Catalytic converters for petrol engines

⁘ As well as its silencing and evacuation functions, the exhaust pipe is now used to treat exhaust gases. Engine exhaust gas is charged with carbon monoxide (CO) and nitrogen oxides (NO_x), particularly dangerous gases that the catalytic converter manages to eliminate by almost 99%. Similarly, the very high temperature required for its operation inside the porous structures, performs "post-combustion" of unburned hydrocarbons.

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⁘ BASIC FACTS

Like all combustion, fuel combustion releases CO_2 and water vapour, two non-toxic gases. However, the very specific conditions occurring in an engine also lead to the formation of carbon monoxide and nitrogen oxides. At high doses, these gases are toxic: they must therefore be eliminated in order to preserve air quality. The catalytic converter carries out this task, which it manages particularly well as it can reduce their concentration in exhaust gases by almost 99%. To do so, it burns the molecules of carbon monoxide and breaks up nitrogen oxide molecules by catalysis – hence its name – to convert them to water vapour and carbon dioxide.

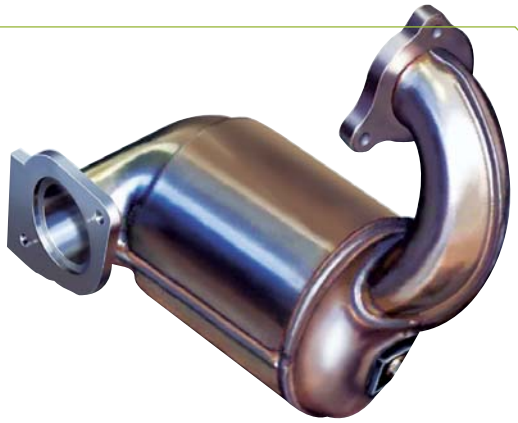
IN SHORT ⁘⁘⁘

The catalytic converter removes toxic compounds from exhaust gases by breaking up their molecules through high-temperature catalysis.

: HOW DOES IT WORK?

Current two-way catalytic converters eliminate toxic components from exhaust gases in two almost simultaneous steps – the first eliminates carbon monoxide and the second deals with the nitrogen oxides (NO_x). These two elements are comprised of a honeycomb structure made of ceramic to be able to resist the very high temperatures essential for catalysis. One of the elements is placed close to the engine to rapidly reach the temperature and deal with pollutant emissions as rapidly as possible. The ceramic is covered with a deposit of precious metals which act as catalysts able to treat the pollutants. A first element of these metals (platinum-rhodium) breaks up the nitrogen oxide molecule, whereas a second element (platinum-palladium) oxidises the carbon monoxide molecules.

Following this dual treatment, the exhaust gases only contain water vapour, carbon dioxide and nitrogen. Only some traces of carbon monoxide and nitrogen oxides persist, but once the temperature has risen in the catalytic converter, their concentration does not exceed 1%. However, the catalytic converter is only efficient in very specific temperature ranges and exhaust gas oxygen concentration conditions. The ideal concentration for full efficiency of catalysis is 1 gram of fuel to 14.7 grams of air. If the proportion of fuel in the mixture is greater than this value, carbon monoxide emissions soar. Inversely, if the mixture contains too much air, the NO_x levels rise steeply. The temperature must be greater than 400° C. In order to ensure these operating conditions, the engine computer adjusts the richness of the engine mixture according to the information communicated to it by the lambda probe (see sheet). It maintains an unburned fuel rate, which, by post-combustion in the catalytic converter, enables its temperature to be raised or lowered, and also manages the quantity of oxygen essential for catalysis. Finally, although the catalytic converter improves air quality by eliminating toxic exhaust gases, it cannot prevent the formation of carbon dioxide. For this reason, other means must be used to reduce emissions of this greenhouse gas.



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