

## Our competence: **Your benefits**

As inventors of the lambda sensors and the largest manufacturer, Bosch offers a clear plus for trade, workshop and vehicle owners with regard to quality and product range. With 30 years' experience and over 500 million produced units, Bosch is no. 1 around the world.

- ▶ From the inventors of lambda sensors: guaranteed original equipment quality
- ▶ Unsurpassed manufacturing experience: with an annual production of more than 33 million
- ▶ Safety: with high data quality and reliable application specifications
- ▶ Original connector: as in original equipment
- ▶ Coordinated cable length: tailored to any vehicle model
- ▶ Simple and fast installation: e.g. by greased thread



This is where you get original Bosch quality:

64.64.XX

AA/SEC-1.987.XXX.XXX/201102

Efficient diagnosis and innovative workshop equipment, technical assistance and competent training, fast delivery service and the world's largest range of spare parts for new parts and replacement parts, all from a single source.

## Practical tips: **Checking and replacing Lambda sensor**



**BOSCH**  
Invented for life



**BOSCH**  
Invented for life

## Perfect!

Bosch Lambda sensors are 100 percent suited to workshops

### Connector

Matching connector for a guaranteed, safe contact to the wiring harness.

### Lambda sensor

Constant technological advance always ensures state-of-the-art technology.

### Connecting cable

Cable length coordinated: suited to the vehicle model.

### Knowhow from the market leader

As the inventors of the lambda sensor, Bosch is pushing the development of this type of exhaust sensor with numerous innovations. As the world's largest manufacturer, Bosch produces more than 33 million lambda sensors annually. All workshops benefit from Bosch's knowledge of the entire fuel injection system and exhaust-gas treatment, which is becoming increasingly more important:

- ▶ Bosch lambda sensors convince with highest manufacturing quality
- ▶ All application specifications are absolutely reliable
- ▶ All sensor types are state of the art
- ▶ The wide range of Bosch replacement parts is tailored to workshops and easily available around the world

Only correctly working lambda sensors prevent damage to the catalytic converter and ensure optimum exhaust-gas values and driving characteristics at minimum consumption.

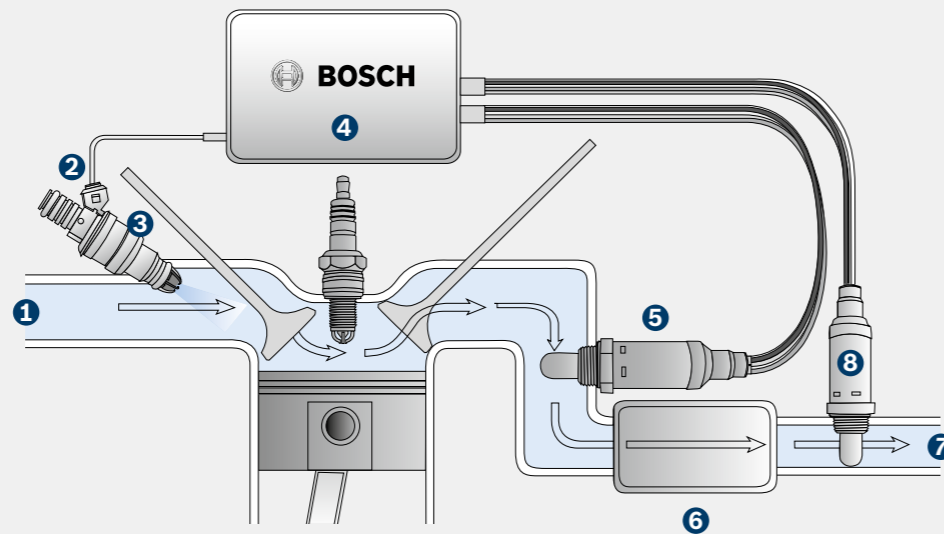
# Convincing facts! Effective exhaust-gas treatment, less fuel consumption

# This creates trust! Tailored original equipment quality

## Injection system

### Lambda control loop

- 1 Intake air
- 2 Fuel supply
- 3 Injector
- 4 Control unit
- 5 Control sensor (upstream of catalytic converter)
- 6 Catalytic converter
- 7 Exhaust gas
- 8 Diagnostic sensor (downstream of the catalytic converter)



### Perfectly geared to one other

Modern exhaust gas systems have a minimum of two lambda sensors. The control sensor is located upstream of the catalytic converter and the diagnostic sensor is located downstream of the catalytic converter. The control sensor ensures optimum mixture composition and hence creates the preconditions for the best-possible exhaust-gas cleaning. The diagnostic sensor mainly checks the catalytic converter's efficiency.

### Hi-tech for clean engine performance

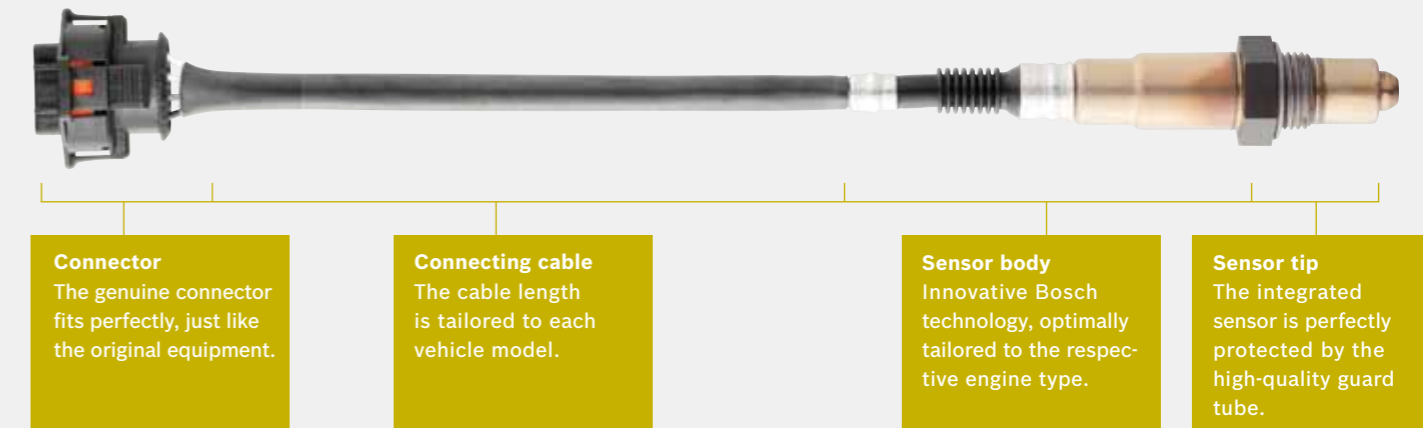
Bosch lambda sensors are central components for exhaust-gas cleaning. There are two different types: Step change sensor and broad-band sensors. Step change sensors detect the "stoichiometric mixture", i.e.  $\lambda = 1$ , and ...

- ▶ ... compare the residual oxygen content in the exhaust gas with the oxygen content in the ambient air
- ▶ ... detect the transfer from rich to lean mixture and vice versa
- ▶ ... create a voltage of between approx. 20 and 900 mV, depending on the oxygen content in the exhaust gas

Broad-band lambda sensors can not only exactly measure  $\lambda = 1$  mixtures, but also lean ( $\lambda > 1$ ) and rich mixtures ( $\lambda < 1$ ). This feature enables the lambda sensor to be used for additional engine control functions (e.g. secondary air diagnosis). The broad-band sensor defines the lambda value using the pump current, which is zero mA at  $\lambda = 1$ .

### Precise process during engine actuation

The control unit detects the mixture composition using the lambda sensor voltage. While taking the engine load into consideration, the injected fuel quantity is controlled so that an optimum mixture composition ( $\lambda = 1$ ) is ensured – this creates ideal preconditions for exhaust-gas treatment in the catalytic converter. If the mixture is too rich ( $\lambda < 1$ ), the fuel quantity is reduced. If the mixture is too lean ( $\lambda > 1$ ), the quantity is increased. An optional second lambda sensor – the diagnosis sensor downstream of the catalytic converter – detects whether the control sensor is working optimally. The control unit is able to compensate for any possible deviations.



**Connector**  
The genuine connector fits perfectly, just like the original equipment.

**Connecting cable**  
The cable length is tailored to each vehicle model.

**Sensor body**  
Innovative Bosch technology, optimally tailored to the respective engine type.

**Sensor tip**  
The integrated sensor is perfectly protected by the high-quality guard tube.

### Bosch from the outset

Bosch is a leader in both the original equipment and in trade. No wonder all European and the majority of vehicle manufacturers worldwide fit Bosch lambda sensors ex works into their vehicles. We make sure that only lambda sensors that meet exactly this high original equipment quality are available in stores.

Bosch offers a uniquely wide range of products: Select the matching lambda sensor from the Bosch original range or from the Bosch universal range.

### The Bosch original range:

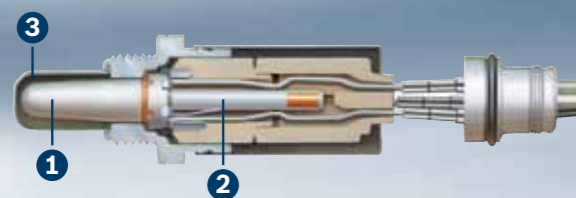
Original lambda sensors are always equipped with the original connector.

- ▶ Plug & play: fit without any additional cost exactly into the vehicle
- ▶ The manufacturer requirements are 100% complied with
- ▶ Bosch lambda sensor cover over 85% of all European vehicles

### The Bosch universal range:

as few as 10 universal sensors replace approximately 1,000 original lambda sensors with all the various sensor elements and heat outputs.

- ▶ Cost-effective storage, highest availability
- ▶ Short number codes ensure you easily keep track
- ▶ No special tools required for installation



- 1 Sensor ceramic element
- 2 Heating element
- 3 Guard tube

### Finger-type sensor

The core element of the finger-type sensor is its sensor ceramic element. It is heated to a temperature of more than 350 °C by a separate heater for control operation. A special guard tube protects the sensor from residue in the exhaust gas. Finger-type sensors are mostly step change sensors.



- 1 Planar sensor element with integrated heating element
- 2 Double-wall guard tube

### Planar sensor

The planar lambda sensor operates with one sensor in the shape of a stretched plate. It houses not only the measuring cell but also the heating element to ensure faster operational readiness.

# This gives you peace of mind! Test and replace Bosch lambda sensors easily

Bosch lambda sensors are characterized by reliability and a long service life. However, they must be regularly checked and replaced as required as they are wearing parts. We recommend checking them every 30,000 km.

## Three steps to diagnose the lambda sensor:

1. Read out the fault memory and check the actual value
2. Check the signal patterns (according to ESI[tronic])
3. Check wires and connectors for secure connections





## Regular checks helps prevent costly subsequent damage

What many vehicle owners do not know: lambda sensors are wearing parts! For this reason, inform your customers about the importance of regularly checking the lambda sensor and a possible replacement.

Only flawless lambda sensors ...

- ▶ ... save up to 15% fuel costs
- ▶ ... enable adherence to strictest exhaust-gas values
- ▶ ... help prevent costly catalytic converter damage

## 1. Perform visual inspection and read out fault memory

	Test step	In the process, please note:
1	 <p><b>Check fault lamp</b> Important: The engine must be warm.</p>	A faulty lambda sensor will trigger the OBD lamp to light up (on-board diagnosis).
2	 <p><b>Read out fault memory</b></p>	Use tester (such as Bosch KTS 570).
3	 <p><b>Perform visual inspection</b> (when fitted)</p>	Connectors, wiring and lambda sensor are affected.
4	 <p><b>Perform leak test on intake and exhaust system</b></p>	In particular, check in the area between engine and lambda sensor. Additionally entering air triggers incorrect lambda sensor signals.

	<p><b>Condition of the lambda sensor:</b> Green, grainy soiling.</p> <p><b>Possible cause:</b> Antifreeze agent has leaked and entered the combustion chamber.</p> <p><b>Action:</b> Replace the lambda sensor. Check the engine block, cylinder head, intake manifold and cylinder head gasket for wear and tear.</p>		<p><b>Condition of the lambda sensor:</b> Red or white soiling.</p> <p><b>Possible cause:</b> Fuel additives in the petrol.</p> <p><b>Action:</b> Do not use fuel additives. Replace the lambda sensor.</p>
	<p><b>Condition of the lambda sensor:</b> Black, with oily soiling.</p> <p><b>Possible cause:</b> Excessively high oil consumption.</p> <p><b>Action:</b> Check the valve guides and seals; these may be worn. Replace the lambda sensor.</p>		<p><b>Condition of the lambda sensor:</b> Cable break.</p> <p><b>Possible cause:</b> Excessive cable tension.</p> <p><b>Action:</b> Replace the lambda sensor. Do not route the cable with too much tension.</p>
	<p><b>Condition of the lambda sensor:</b> Dark brown color.</p> <p><b>Possible cause:</b> Fuel/air mixture too rich.</p> <p><b>Action:</b> Check the fuel pressure. Replace the lambda sensor.</p>		<p><b>Condition of the lambda sensor:</b> The molded cable tubing is damaged.</p> <p><b>Possible cause:</b> Stone chips.</p> <p><b>Action:</b> Replace the lambda sensor.</p>

## 2. Check lambda sensor systematically

Faulty lambda sensors may have many causes:

- ▶ Electrical faults
- ▶ Mechanical faults
- ▶ Poisoning/soiling
- ▶ Thermal overload

You can reliably find the fault if you adhere to the following test steps. Please note: The engine mechanical system and the ignition system must be OK to perform reliable diagnosis. Detailed test steps and test values are contained in ESI[tronic].

### Check lambda sensor heater

1		<p><b>Check the power supply for the lambda sensor heating.</b></p> <p>The power supply must constantly be between 10.5 V - 13.5 V.</p> <p>Power supply OK?</p>	<p><b>No</b></p> <p>Possible causes:</p> <ul style="list-style-type: none"> <li>▶ Relay does not switch to "Continuous positive"</li> <li>▶ No ground actuation by control unit</li> <li>▶ Open circuit, short circuit to ground, short circuit to positive</li> </ul>
Yes			
2		<p><b>Check heating resistance at ambient temperature.</b></p> <p>The higher the temperature of the lambda sensor, the higher the heating resistance and vice versa.</p> <p>Test values OK?</p>	<p><b>No</b> Lambda sensor faulty</p>
Yes			
3		<p><b>Allow engine to warm up, measure heating current.</b></p> <p>To ensure the lambda sensor is quickly ready for operation, it is initially energized stronger and gradually less by switching the ground supply on and off.</p> <p>Does the heating current reduce with increasing temperature?</p>	<p><b>No</b> Lambda sensor faulty</p>
Yes			
4		<p><b>Check vehicle wiring harness for:</b></p> <ul style="list-style-type: none"> <li>▶ Damage</li> <li>▶ Corrosion</li> <li>▶ Contact faults at the connectors</li> <li>▶ Open circuit, short to ground, short to positive and transfer resistances</li> </ul> <p>Is the wiring harness OK between lambda sensor and control unit?</p>	<p><b>No</b> Repair/replace wiring harness</p>
Yes			
5		<p><b>Check control unit:</b></p> <ul style="list-style-type: none"> <li>▶ Check multi-point connector for damage, corrosion and contact faults.</li> </ul> <p>Is the control unit OK?</p>	<p><b>No</b> Control unit faulty/replace</p>
Yes			
<p><b>Lambda sensor heater OK.</b></p> <ul style="list-style-type: none"> <li>▶ Delete fault memory</li> <li>▶ Go for test drive</li> <li>▶ Check fault memory</li> </ul>			

### Check lambda sensor signal

1		<p><b>Test requirements:</b></p> <ul style="list-style-type: none"> <li>▶ Fuel injection system, ignition and engine mechanical system OK</li> <li>▶ No leaks in intake system and exhaust-gas system</li> <li>▶ Engine warm and idling:</li> </ul>	
2		<p><b>Check signal profile – step change sensor:</b></p> <ul style="list-style-type: none"> <li>▶ Signal moves between approximately 0.1...0.9 V</li> <li>▶ The larger the voltage boost, the better the signal</li> <li>▶ Frequency between 0.5...3 Hz</li> <li>▶ Voltage below 0.4 V → lean mixture</li> <li>▶ Voltage in excess of 0.5 V → rich mixture</li> </ul>	<p>This measurement setup allows the most test steps to be performed.</p>
or			
3		<p><b>Check signal profile – broad-band sensor:</b></p> <ul style="list-style-type: none"> <li>▶ At lambda = 1 → pump current 0 mA</li> <li>▶ Pump current below 0 mA → rich mixture</li> <li>▶ Pump current in excess of 0 mA → lean mixture</li> </ul> <p>Is the signal profile OK?</p>	<p><b>No</b> Lambda sensor faulty</p>
Yes			
4		<p><b>Check vehicle wiring harness for:</b></p> <ul style="list-style-type: none"> <li>▶ Damage</li> <li>▶ Corrosion</li> <li>▶ Contact faults at the connectors</li> <li>▶ Open circuit, short to ground, short to positive and transfer resistances</li> </ul> <p>Is the wiring harness OK between lambda sensor and control unit?</p>	<p><b>No</b> Repair/replace wiring harness</p>
Yes			
5		<p><b>Check control unit:</b></p> <p>Is the reference 450 mV? Check multi-point connector for damage, corrosion and contact fault</p> <p>Is the control unit OK?</p>	<p><b>No</b> Control unit faulty/replace</p>
Yes			
<p><b>Lambda sensor heater OK.</b></p> <ul style="list-style-type: none"> <li>▶ Delete fault memory</li> <li>▶ Go for test drive</li> <li>▶ Check fault memory</li> </ul>			

### 3. Removal and installation

Bosch lambda sensors are 100% tailored to workshops. For this reason, you can quickly and safely install and remove them. Positive aspects:

- ▶ The lambda sensor can be easily and quickly replaced with the pre-greased thread. This saves time and effort during replacement

- ▶ The coordinated cable length allows the lambda sensor to be tailored to each vehicle model
- ▶ The original connector fits perfectly, just like the original equipment

#### Important

- ▶ Fill unleaded fuel without additives only
- ▶ Regularly service vehicle
- ▶ If required, only jump start the vehicle using jump leads, as pushing the vehicle may cause unburnt fuel to reach the exhaust system
- ▶ Do not fill engine oil above the maximum mark on the dipstick
- ▶ Keep to test and replacement intervals: Check lambda sensor regularly every 30,000 km and replace within the replacement intervals recommended by Bosch

	Operation	Special features
1	 <p>Select assembly tool</p>	Use open 22 mm box wrench or tool adapter.
2	 <p>Set tightening torque</p>	Monitor 40...60 Nm using torque wrench.
3	 <p>Refit the sensor</p>	<b>Attention:</b> ensure the assembly paste does not come into contact with the guard tube.
4	 <p>Fitting a new sensor</p>	Bosch lambda sensors are supplied with a pre-greased thread and protective cap. Remove the protective cap only shortly before installation.
<p><b>Assembly instructions</b></p> <ul style="list-style-type: none"> <li>▶ Make sure not to twist the wiring harness during assembly/tightening of the sensor. Avoid pulling heavily on the cable or the connector.</li> <li>▶ Sensors with soiled or damaged connectors must not be used.</li> <li>▶ Cleanliness inside the connector is essential for the function of the lambda sensor.</li> <li>▶ For this purpose, protect the connector from any kind of soiling.</li> <li>▶ Route an excessively long connecting cable to a bow using cable ties.</li> </ul>		

Correct handling	Caution
 <p><b>Connectors</b></p> <p>Always cover sensor and connector prior to engine washing or applying the underbody protection.</p>	<p>Do not apply contact spray or grease as ambient air is required for operation of the lambda sensor.</p>
 <p><b>Connecting cable</b></p> <p>Look for kinking and chafing points due to tension, pressure or vibration.</p>	<p>Avoid hot resting points and contact surfaces on or at the exhaust system.</p>
 <p><b>Sensor body</b></p> <p>Handle the lambda sensor with care, do not throw or drop! Protect from mechanical strain!</p>	<p>Protect from impacts and do not clean using high pressure jets.</p>
 <p><b>Sensor tip</b></p> <p>Install with pre-greased thread.</p>	<p>Do not use leaded fuels. Do not apply thread grease to the guard tube. Ensure mechanically flawless engine, as e.g. combustion residue may cause deposits on the lambda sensor.</p>