set-up testing station*. In addition to the *CSC Tool with radar attachment,* the mechanic needs a connected *battery charger* as well as the *mega macs diagnostic unit*. From the beginning, the *mega macs* will guide you through the process.

2 For the radar adjustment, the *CSC Tool* must be aligned parallel to the front of the vehicle, and to the vehicle's longitudinal axis (in the example, to the rear left wheel bracket).

3 The vehicle distance which must be maintained is – according to the vehicle – specified by the *mega macs* and must be measured at the designated points (vehicle dependent). The bubble level helps to check the alignment of the *CSC Tool*.



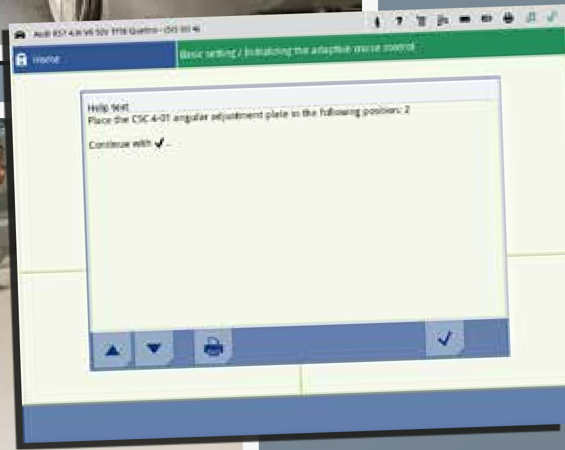


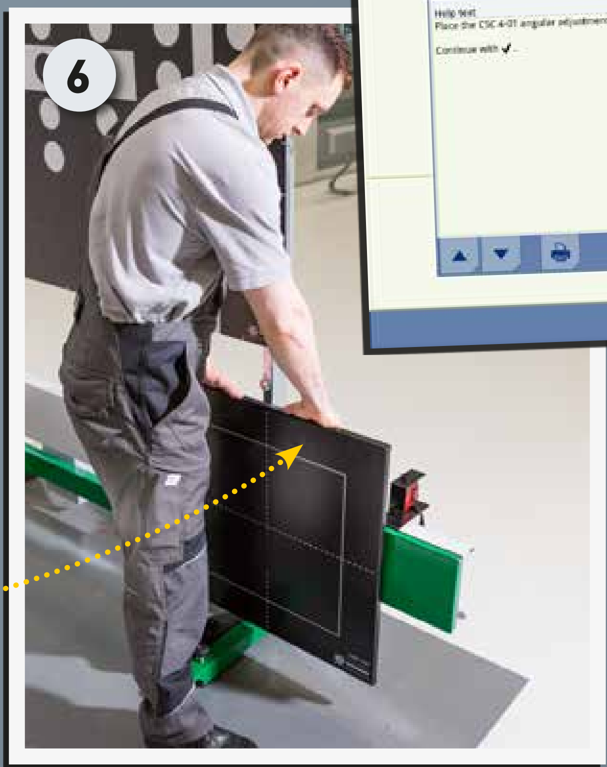


4 The Audi RS 7 has two radar sensors which must be aligned one after the other. The *mega macs* specifies the sequence. Before adjusting, the sensor must be exposed.

5 The vehicle is now ready for the adjustment of the first sensor.

6 The radar reflector (= angle adjustment plate) has a three-level mounting bracket. This means it can be aligned with a positive angle upward (level 1), precisely perpendicular (level 2) or with a tilt downward (level 3). This means that normal driving, as well as acceleration and braking processes are taken into account (compare with graphic on the right-hand side).





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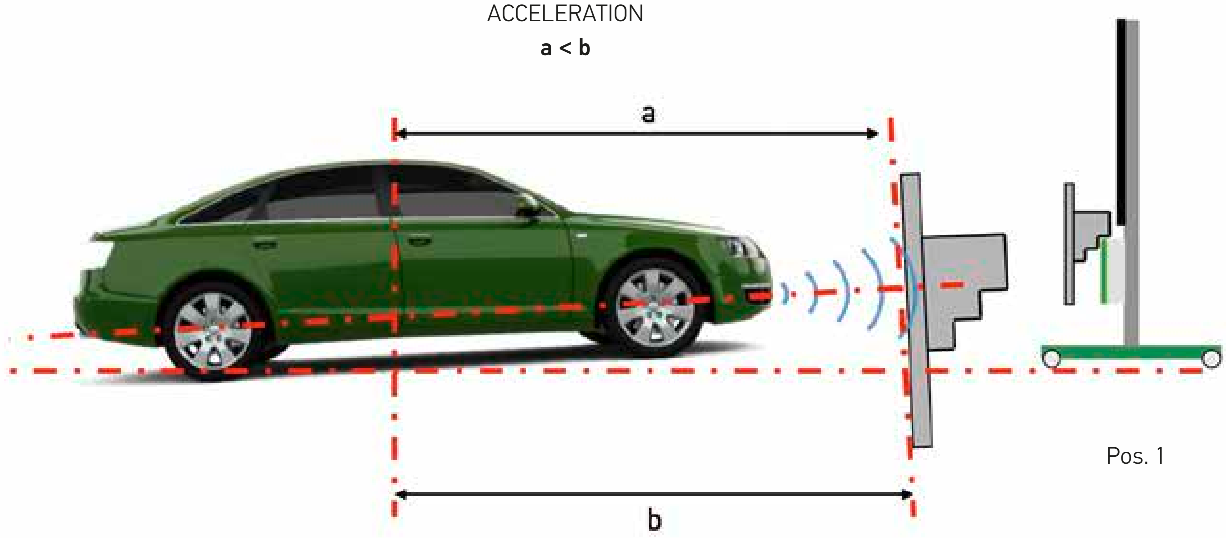
THREE-LEVEL ADJUSTMENT OF THE RADAR REFLECTOR

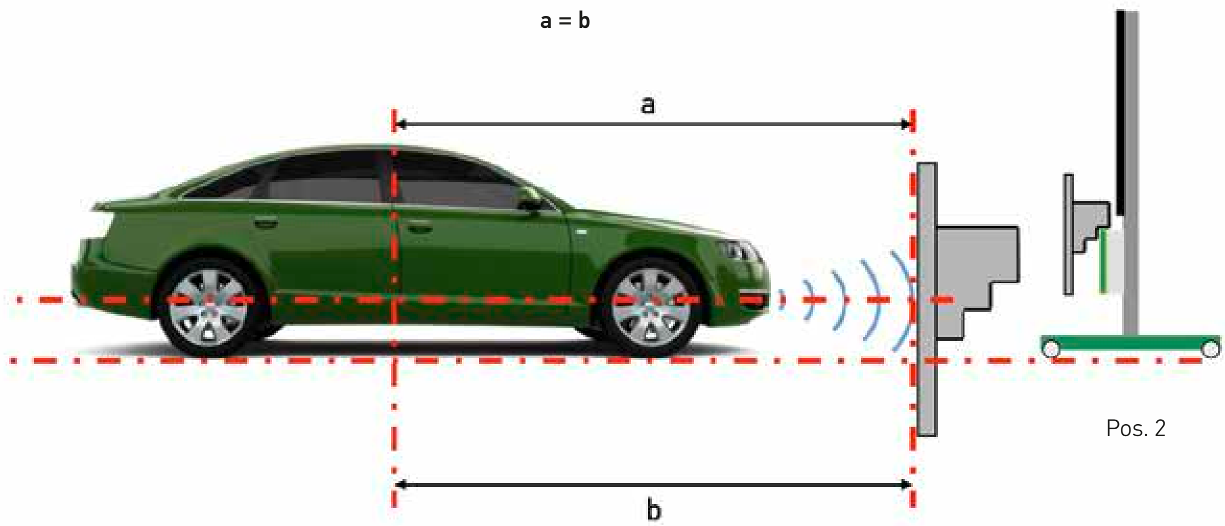
ACCELERATION

a < b



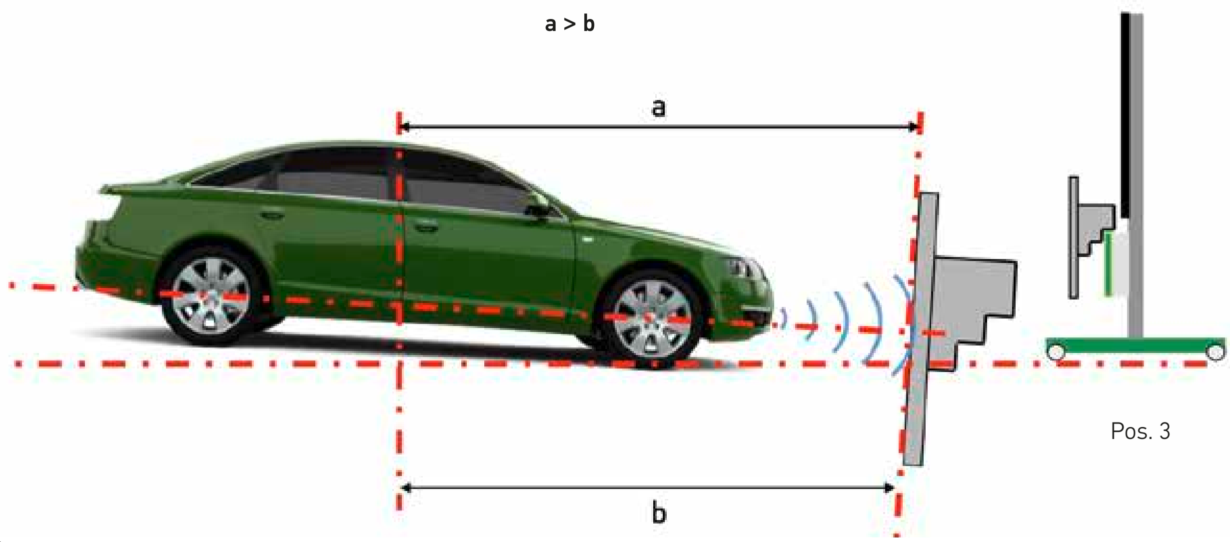
DRIVING WITH CONSTANT SPEED

a = b

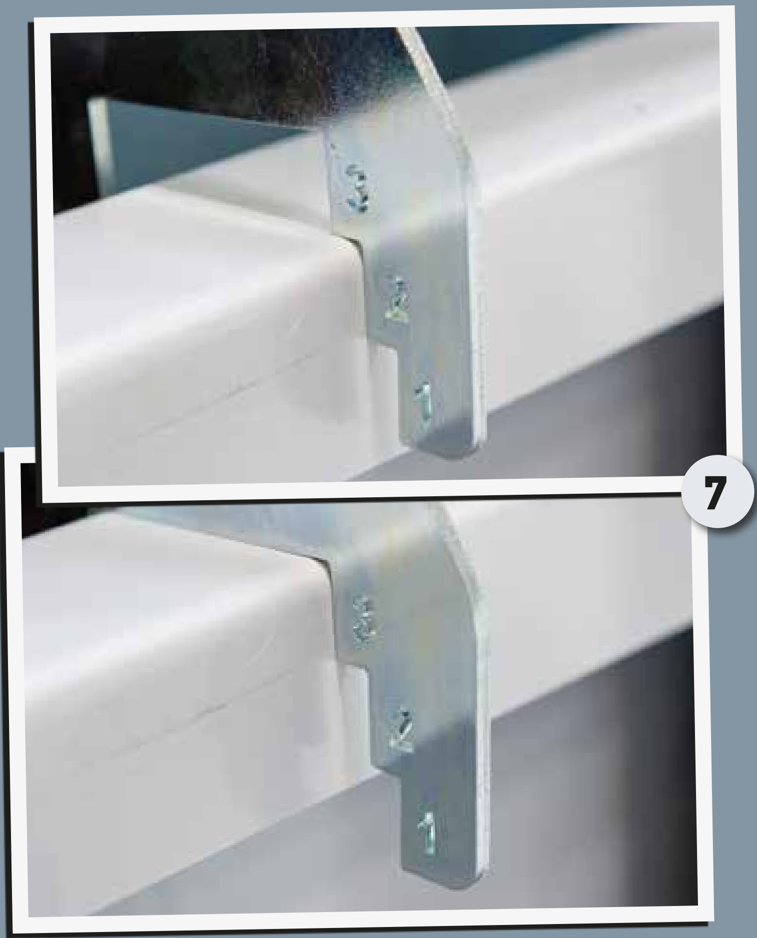


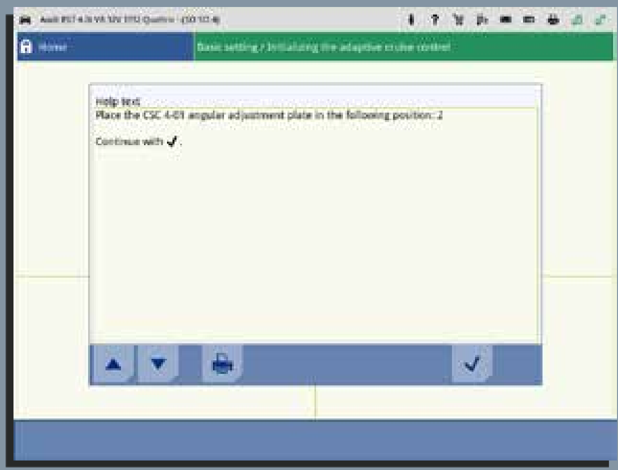
BRAKING

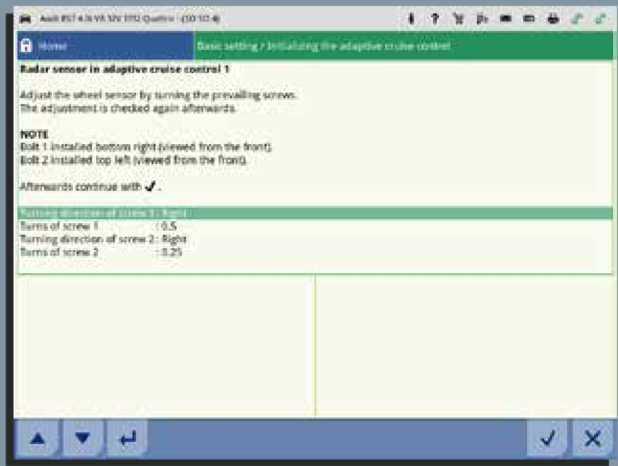
a > b

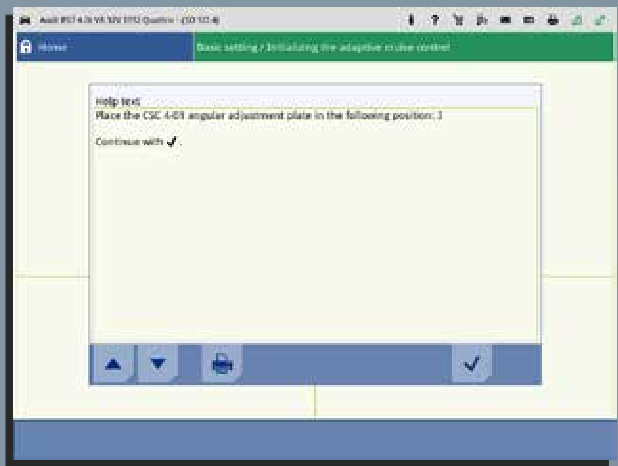


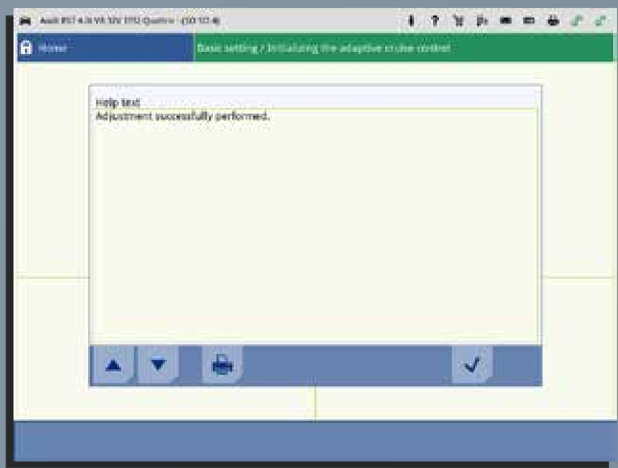
PRACTICAL EXAMPLE OF RADAR ADJUSTMENT – AUDI RS 7











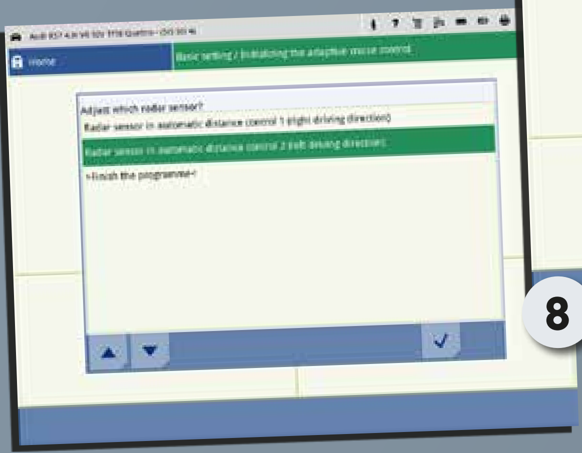
❼ All three levels have to be set one after the other. The *mega macs* will guide you through each process.

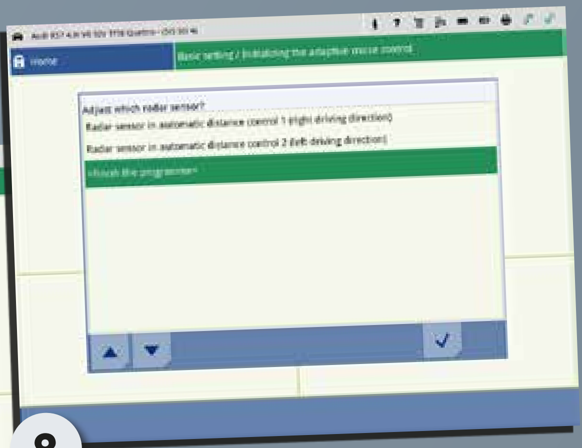
If the sensor requires re-adjustment, the *mega macs* provides precise instructions.

Following successful adjustment of the first sensor, this is shown.

❽ For the second sensor, the described steps are carried out in the same way.

❾ Once the second sensor has also be successfully adjusted, the radar functions of the RS 7 can be used optimally again.
With confidence!





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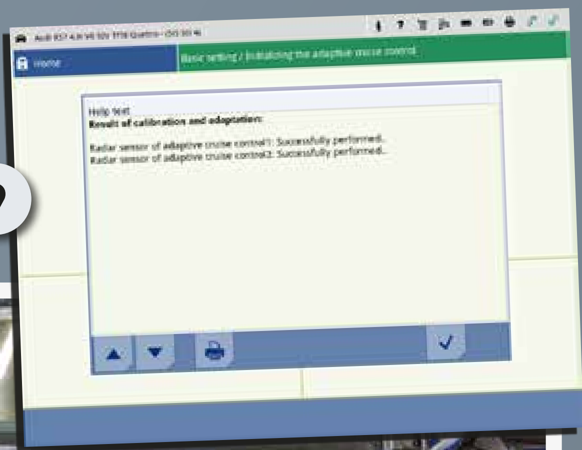

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FURTHER INFORMATION CAN BE FOUND IN THE TECHNICAL NOTES.

HELLA

Milestones from more than 80 years of rear lamp development

1935 Legal approval of two-colour rear lights
1957 First rear lamp with integrated reflex reflector
1961 Integration of the reversing light and the direction indicator
(instead of the direction indicator standard up to that point)
1973 First rear combination light with all lighting functions including rear fog light
1995 Introduction of free-form technology
1999 World premiere of LED light guides
2001 First macro reflex reflector
2003 Multistage stop light
2004 First full-LED rear lamp
2005 Multicolour LED tail light and direction indicator light function
2006 First light guide in 3D optic
2009 First light curtain: Lighting of the complete lamp surface
2010 EdgeLight technology in combination with light curtain
2011 Glowing body technology
2013 Tail light and stop light in mirror tunnel technology
2015 Full-LED rear combination lamp with sequential direction indicator function for the Audi A4 ("wiping")

REAR LAMPS

The crowning glory for every vehicle

From the initial rear lamps with bulbs and mechanical direction indicators to the first rear combination lamps, right up to the state-of-the-art LED lights of today, a lot has happened in the field of rear lighting in the past decades. Here, the advent of LED technology also provided a quantum leap. Continued developments lead to ever new application options and more energy efficient illumination solutions.

But LED rear combination lamps have much more to offer than innovative technology. The combination possibilities of LEDs and advanced optic systems open up attractive design options to vehicle manufacturers and lighting designers – for an unmistakable appearance typical of the brand.

On the following pages, we provide you with an overview of the different optical systems and the diversity that can be found in the field of rear lighting.

REAR LAMP HIGHLIGHTS

LED multi-function rear lamp, part 1

Audi A4 from model year 06/2015

LED multi-function rear lamp, part 2

Audi A4 from model year 06/2015

LED multi-function rear lamp

Range Rover Evoque from model year 06/2015

LED multi-function rear lamp

VW T6 Transporter from model year 04/2015

- → Technology transfer: We transfer our OE know-how directly to the independent aftermarket.
- → Original equipment manufacturer quality with high market coverage: Spare parts that fit many vehicles.
- → Simple vehicle identification: Our OE references make your work easier.
- → Comprehensive service and support: For example via technical hotlines.

OPTICAL SYSTEMS – AN OVERVIEW

Direct reflector

- → Common and frequently used optical system
- → Very high efficiency
- → Positioning of the directly visible light sources in the vertex of the reflector
- → Arrangement in any angle possible (horizontal, vertical, diagonal)
- → Overall performance depends on the dimensioning, number, and type of LEDs
- → LEDs shine into the reflector from behind; the light is deflected in the direction of the light exit

Indirect reflector

- → Efficient optical system with "invisible" light sources
- → Arrangement in any angle possible (horizontal, vertical, or diagonal) and can be equipped with a conventional, rigid PCB
- → A section of the reflector is assigned to each LED; the individual sections of the reflector are staggered
- → Overall performance depends on the dimensioning, number, and type of LEDs
- → LEDs shine into the reflector from the side; the light is deflected by the reflector by approx. 90° into the direction of the light exit

TIR (Total-Internal-Reflection) reflector

- → System that is based on total reflection without a conventional reflector
- → The light emitted by the LED is bundled by a lens/reflector combination into a parallel light beam and deflected to the front of the optics
- → Compared with conventional reflector systems, a narrow, bundled light beam with a wide range is created
- → TIR reflectors can be used individually or in multiple arrangements
- → Overall performance depends on the dimensioning, number, and type of LEDs

Prism light conductor

- → Long, rod-shaped light guides made from PMMA or PC with diameters between 7 mm and 10 mm
- → Homogeneous, linear illumination along the entire rod
- → Placement of the LEDs at one or both ends
- → Light is coupled into the light guide via the optics and transported further by total reflection
- → Rear prisms emit a part of the light transversely to the longitudinal axis out of the rod again

Light curtain

- → Flat light guide
- → The light of the LEDs is coupled in by one or more edges
- → Light is radiated by the optical surface structure
- → The light curtain can be used both as a small, partial lens as well as a large additional lens
- → This provides the option of large or partial illumination

Edge Light

- → Light guide with clear signature due to light-emitting edge
- → The LED light is coupled in at the rear edge, deflected through the light guide plate using total reflection, and emitted at the front edge
- → Possibility to highlight the depth of the system due to an optical structure on the sides
- → The wall thickness of the Edge Light light guide is decisive for the light performance

Glowing body

- → A diffusely illuminated solid body creates a three-dimensional impression
- → Diverse design options are possible due to the use of different optical systems
- → A volume spot designed as a glowing body ensures highly consistent lighting of the illuminated surface
- → The light performance depends both on the optical system as well as on the number and type of LED

Mirror tunnel

- → The tunnel light system creates a tunnel-like effect despite the flat installed depth
- → The tunnel effect may vary depending on the desired design
- → The reflective paths are controlled via mirror and half-mirror surfaces and thus offer a multitude of stylistic possibilities
- → Light performance depends on the mirror system

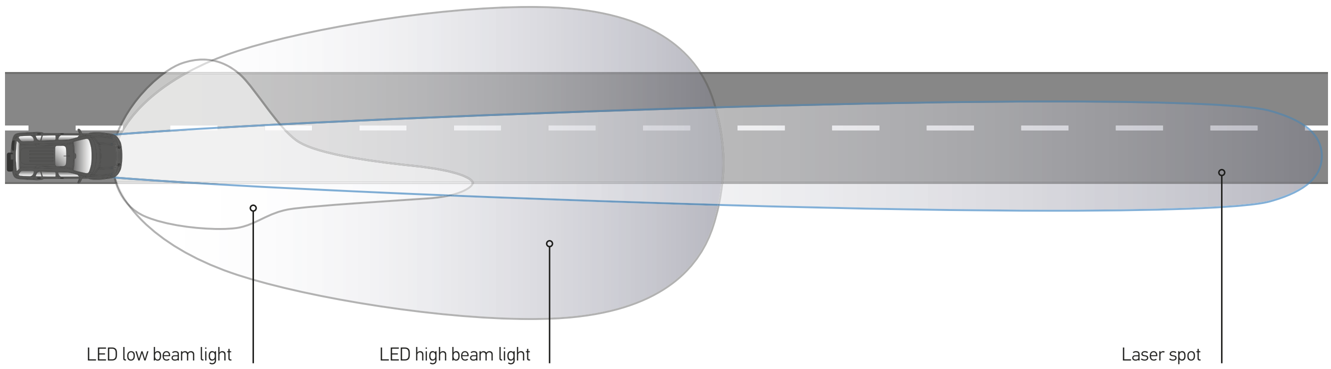
VW Golf VII:
A modern LED multi-function rear lamp

THE FUTURE OF AUTOMOTIVE LIGHTING

From the first halogen headlamp to modern lighting systems such as the matrix HD84, automotive lighting technology has undergone breathtaking development in the last decades.

A development process which is far from over today – in fact it is just getting started! Innovative new technologies such as the liquid crystal HD headlamp from HELLA or OLED-based rear lamp systems offer more and more. Not only do factors such as light output and comfort play a role, but increasingly also automotive trends such as greater connectivity, automated driving, electrification, and customisation. And there are more and more design options for vehicle and light designers.

On the following pages, we provide a look at the illumination technologies you may soon find in modern vehicles on the road – and maybe also in your workshop!



Laser lighting

Laser light was discovered for the automotive industry a few years ago. Today, it is already partly used in series vehicles. High-beam headlamps with the right equipment can achieve a range of 600 m in certain situations. The reason is the very high luminance of the laser, which is clearly above that of LEDs. In addition to the high range, special technologies such as LARP (Laser-Activated-Remote-Phosphor-Technology) also enable an extremely compact design. Vehicle designers are therefore provided with new possibilities.

Laser light is currently rather more of an additional technology, however. With its extremely bundled light beam, it can supplement other technologies such as LED, for the high beam function, for example. Furthermore, the costs for the components are also currently significantly above LED technology.

A futuristic impression:
Prototype of a liquid crystal HD headlamp

Liquid Crystal HD

The fast developments in the field of front headlamps continue – and HELLA is at the forefront. Together with project partners Merck, the Institute for Large Area Microelectronics (IGM) at the University of Stuttgart, Porsche, Elmos Semiconductor, Schweizer Electronic and Paderborn University, the lighting experts have developed and built a headlamp based on a Liquid Crystal Display (LCD).

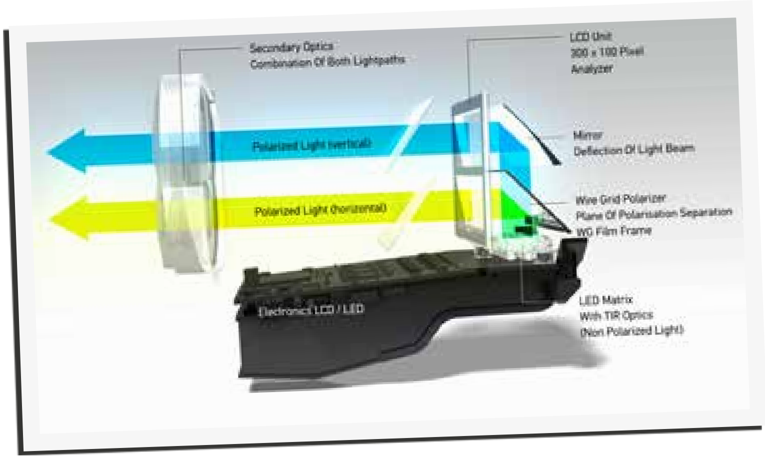
The highlights:

→ The LCD headlamp adjusts the light distribution to different traffic situations in an intelligent and continuous manner in real time
→ 30,000 pixels allow image projections in addition to fully adaptive light distribution
→ The core component of the headlamp is the LC display between the LED light source and the projection lens
→ The display generates a matrix with 100 x 300 pixels that can be individually controlled and dimmed

Endless possibilities:
With the LCD headlamp, complete graphics can be projected.

A camera installed in the vehicle as well as a sensor optically reading distances and speeds (light detection and ranging sensor LiDAR), will forward the ambient information to the headlamp control unit via a processor. This will then control the individual display pixels up to 60 times per second. 25 high-power LEDs arranged in three rows will serve as light source. Each LED's light intensity will be adjusted to the respective lighting situation.

In conjunction with assistance systems, such as the front camera, innovative functions can be realized which increasingly break down the boundaries between lighting and assistance systems.
For example, a speed-dependent ideal lane can be projected directly in front of the vehicle. Lane boundaries can also be visualised and obstacles marked clearly. So this is not only a question of comfort.



Operating principle behind the LCD HD headlamp

Holographic film

It is not only in the field of front lighting that technological developments are moving ahead with increasing speed – this also applies to the rear lighting. In this area in particular, in addition to the technology, the design also has a particular significance – as with the joint holographic technology developed by HELLA and Covestro.

With this world premiere, the rear end of the vehicle is comprised of a light with three parts, each equipped with holographic technology. Designers at HELLA developed the holograms. Covestro then incorporated these into a transparent holographic film which retains the design, and which is laminated onto a 3 mm thick glass or plastic plate. The holographic film is illuminated from behind using LED light sources and reflectors, resulting in a 3D effect. In both of the outer elements of the rear lamps, the companies inserted a hologram with numerous illuminating areas ("flakes"). The middle light is integrated into the tailgate; on it, the company logos of HELLA and Covestro appear to be floating.

Progressive design of the rear of the vehicle: Concept study from HELLA and Covestro

Holographic films are perfectly suited for integrating different lighting functions into the body in a space-saving and unobtrusive way. This not only applies to the rear of the vehicle, by the way, but also to the sides and front. With the use of the films, the installation depth can be reduced and automobile manufacturers have the possibility to install more compact lamps.

Holographics can also be used for the front lighting – in combination with other technologies such as the LED matrix display (writing "Autonomous Mode").

LED displays are integrated in both the front and rear of the vehicle in order to enable additional animations, such as greeting the driver. In the future, this could be possible not only when stationary but also during driving, in combination with other lighting functions, for example. During braking, for example, it would be possible for not only the stop lamp to illuminate, but also the additional indicator "STOP" – a clear benefit in terms of safety for following vehicles.

OLED

Another technology which promises future potential especially in the field of rear lighting is the OLED (organic LED). Organic LEDs are comprised of ultra-thin organic semiconductor layers which emit diffuse, homogenous, and glare-free light. In contrast to the LED, which emits light in a spot-based manner, due to the plane character of the OLED, there are diverse new options in relation to the design in and on a car.

HELLA is in the process of developing technologies, which allow a rigid, bent OLED module to be created out of a flexible, organic, light emitting diode. In this way, the potential of this new, innovative light source can be exploited further – as with the rear combination lamp prototype developed in cooperation with BMW and LG Chem.

The bent shape of the organic LEDs is brought about by the use of a flexible OLED substrate which, unlike the rigid glass substrates used up until now, enables virtually three-dimensional shapes to be fashioned with bend radii of just a few millimeters.

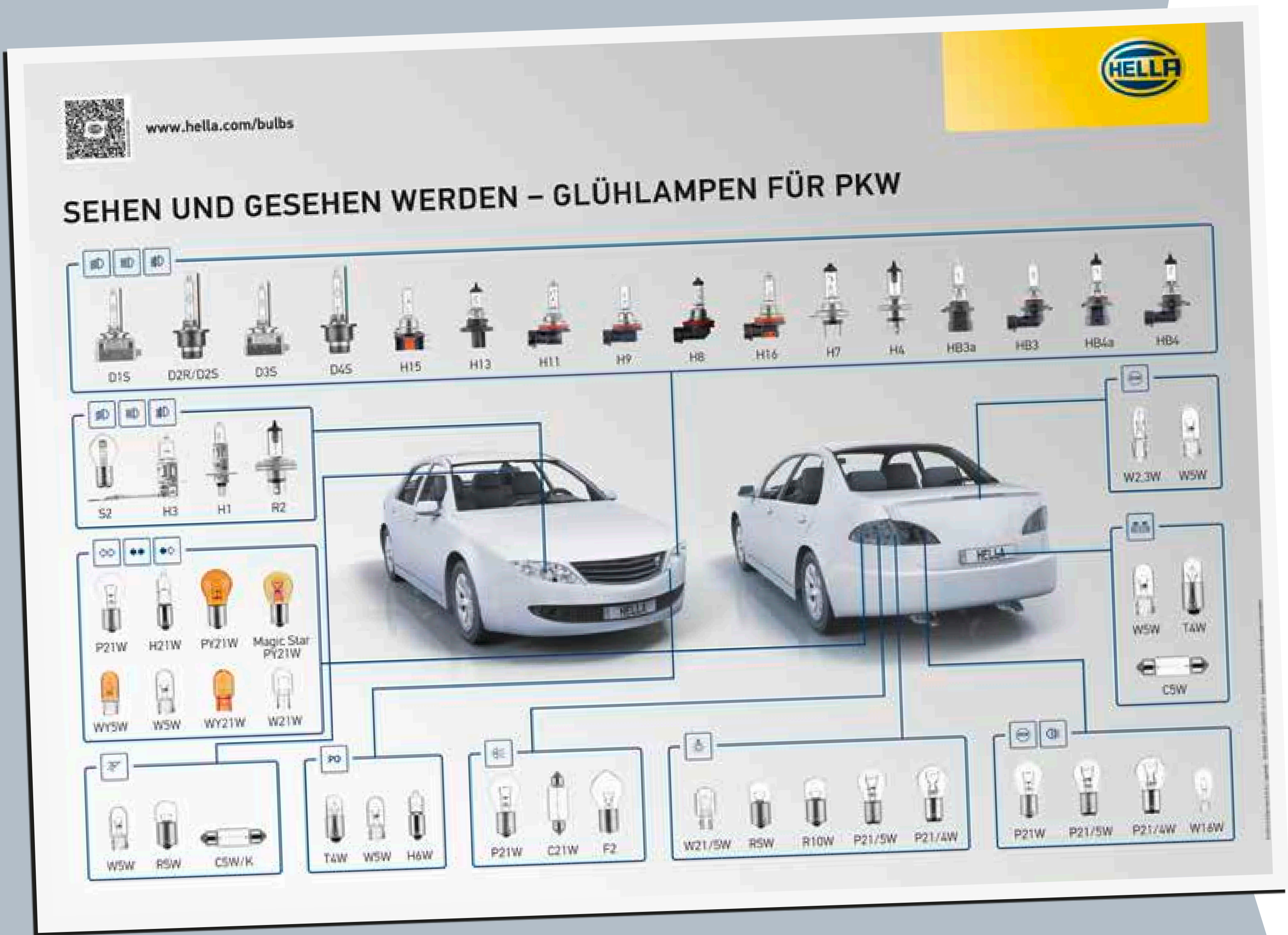
Rear combination lamp prototype based on OLEDs

TECHNICAL
NOTES

BULBS

In combination with headlamps, rear lamps, and other lighting components, bulbs play a key role in providing good illumination of the road and optimal visibility of the vehicle. This means they are a crucial safety factor for all road users. Faulty lamps should be replaced immediately as the correct functioning of the lighting system is otherwise not guaranteed.

Here, it is necessary, however, to select the right light source and to regularly check the function. In the worst case, incorrect light sources can lead to insufficient light output or thermal overloading with corresponding faults. We provide an overview of the common types of light source and their areas of application, and show you how the HELLA bulb configuration tool will quickly help you find the right light source!



The right light source for every lighting function
Overview of light source according to vehicle functions

COMMON LIGHT SOURCES

H1 (55 W): Introduced in the year 1964, the oldest single-filament halogen bulb is still used today – above all in dual headlamp and projector-type systems and large auxiliary headlamps. From today's perspective, the light output is still up-to-date.

H3 (55 W): Introduced with the H1 halogen bulb, due to its compact design, the halogen H3 single-filament bulb is suitable above all for headlamps with smaller designs such as fog lamps.

H4 (55 W / 60 W): Available on the market since 1971, the H4 halogen bulb is the first dual-filament bulb for combined low beam and high beam. Still today, this bulb is common in numerous halogen headlamps.

H7 (55 W): The H7 halogen bulb, like the H1, is a single-filament bulb for dual headlamps with separate low beam and high beam. The light output exceeds that of the H1 bulb. A simple "conversion" of H1 to H7 is, however, not possible as both the lamp base as well as the headlamp geometry must be designed for the respective light source. The H7 bulb is used in many modern headlamps.

HB3 (60 W): Developed for high-beam headlamps, this bulb with watertight base, which is generally more common in the USA, is only used in a few European vehicles.

HB4 (51 W): As with the HB3, the HB4 is a light source with a watertight base, which is above all used in the American market – above all in fog lamps.

H8 (35 W): The H8 bulb is a latest generation halogen light source for fog lamps. Due to a special base with integrated seal, the lamp sits particularly tightly in the holder and, despite low electrical power consumption, generates a lot of light.

H9 (65 W): The modern H9 halogen bulb is especially suited to high-beam headlamps. It generates a particularly strong light.

H11 (55 W): The current H11 single-filament halogen bulb was developed based on the H7, provides a particularly powerful low beam, and forms the basis of modern halogen headlamp concepts.

H15 (15/55 W): The H15 halogen bulb is a dual-filament bulb. In contrast to the H4, however, it is not the low beam and high beam which are combined but the high beam and daytime running lights.

H16 (19 W): The H16 halogen bulb is used above all in fog lamps.

D1 / D3 / D8 (35 W or 25 W): The "D bulbs" (D = discharge) are gas discharge lamps for xenon headlights with integrated igniter. The light sources are available for both projection headlamps (with the suffix "S") and reflection systems (with the suffix "R"). The old D1 burners do not have a protective glass bulb and contain a small amount of mercury. The more modern D3 and D8 bulbs (for 25 W systems), are however, mercury-free.

D2 / D4 (35 W): The D2 and D4 xenon gas discharge lamps are suited to xenon headlights with an external ballast. As with the D1/D3/D8 bulbs, the suffixes "S" or "R" are used for projection or reflector systems. The newer D4 variant is mercury-free.

D5 (25 W): The D5 bulb is a fully integrated special form for 25 W systems. It contains the burner, igniter, and ballast in a single unit.

P21/5W: One of the most commonly used light sources in the rear lamps of numerous vehicles is the P21/5W with combined braking and tail light function.

P21W / PY21W (21 W): The P21W is the most commonly used signal light. It is used, for example, for direction indicators with an amber cover lens. In contrast to the P21W, the PY21W has amber coloured glass and another base. It is therefore used for direction indicators with clear glass.

W5W: The small W5W bulb is often used for parking and position lights, but also for interior lights.

WHEN SHOULD A LIGHT SOURCE BE REPLACED?

In the event of (mostly one-sided) failure of a light source, it soon becomes clear that the light source must be replaced without delay (when replacing, please replace both sides – see page 80).

But there are also cases in which the light source does not fail completely, but should still be replaced. In our example, the flasher function on the right headlamp of a Mercedes W 202 is still present, but the signal pattern is very weak. The reason is the light source's glass, which has become opaque in various areas – this is shown following removal of the corresponding PY21W bulb.

Left figure: Weak direction indicator due to opaque light source

Right figure: Following replacement with a new PY21W light source, the flasher function is completely restored.

ANOTHER EXAMPLE:

For the Opel Corsa D (year of manufacture 2014) with combined position/daytime running light (light source P21/5W) shown, the right position light has failed. This becomes visible as soon as the low beam is switched on, and the lights are automatically dimmed from daytime running lights to position lights.

THE RIGHT LIGHT SOURCE AND FAST –
THE HELLA BULB CONFIGURATION TOOL

Searching long lists for the right light source – with the HELLA bulb configuration tool at **www.hella.com/bulbs** this is finally a thing of the past. In just a few clicks the applicable vehicle can be selected from the areas of passenger car, truck, or agricultural vehicle. Then just select the required lighting function – and the right HELLA light source is shown including designation, wattage, and part number. It doesn't get any easier!

REPLACE IN PAIRS!

Failed or faulty light sources should always be replaced in pairs – this applies especially for the low beam and high beam. The reason is that the right and left headlamps should always have the same type of bulb. If just one side is replaced, this is not always guaranteed, meaning that a deviating light pattern might result between left and right. Furthermore, the luminous flux or the illuminating power of halogen light sources diminishes over time – if replacement is only carried out on one side of the vehicle, both sides may therefore emit light to a different strength. This is something you can often see in oncoming traffic when it is dark.

SAFETY IS THE PRIORITY: CHECK THE HEADLAMP ADJUSTMENT!

If the light source is replaced in the headlamp, the headlamp adjustment should also be checked to be on the safe side. This is because even the smallest, unnoticeable adjustment during replacement can result in the headlamp having a significantly different light pattern afterwards. This may cause dangerous glare for the oncoming traffic! You can find tips and tricks on the topic of checking headlamps from page 22.

LEGAL REGULATIONS

In order to optimally equip or retrofit a vehicle, certain legal regulations must be complied with. On the following pages, we provide you with an overview of the most important of these legal regulations concerning vehicle lighting. Experience has shown that statutory regulations frequently change. HELLA therefore assumes no liability for the equipment regulations listed.

Detailed information on the legal provisions in accordance with ECE regulation 48 for the mounting of front, side, and rear lighting can be found in the HELLA brochure "Legal regulations for cars and trailers based on ECE regulation 48."

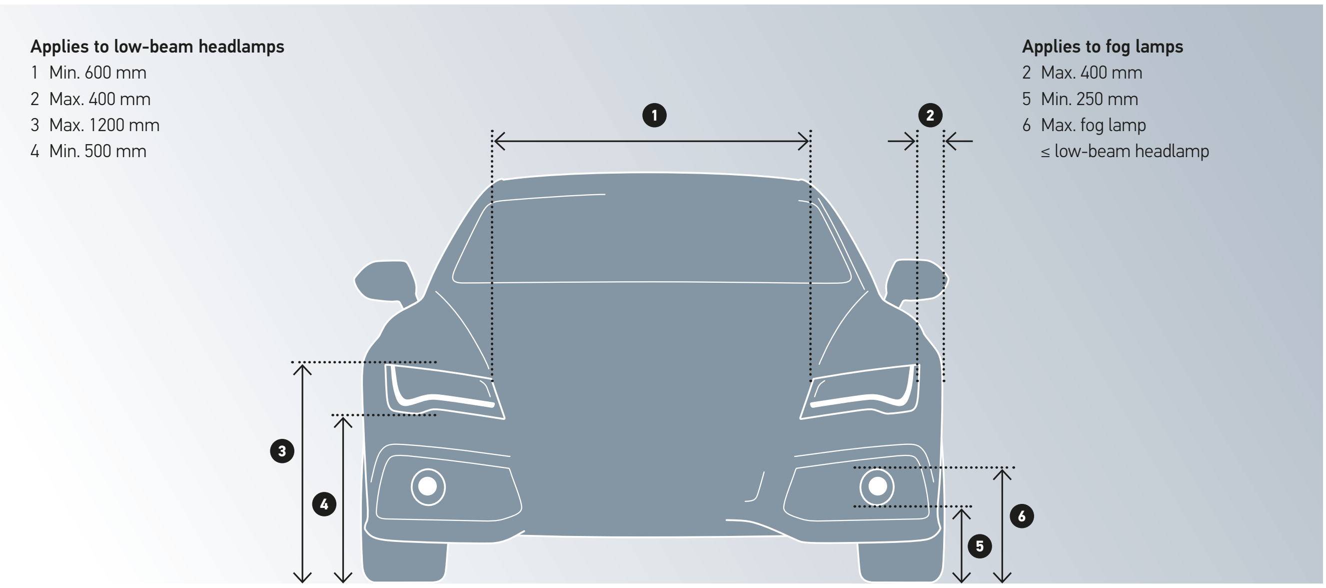
Due to the scope of the statutory regulations, only the most important are explained here. Comprehensive information regarding headlamps, as well as properties and uses, can be found in the following regulations:

- → **ECE-R20:** Headlamps with H4 bulbs
- → **StVZO § 50:** Headlamps for high and low beam
- → **UN-R48:** Attachment and use
- → **UN-R98:** Headlamps with gas discharge lamp
- → **UN-R112:** Headlamps with asymmetric low beam (also LED)
- → **UN-R119:** Cornering lights
- → **UN-R123:** Advanced Frontlighting System (AFS)

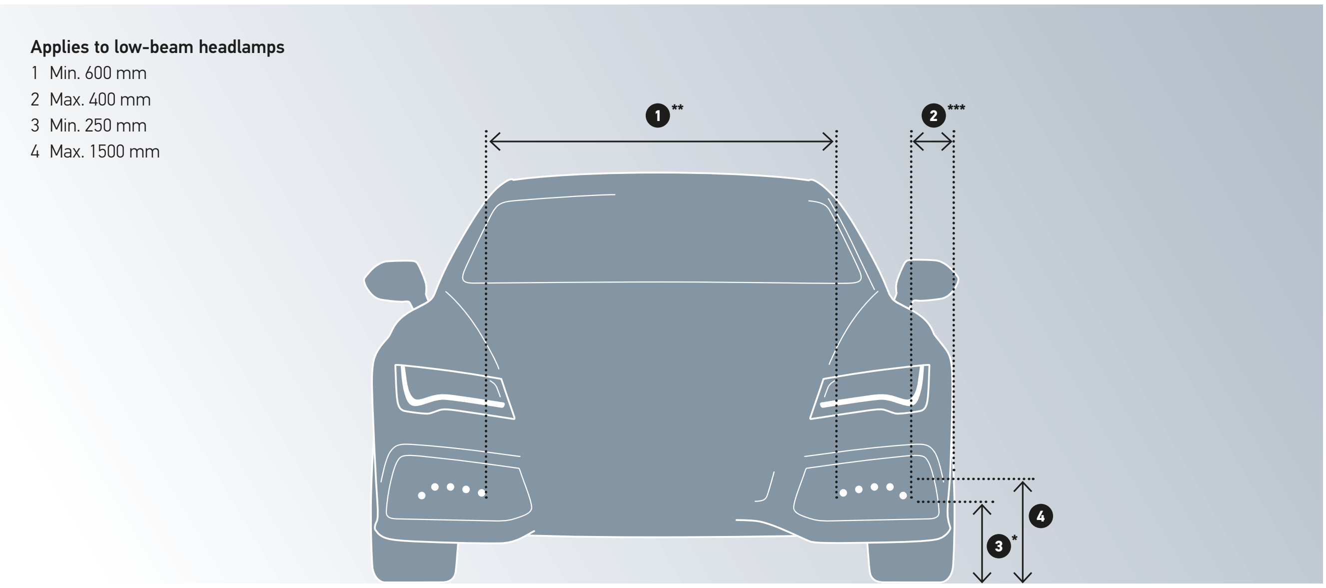
STATUTORY REGULATIONS FOR HEADLAMPS (CARS AND COMMERCIAL VEHICLES)

Installation regulations

Front view



	Headlamps for low beam	Headlamps for high beam	Fog lamps
Number	2	2 or 4	2, white or light amber
Width position	Max. 400 mm from the outermost point	No special regulations but must be installed in such a way that the driver is not disturbed by reflections.	No particular regulations
Height position	500 - 1200 mm permissible	No particular regulations	Not higher than the low beam headlamps, but according to ECE at least 250 mm
Electrical circuit	Switching on pairs of auxiliary headlamps in addition to the low beam and/or high beam is permitted. When changing to low beam, all high-beam headlamps must switch off simultaneously.	Switching on pairs of auxiliary high-beam headlamps in addition to the low beam and/or high beam is permitted. When changing to low beam, all high-beam headlamps must switch off simultaneously.	With low and high beam. Also possible with marker light if the light exit area of the fog lamp is no further than 400 mm away from the outermost point of the vehicle width.
Switch-on control	Green indicator lamp, optional	Blue indicator lamp, prescribed	–
Miscellaneous	If the headlamps are fitted with gas discharge lamps (high and low beam), automatic headlamp leveling and a headlamp cleaning system also have to be installed. These requirements also apply when such headlamps are retrofitted to vehicles already on the road if the retrofitting took place after April 1, 2000.	The luminous intensity of all the switchable high-beam headlamps must not exceed 430 000 Candela. The sum of the reference numbers may not be greater than 100.	–



Daytime running light

Legislation allows for various installation options for daytime running lights. However, there are predefined distances and beam angles that must be adhered to.

→ * When used as a position light, the minimum permitted installation height is 350 mm and the lights must not be more than 400 mm from the outer edge of the vehicle.
→ ** For vehicles with a width < 1300 mm, the distance must be at least 400 mm.
→ *** When used as a position light max. 400 mm. If the light is only used for the daytime running light function, this restriction does not apply.
→ When using daytime running light as a position light, the standard position light must be permanently decommissioned in accordance with ECE-R48.

For more information on legal stipulations and attachment regulations, please refer to the Internet or a qualified garage. Please refer to the assembly instructions for more detailed information.

Type approval numbers for headlamps

National and international design and operating regulations apply for the manufacture and testing of vehicle lighting equipment. Special approval marks exist for headlamps and can be found on the cover lens or on the housing.

Example:
The following can be found on a cover lens
HC/R 25 E1 02 A 44457

→ Code **HC/R** means: H for Halogen, C for low beam, and R for high beam.
→ The **slash** between C and R means that low beam and high beam cannot be switched on simultaneously (H4 headlamps).
→ The subsequent **reference number** provides information about the luminous intensity of the high-beam headlamp.
→ The code **E1** means that the headlamp has been approved in Germany.
→ **02 A** indicates that there is a marker light (parking light) (A) in the headlamp, the regulations for which have been revised twice (02) since publication.
→ The five-digit **type approval number** at the end is the number which is assigned individually for every headlamp design approval.

The headlamp housing shows all the headlamp versions that are used in one vehicle type.

Headlamp version

UN regulation 1

A	Marker light
B	Fog light
C	Low beam
R	High beam
CR	High and low beam
C/R	High or low beam

UN regulation 20 (only H4)

HC	Halogen low beam
HCR	Halogen high and low beam
HC/R	Halogen high or low beam

UN regulation 98

DC	Xenon low beam
DR	Xenon high beam
DC/R	Xenon high or low beam Simultaneous operation is prohibited.

UN regulation 123

X	Advanced Frontlighting System

Marking of illuminance reference numbers

High beam
7,5; 10; 12,5; 17,5; 20; 25; 27,5; 30; 37,5; 40; 45; 50
per headlamp (in Germany max. four simultaneously switched-on high-beam headlamps are permitted, and the reference number 100 or 480 lx is the maximum value that must not be exceeded)

Headlamp – direction of traffic flow

Left-hand traffic: No arrow
Right-hand traffic:

Left- and right-hand traffic:

LEGAL REGULATIONS FOR HEADLAMP LEVELING SYSTEMS

Since 1993, new vehicles have been required to have a headlamp leveling system by law. The regulations can be found in the directives 76/756/EEC and ECE-R48.

LEGAL REGULATIONS FOR HEADLAMP CLEANING SYSTEMS

For Europe the main requirements are as follows:

- → The cleaning systems are subject to type approval according to UN-R45 with regard to their cleaning power.
- → The fitting of such systems when gas discharge lamps are used has been compulsory since 1996 in compliance with UN-R48.
- → Water reserves for 25 or 50 cleaning cycles (class 25, class 50)
- → Cleaning efficiency of > 70% on a headlamp that is dirty to such an extent that only 20% of the original luminous flux is available
- → Functional capacity up to 130 km/h and from –10 °C to +35 °C

LEGAL REGULATIONS FOR SIGNAL LIGHTS

Due to the scope of the statutory regulations, only the most important are explained here.

The following regulations contain all the relevant information about signal lights, their properties, and uses:

- → UN-R6, StVZO § 54: Direction indicators front, rear, and side
- → UN-R7, StVZO §§ 51 and 53: Marker lights and tail lights front and rear
- → UN-R77, StVZO § 51: Parking lights front and rear
- → UN-R87: Daytime running lights
- → UN-R23, StVZO § 52: Reversing lights
- → UN-R7, StVZO § 53: Stop lights
- → UN-R38, StVZO § 53d: Rear fog lamps
- → UN-R4, StVZO § 60: License plate lamps
- → UN-R3: Reflex reflectors

Direction indicators front, rear and side	
Number at the front	Two
Number at the rear	Two or four
Number at the side (optional)	One per side
Colour	Amber
Height position	Between 350 mm and 1500 mm permissible
Width position	Max. 400 mm from the outermost edge of the body, min. 600 mm apart
Side position	Installation height between 350 mm and 1500 mm and max. 1800 mm from the front edge of the vehicle
Electrical circuit	An electronic warning flasher unit is made up of a pulse generator which switches the lights on via a relay. In addition, it also has a control circuit which is dependent on current and changes the flashing frequency in the event of light failure. The frequency of the flashing signals is between 60 and 120 per minute. All the direction indicators on the same side of the vehicle have to work synchronously.
Switch-on control	Indicator lamp, prescribed
Miscellaneous	Depending on the requirements, there are different functional controls for monitoring the indicator system (single-circuit, dual-circuit control).

Marker lights (passenger vehicles), front	
Number	Two or four
Colour	White
Mounting	The arrangement is the same as for the front direction indicators.
Miscellaneous	Vehicles and trailers over 1600 mm wide require marker lights (to the front).

Stop lights	
Number	Two of the category S1 or S2 and one of the category S3
Colour	Red
Height position	Between 350 mm and 1500 mm permissible; central stop lamp min. 850 mm, but max. 150 mm below the top reference edge of the vehicle
Width position	Max. 400 mm from the outermost edge of the body, min. 600 mm apart
Electrical circuit	The lamps are activated by means of a switch on the brake pedal.
Miscellaneous	Category S3 stop lamps (central stop lamp) may not be reciprocally incorporated with any other light.

Tail lights	
Number	Two or four
Colour	Red
Height position	Between 350 mm and 1500 mm permissible
Width position	Max. 400 mm from the outermost edge of the body, min. 600 mm apart
Electrical circuit	No particular regulations
Miscellaneous	In the case of a double function (stop, tail light) the ratio of luminous intensity of the individual functions must be at least 5 to 1.

Rear fog lamps	
Number	One or two
Colour	Red
Height position	Between 250 mm and 1000 mm permissible
Width position	The distance to the stop lamp must be at least 100 mm.
Electrical circuit	Rear fog lights may only work when low beam, high beam or fog lights are switched on. They must be able to be switched off independently of the fog lamps.
Switch-on control	Amber, vehicles approved before 1981 also green
Miscellaneous	The visible illuminated area must not be more than 140 cm^2. The light may only be switched on when visibility is less than 50 m.

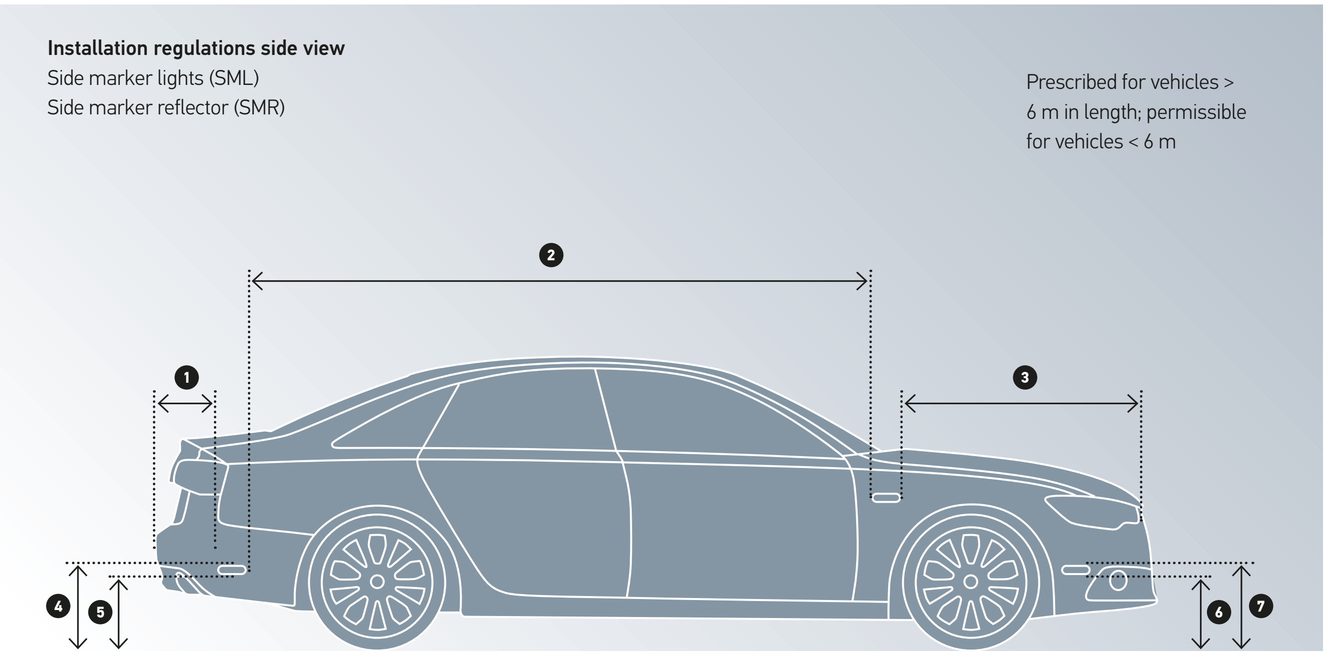
Reversing lights	
Number	One or two
Colour	White
Height position	250 to 1200 mm permitted
Width position	No particular regulations
Electrical circuit	The circuit only works with the ignition switched on and the reverse gear engaged.

Side marker lights	
Number	Depending on the length of the vehicle
Colour	Amber
Height position	Between 250 mm and 1500 mm permissible
Side position	Max. 3000 mm from the front edge of the vehicle and max. 1000 mm from the rear edge of the vehicle
Electrical circuit	For passenger cars, may also flash too

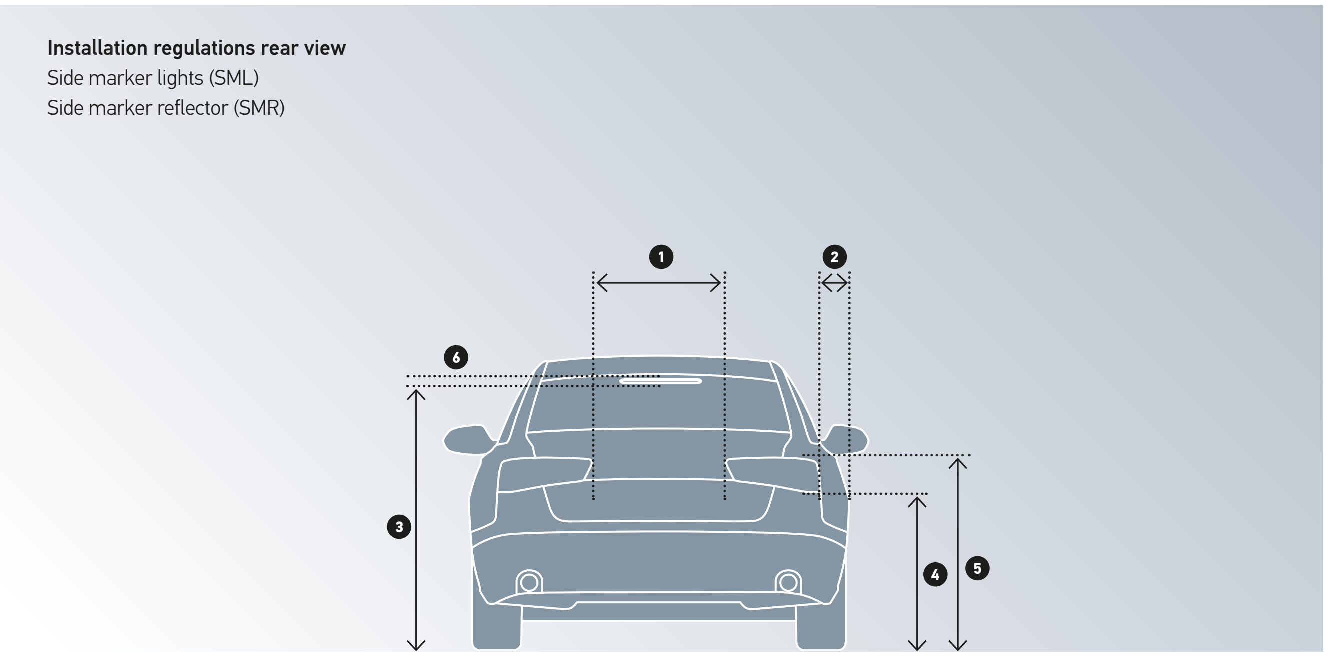
Licence plate lamps	
Number	Depending on requirements one or two lamps
Colour	White
Mounting	No particular regulations
Electrical circuit	No particular regulations
Miscellaneous	The rear licence plate must be illuminated in such a way that it can be read at a distance of 25 m. The min. luminance of the complete surface area must be at least 2.5 cd/m^2.

Parking lights	
Number	Depending on requirements two at the front and two at the rear or one at each side
Colours	White/red
Height position	Between 350 mm and 1500 mm permissible
Width position	Max. 400 mm from the outermost edge of the body, min. 600 mm apart
Electrical circuit	The parking lights must be able to work without other lamps being switched on.
Miscellaneous	The parking light function is usually taken over by the tail lights and the front position lights.

Daytime running lights	
Number	Two at the front
Colour	White
Height position	Between 250 mm and 1500 mm permissible
Width position	Min. 600 mm apart
Electrical circuit	The daytime running lights must switch off automatically if the low-beam headlamps are switched on.



1 SML/SMR: Max. 1000 mm (from rear vehicle edge)
2 All: Max. 3000 mm
3 Direction indicator: Max. 1800 mm
SML/SMR: Max. 3000 mm (from front vehicle edge)
4 SMR: Max. 900 mm, SML: 1500 mm
5 SML/SMR: Min. 250 mm
6 SMR/SML: Min. 250 mm, direction indicator: 350 mm
7 SMR: Max. 900 mm, SML/direction indicator: 1500 mm



1 Valid for direction indicator/stop light/tail light/reflex reflector: Max. 600 mm
2 Valid for direction indicator/tail light/reflex reflector
3 Centre high-mounted stop lamp: Min. 850 mm
4 Rear combination lamp: Min. 350 mm
5 Rear combination lamp: Max. 1500 mm
6 Centre high-mounted stop lamp: Max. 150 mm below rear combination lamp or 3

Type approval numbers on signal lights

National and international design and operating regulations exist for the manufacture and testing of vehicle lighting equipment.

Special approval marks exist for signal lights and can be found on the light.

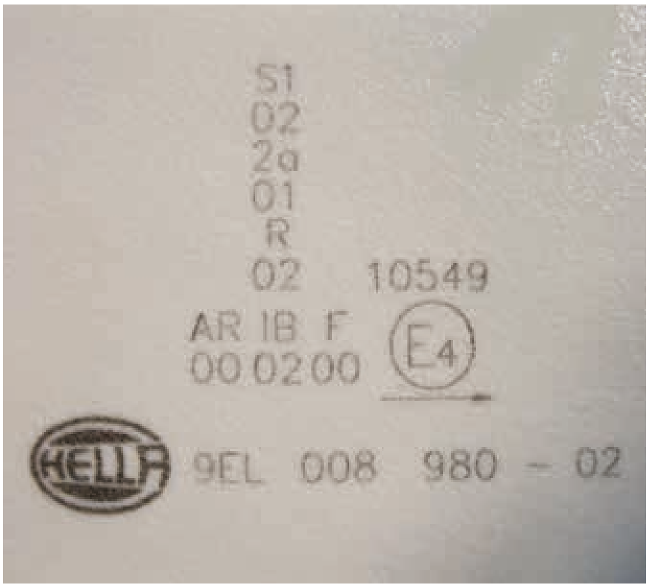
Example:

The following can be found on a light **RS1 IAF 02 E1 → 31483**

- → R stands for tail light,
- → S1 for stop light,
- → IA for reflex reflector,
- → F for rear fog light. 02 means that the regulation has been revised twice since publication.

These features are integrated in the rear combination lamp:

- → The E1 marking means that the light has been approved in Germany.
- → The arrow shows which way the light can be installed and always points to the outer edge of the vehicle. If there is no arrow on the light it can be installed at the right or left rear side.
- → The five-digit number at the end is the type approval number.



Explanation of the combinations of numbers and letters on signal lights:

A	Marker light
AR	Reversing light
F	Rear fog light
IA	Reflex reflector
R	Tail light
S1	Stop lamp
1	Front direction indicator (different technical design)
1a	Front direction indicator (different technical design)
1b	Front direction indicator (different technical design)
2a	Rear direction indicator
5	Additional side direction indicator (for vehicles up to 6 m in length)
6	Additional side direction indicator (for vehicles longer than 6 m)
SM1	Side marker light (for all vehicles)
SM2	Side marker light (for vehicles up to 6 m in length)

CHECK LISTS

A QUICK CHECK

What should be tested during the light check? When should the front camera be calibrated? And how is a vehicle prepared for the lighting test?

For these and other questions, our practical checklists and inspection overviews can provide you with helpful information. Just pick them up and never forget a test step again!

COPY TEMPLATES

Vehicle preparation for a light test

- [ ] Test the headlamp function.
- [ ] Check the cover lenses for gravel throw damage, scratches, and for dullness.
- [ ] The tyres must have the prescribed air pressure.
- [ ] Load the vehicle with a person or a weight of 75 kg on the driver's seat. The vehicle 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 loaded with a person or 75 kg on the driver's seat.
- [ ] In the case of vehicles with hydraulic or air suspension, heed the manufacturers' instructions.
- [ ] For automatic correction of the headlamps or an infinite or multi-stage setting fixture: Follow the manufacturer's instructions as regards additional function tests.
- [ ] For various vehicles with automatic headlamp leveling: Use a diagnostic tester. The reason is that the control unit has to be set to "basic mode" during adjustment. Once the cut-off line has been set correctly, this value will be stored as the new standard position.

When should a front camera be calibrated?

- → Faulty camera
- → Faulty control unit
- → After the windshield has been replaced
- → Following axle alignment
- → If the customer complains about the function
- → Following encoding or replacement of network control units

The vehicle-specific manufacturer's specifications must be observed!

When is it necessary to adjust a radar sensor?

- → Following replacement or removal/installation of the radar sensor
- → Following accident repair work
- → After changes to the vehicle level at the front or rear axle
- → After changes to the rear axle tracking and/or camber
- → If the tolerances of the misalignment angle are exceeded
- → After a suspected impact
- → If the hood latch was in the "service position"

The vehicle-specific manufacturer's specifications must be observed!

Practical tips for handling light sources

- → Xenon headlights require a high voltage for ignition, which is why the ballast voltage supply connector should always be removed before any work is carried out on the headlamps.
- → When replacing bulbs, never touch the new glass bulb since fingerprints will be burnt on and make the bulb opaque.
- → If a xenon bulb breaks in a closed room (workshop) the room should be ventilated to prevent a health hazard due to toxic gases.
- → D3 and D4 xenon lamps do not contain mercury and are therefore more environmentally compatible.
- → Standard filament and halogen bulbs do not contain any materials which are problematic from an environmental point of view, and can be disposed of with normal household waste.
- → Xenon bulbs are special waste. If the bulb is faulty but the glass bulb is still intact, it has to be disposed of as special waste since the gas/metal vapor mixture contains mercury and is thus extremely toxic when inhaled.
- → If the glass bulb has been destroyed e.g. in an accident, the xenon bulb can be disposed of with normal household waste since the mercury will have evaporated.
- → In D3 and D4 xenon lamps, the mercury was replaced with non-toxic zinc iodide. These bulbs can be disposed of with normal household waste.

Testing with beamsetters

Beamsetters may only be used for testing the adjustment of the headlamps when it has been confirmed that the beamsetter meets certain requirements. The following list is an aid for your own testing.

COMPONENT/ELEMENT	OK	not OK	REMARKS
Device is clean	☐	☐	
Type plate is present and legible	☐	☐	
Operating instructions are to hand	☐	☐	
Rollers, rails, mounting are OK	☐	☐	
Beamsetter box tilt system is secured	☐	☐	
Diagnostic mirror	☐	☐	
Column with side adjusting device	☐	☐	
Guides for beamsetter box	☐	☐	
Brakes for height adjustment	☐	☐	
Actuation elements (handwheels etc.)	☐	☐	
Sight lens is OK	☐	☐	
Aiming screen is OK	☐	☐	
Adjusting device for aiming screen	☐	☐	
Sight lens, seal	☐	☐	

Every day is light testing day –
so check every vehicle

Order No.	Date	Vehicle type	Licence plate	Kilometer reading

	Left		Right		Fault rectified	
	Defective	OK	Defective	OK	No	Yes
Front						
High beam	☐	☐	☐	☐	☐	☐
Low beam	☐	☐	☐	☐	☐	☐
Parking light	☐	☐	☐	☐	☐	☐
Marker lights	☐	☐	☐	☐	☐	☐
Fog lamps	☐	☐	☐	☐	☐	☐
Direction indicator	☐	☐	☐	☐	☐	☐
Side						
Direction indicator, body	☐	☐	☐	☐	☐	☐
Direction indicator, mirror	☐	☐	☐	☐	☐	☐
Side marker light	☐	☐	☐	☐	☐	☐
Rear						
Direction indicator	☐	☐	☐	☐	☐	☐
Stop lamp	☐	☐	☐	☐	☐	☐
Reverse lamp	☐	☐	☐	☐	☐	☐
Tail light	☐	☐	☐	☐	☐	☐
Rear fog lamp	☐	☐	☐	☐	☐	☐
Licence plate lamp	☐	☐	☐	☐	☐	☐
Interior						
Instrument lighting	☐	☐	☐	☐	☐	☐
Direction indicator, indicator lamp	☐	☐	☐	☐	☐	☐
High beam, indicator lamp	☐	☐	☐	☐	☐	☐
Hazard light, indicator lamp	☐	☐	☐	☐	☐	☐
Front interior lighting	☐	☐	☐	☐	☐	☐
Rear interior lighting	☐	☐	☐	☐	☐	☐

Headlamp check

Damage pattern	Condensation		Gravel throw		Reflector cloudy		Fault rectified	
	☐ Left	☐ Right	☐ Left	☐ Right	☐ Left	☐ Right	☐ No	☐ Yes

			Fault rectified	
Height adjustment	☐ Too high	☐ Too low	☐ No	☐ Yes
Identical luminous intensity	☐ No	☐ Yes	☐ No	☐ Yes

Date	Follow-up work	Signature
	☐ Yes ☐ No	

PERFECTLY TRAINED
TRAINING PROGRAM FOR WORKSHOPS

New vehicles, new technologies, modified legal requirements. It is always important for workshops to be up to date in terms of knowledge – because only when they are in the know can the customer's car be put back on the road quickly. To help you in the process, HELLA and Hella Gutmann Solutions provide targeted seminars, specialist talks, and practical training for workshop employees.

Classic:
The training and development in our training rooms, which are equipped with state-of-the-art technology and different vehicle models, provide you with the opportunity to master and carry out diagnostics on modern systems.

Online:
In the HELLA TECH WORLD you can find interactive online training courses on the topics of lighting, electrics, as well as air conditioning and engine cooling. You can decide yourself when and at what speed you want to learn.

Make the most of our training program to prepare yourself for the future.

Register for training courses directly in
HELLA TECH WORLD

www.hella.com/techworld

Direct access to
HELLA TECH WORLD

We can make your workshop future-proof.

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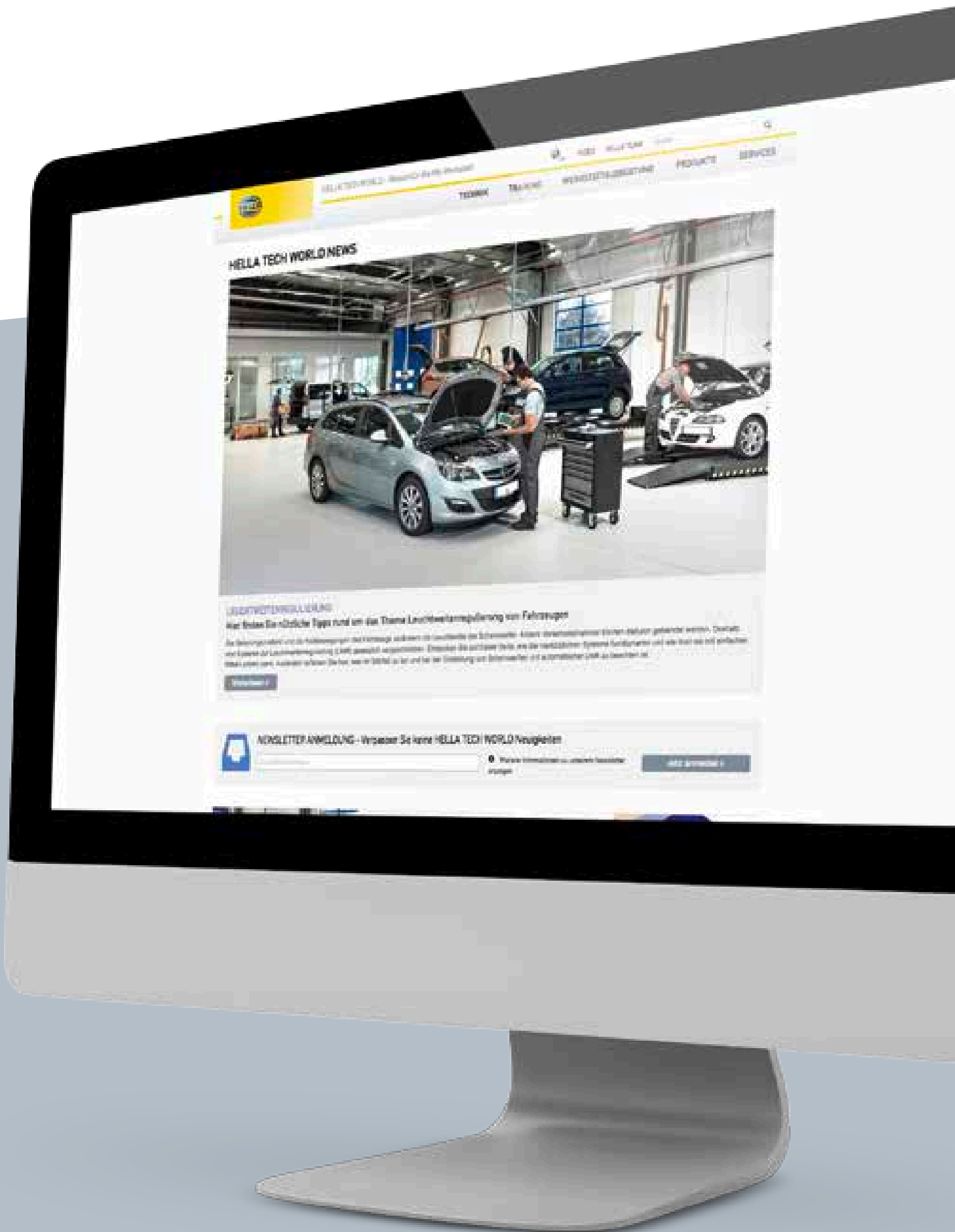

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