



# The particulate filter

❖ In an engine, combustion of the **mix provides energy but also creates residues**. For the most part, these consist of CO<sub>2</sub>. However, particulates are also formed and these are primarily composed of carbon – the origin of exhaust gas fumes' black colour. Although their production has been reduced on current engines, it can never be completely eliminated. The only solution to completely getting rid of particulates is by using a filter.



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## ❖ BASIC FACTS

The particulate filter consists of a porous cellular substrate, with pores the diameter of which is smaller than that of the particulates rejected by the engine. By retaining these, it purifies the exhaust gas. To achieve this, the substrate is directly impregnated with catalytic materials. The particulate filter is fitted to the exhaust line, downstream from the catalytic converter, and supplements it without replacing it completely. However, like any filter, the particulate filter gets clogged quickly, over the kilometres. So that it remains effective and does not block evacuation of exhaust gas, it must regularly be regenerated, an operation which is carried out automatically and is undetectable to the driver.

### IN SHORT ❖❖

The particulate filter rids exhaust gases of the particulate matter s they contain by retaining it in a micro-porous cellular structure. This is regenerated automatically every 300 to 500 kilometres.



## ➤ HOW DOES IT WORK?

It is necessary to distinguish two phases of particulate filter operation: storage of soot and regeneration.

During the **storage phase**, the particulate filter behaves like a traditional filter. It accumulates soot on the walls of its substrate cells and releases only purified gas. A pressure sensor measures particulate matter accumulation by detecting variations in the permeability of the porous substrate and communicates this information to the particulate filter management unit. As soon as this detects that the saturation threshold of the filter has been reached, which occurs after around 300 to 500 km, it begins the process of regeneration.

The **regeneration phase** consists of bringing the particulate filter up to a very high temperature. To achieve this, the calculator adds to the injection cycle one, or even two, post-injections that are not present in the normal injection cycle. This modification of the injection cycle at the time of the particulate filter regeneration phase is completely “transparent” to the user because the system permanently adjusts the torque according to “pedal” requirements and therefore to the pressure that the driver exerts on the accelerator.

Although the particulate filter is basically intended for vehicles equipped with a common rail multi-injection system, it may also be present on engines equipped with pump injectors, although they are less flexible in terms of multi-injection. The advantage of post-injection is that it involves a high increase in the exhaust gas temperature. This then brings the particulate filter porous substrate to a temperature of over 570° C. Subjected to this temperature, soot, primarily composed of carbon, is transformed into carbon dioxide and water vapour. This is what is known as controlled afterburning. These gases easily cross the porous wall of the particulate filter and are eliminated through the exhaust. This regeneration cycle lasts some 20 minutes. When it ends, the multi-injection management system returns to normal operation.

The regeneration of the particulate filter slightly modifies engine torque because of the increase in value in the close post-injection, also known as secondary post-injection. To compensate for this effect and to make this phase imperceptible to the driver, the injection management unit also slightly modifies the values of the other basic injections. Engine behaviour thus remains unchanged.