

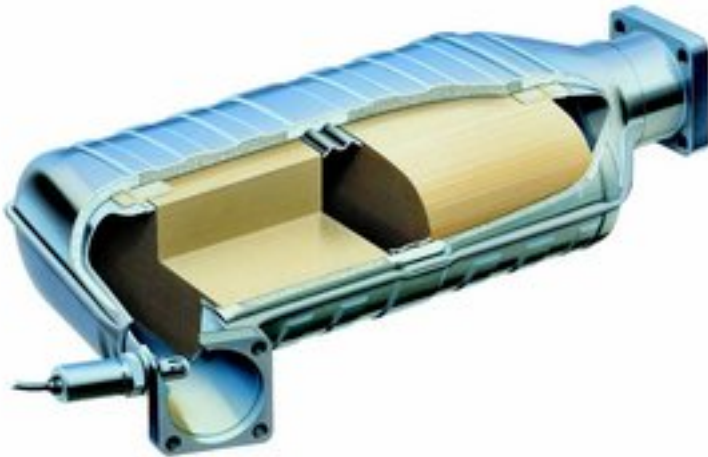
## Catalytic converter

The catalytic converter consists of a stainless steel housing and is a key component of modern exhaust aftertreatment systems for petrol and diesel engines. It ensures that harmful exhaust emissions from combustion engines are converted into harmless gases.

### Function

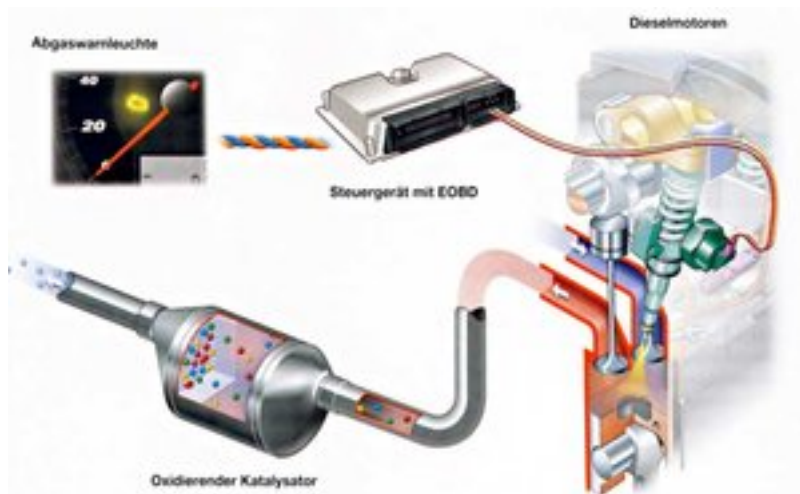
The catalytic converter is responsible for chemically converting harmful exhaust gases from combustion engines into less harmful substances.

### Structure of catalytic converters



A catalytic converter consists of a stainless steel housing that contains either a metallic (metalith) or ceramic (monolith) substrate. This substrate features numerous small longitudinal channels, designed to maximise the surface area for optimal efficiency. The surface of the substrate is coated with a highly porous wash coat layer, into which precious metals, such as platinum, palladium, and/or rhodium are embedded.

### Types of catalytic converters



### Three Way Catalytic Converter

This type of catalytic converter is designed for petrol engines. When it reaches operating temperature, it converts:

- ? Unburned hydrocarbons (HC) into carbon dioxide (CO<sub>2</sub>) and water vapour (H<sub>2</sub>O)
- ? Carbon monoxide (CO) into carbon dioxide (CO<sub>2</sub>)
- ? Nitrogen oxides (NO, NO<sub>2</sub>) into nitrogen (N<sub>2</sub>) and oxygen (O<sub>2</sub>)

These three processes occur simultaneously, which is why it is called a three way catalytic converter. To function effectively, the catalytic converter requires precise exhaust gas composition. This is achieved when a stoichiometric air/fuel mixture ( $\lambda = 1$ ) is maintained, meaning 1 part of fuel is mixed with 14.7 parts of air. An oxygen sensor (Lambda sensor), placed between the engine and the catalytic converter, monitors the oxygen content in the exhaust gases. The engine control unit processes this data to regulate the air/fuel mixture.

Modern three way catalytic converters have been improved to reach operating temperature in just a few seconds, a characteristic known as "light-off" behaviour, facilitated by advanced coating technologies. Additionally, some modern designs, such as close coupled catalytic converters, position the converter near the engine exhaust manifold to ensure rapid heat up and efficient emissions reduction.

### EOBD-Compatible Catalytic Converters

EOBD (European On-Board Diagnostics) catalytic converters are designed for vehicles that comply with Euro 3 and Euro 4 emissions standards. The EOBD system continuously monitors all emission relevant components and sensors during driving, detecting malfunctions and alerting the driver via a Malfunction Indicator Light (MIL).

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## Oxidation Catalytic Converter

Diesel engines operate with an excess of air, resulting in a high oxygen content in the exhaust. The oxidation catalytic converter for diesel engines facilitates two key chemical reactions:

- ? Carbon monoxide (CO) is oxidised into carbon dioxide (CO<sub>2</sub>)
- ? Hydrocarbons (HC) are converted into carbon dioxide (CO<sub>2</sub>) and water vapour (H<sub>2</sub>O)

## SCR Catalytic Converter

Selective Catalytic Reduction (SCR) catalytic converters are also used in hybrid vehicles, where they reduce emissions from the internal combustion engine. The incorporation of SCR systems in hybrid vehicles helps them meet stringent environmental regulations, making them more attractive to environmentally conscious consumers.

## Safety

Catalytic converters using ceramic monoliths require support mats to secure the substrate and prevent damage from vibrations and impacts. Previously, fine ceramic fibres, suspected of being carcinogenic, were used. However, modern "green mats" have been introduced, which are either biodegradable or have fibres too large to be inhaled into the lungs, ensuring improved environmental compatibility.

## Depreciation

Catalytic converters are subject to natural ageing. This is partly caused by the high temperatures (sometimes over 800 °C) and mechanical stresses (vibrations) that occur during normal vehicle operation. This can cause the coating of precious metals on the substrate to degrade over time. Today's catalytic converters are assumed to have an average lifespan of 80,000 to 100,000 km.

Problems with the catalytic converter are often only indirectly noticeable for drivers: an illuminated check engine light, increased fuel consumption, rough engine operation, or a failed emissions test can indicate a deteriorating or defective catalytic converter.

It is important to note that catalytic converter damage is often a secondary issue—for example, caused by a faulty oxygen sensor, oil loss, or mechanical impacts when hitting obstacles. A qualified automotive workshop can assess the condition of the catalytic converter through exhaust gas analysis and fault memory diagnostics.

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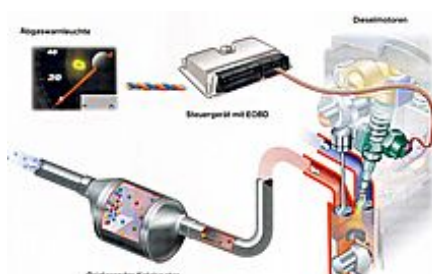
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When replacement is necessary, experts recommend using branded replacement parts that comply with the vehicle's specified emission standards and ensure the required cleaning performance over the long term.

## Environmental protection

Modern exhaust aftertreatment systems significantly improve air quality by reducing harmful pollutants such as carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), sulphur dioxide (SO<sub>2</sub>), and particulate matter (PM). Technological advances in emission control ensure that vehicles comply with strict national and international environmental regulations while also providing tax benefits and increasing resale value for vehicle owners.

## Images



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