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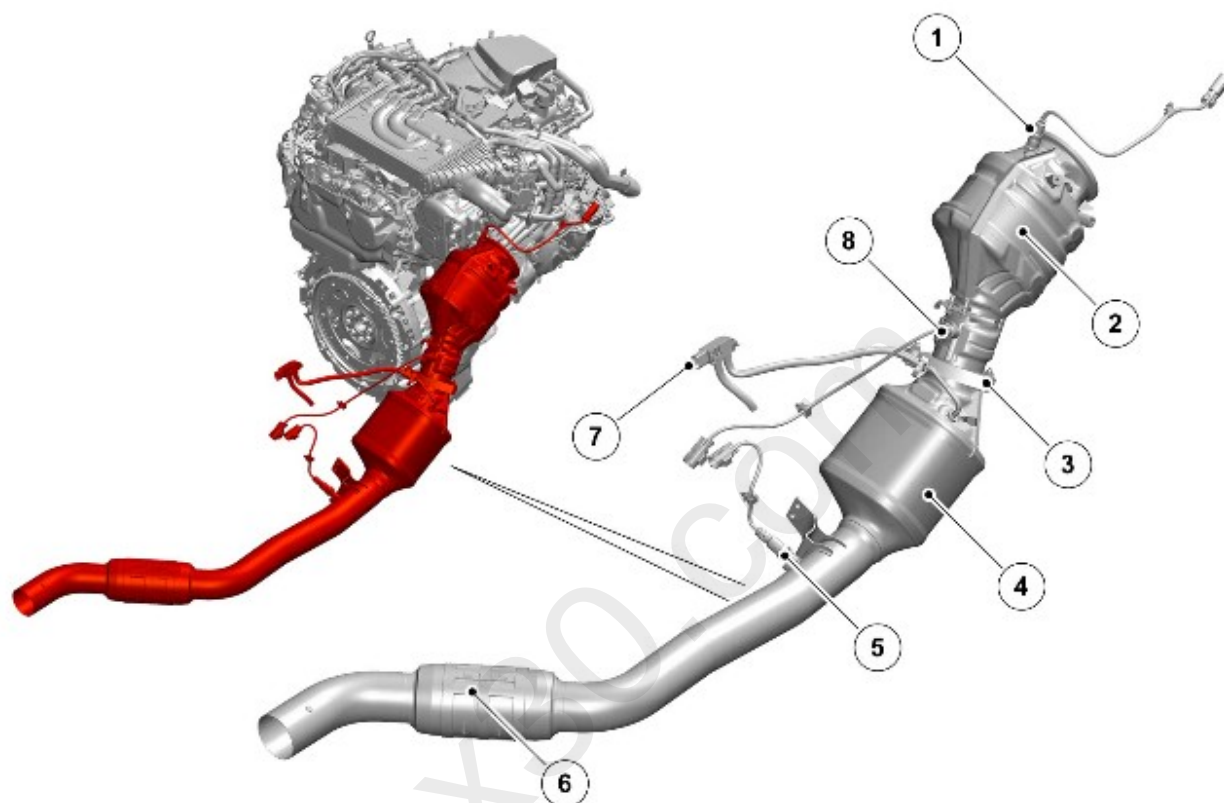
EXHAUST SYSTEM – INGENIUM I6 3.0L PETROL

GASOLINE PARTICULATE FILTER (G2300017)

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DESCRIPTION AND OPERATION

COMPONENT LOCATION



E238017

ITEM	DESCRIPTION
1	Pre catalytic converter - Heated Oxygen Sensor (HO2S)
2	Catalytic converter
3	Exhaust clamp
4	Gasoline Particulate Filter (GPF)
5	Exhaust flexible section
6	Post catalytic converter - HO2S
7	Exhaust back-pressure sensor
8	Post GPF - HO2S

OVERVIEW

The Gasoline Particulate Filter (GPF) is used to decrease the particulate emissions from the petrol engine exhaust system.

For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - INGENIUM I6 3.0L Petrol, Description and Operation).

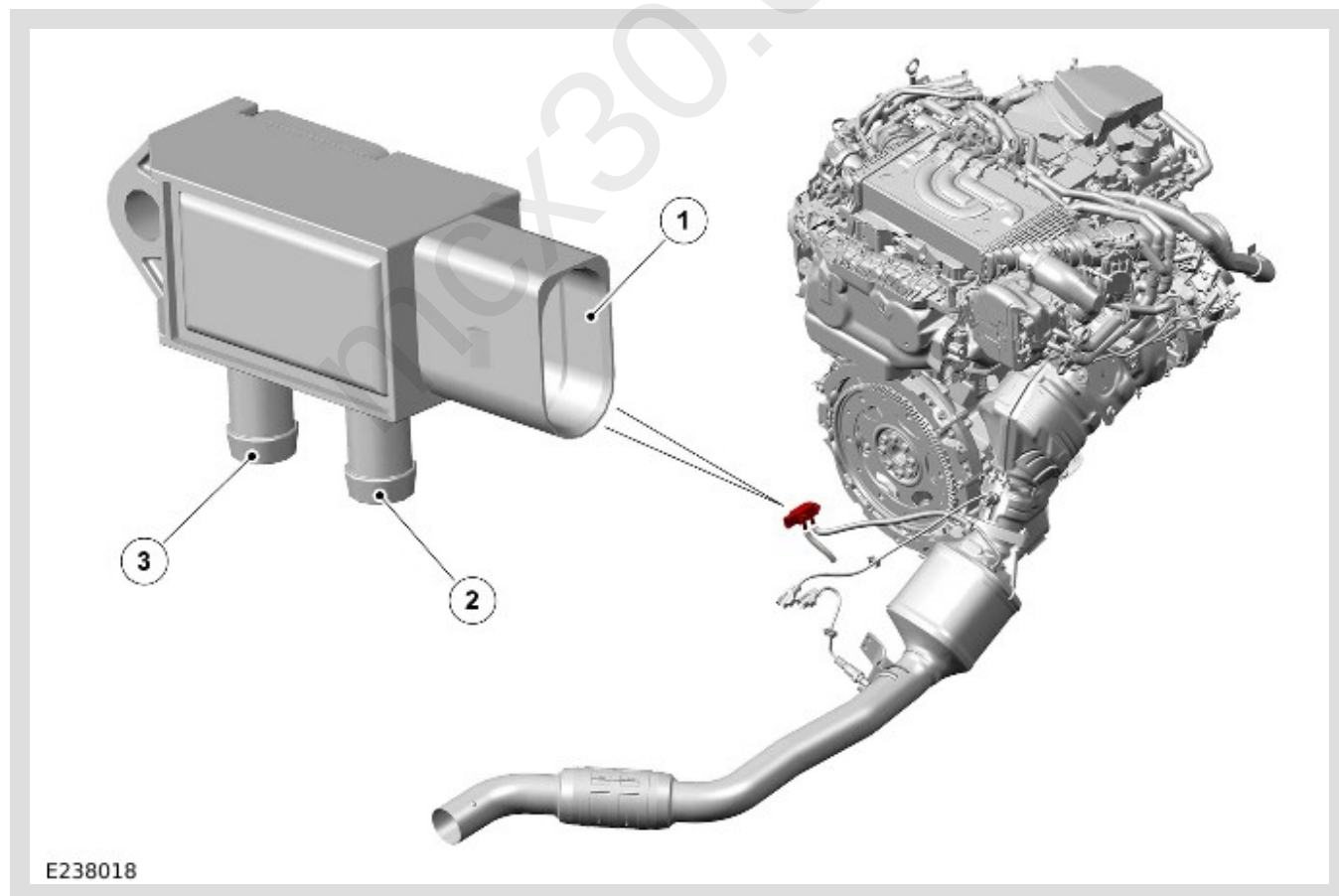
DESCRIPTION

GASOLINE PARTICULATE FILTER

The Gasoline Particulate Filter (GPF) is located in the exhaust system. The GPF traps the particulates in the exhaust gases from the petrol engine combustion process. The GPF has a core made from cordierite in a steel container.

The GPF will trap exhaust gas particulates that are too large to pass through the GPF filter. The trapped particulates are mainly carbon and hydrocarbons. These particulates require heat and oxygen to enable the GPF to regenerate.

EXHAUST BACK-PRESSURE SENSOR



ITEM	DESCRIPTION
1	Electrical connection
2	Vent hose
3	Connection to exhaust system

The exhaust back-pressure sensor is mounted on a bracket at the rear of the engine. The exhaust back-pressure sensor sends a pressure signal to the Powertrain Control Module (PCM).

The primary purpose of the exhaust back-pressure sensor is to monitor the back-pressure in the exhaust system to prevent damage to the engine. However if very high levels of exhaust back-pressure are identified the output of the exhaust back-pressure sensor may be used to start the active regeneration.

The exhaust back-pressure sensor has 2 hoses connected to it. The hoses are for:

- Vent hose to the atmosphere.
- Connection to the exhaust system for the exhaust back-pressure.

The vent hose must be kept clear of obstructions. Any obstruction of the vent hose will cause the exhaust back-pressure sensor to provide incorrect data to the PCM.

The exhaust back-pressure sensor has a 3-pin electrical connector. The 3-pin connector has the following electrical connections:

- A 5V reference voltage from the PCM.
- An exhaust back-pressure signal to the PCM.
- A ground connection.

OPERATION

REGENERATION

The accumulation of particulate matter in the Gasoline Particulate Filter (GPF) will decrease the exhaust gas flow through the exhaust system. The decrease in exhaust gas flow and increased exhaust back-pressure will reduce the engine's performance and efficiency if the GPF does not regenerate.

For the GPF to regenerate there needs to be 2 conditions:

- There must be sufficient oxygen in the exhaust gases to allow the particulate matter to oxidize.
- The exhaust system temperature is high enough for the particulate matter to react with the oxygen.

The GPF is regenerated by 2 methods:

- Passive regeneration
- Active regeneration.

PASSIVE REGENERATION

The Gasoline Particulate Filter (GPF) operation and regeneration will not affect the operation of the engine when the vehicle is driven normally. Passive regeneration of the GPF occurs when the vehicle is driven normally.

The exhaust gas temperature of a gasoline engine is a lot higher than diesels. Typically the exhaust gas temperature is between 300°C and 500°C (572°F and 932°F) during urban driving and up to 700°C (1292°F) during continuous load situations (motorway driving). However the gasoline engine exhaust gas contains little oxygen. The Powertrain Control Module (PCM) must increase the amount of oxygen in the exhaust gas oxygen to enable regeneration of the GPF.

When the driver removes their foot from the accelerator pedal or applies the brake pedal, the PCM stops fuel injection. The air then passes through the engines combustion chambers, without combustion increasing the oxygen in the exhaust gas. As the exhaust system is already at suitable temperature for regeneration, this additional oxygen is utilised to regenerate the GPF by oxidising the particulate matter.

The oxidation of the particulates in the GPF passive regeneration mode, presents no risk of restricting the exhaust gas flow and requires no intervention from the driver or the PCM.

The GPF is designed to last for the life of the vehicle.

ACTIVE REGENERATION

Under normal driving conditions passive regeneration of the Gasoline Particulate Filter (GPF) is sufficient to not restrict the flow of exhaust gases in the exhaust system. However some driving styles may cause problems with the passive regeneration of the GPF.

Examples of the driving styles that may cause problems with the passive regeneration of the GPF are:

- 1. When the vehicles engine is used at low engine speeds or for long periods of time with the vehicle stationary. Under these conditions the exhaust system temperature may not get sufficiently high to enable passive regeneration of the GPF.
- 2. Driving the vehicle at high loads for long periods of time. For example, towing at high speeds. Insufficient oxygen in the exhaust gases to enable passive regeneration of the GPF.

In these conditions the driver may be shown a GPF warning indicator in the Instrument Cluster (IC) and messages in the IC message center. The driver should follow the messages in the IC message center to enable the active regeneration of the GPF.

The active regeneration of the GPF is controlled by the Powertrain Control Module (PCM). The PCM increases the amount of oxygen in the exhaust gas by increasing the air/fuel ratio. The PCM maintains the temperature in the

exhaust system for the regeneration of the GPF to occur. The active regeneration of the GPF can take up to 20 minutes to reduce the GPF soot load to low.

There are 6 ranges of soot load accumulation in the GPF:

1. Low GPF soot load

- GPF regenerated.
- No active regeneration.

2. Less than 50% GPF soot load.

- No active regeneration.

3. More than 50% and less than high level 1 GPF soot load.

- Active regeneration.
- No warning indicators displayed in the IC.

4. More than high level 1 and less than high level 2 GPF soot load.

- Amber GPF warning indicator displayed in the IC.
- Driver to follow the IC message center instructions for active regeneration by the PCM.

5. More than high level 2 and less than high level 3 GPF soot load.

- Red GPF warning indicator displayed in the IC.
- Driver to follow the IC message center instructions for active regeneration by the PCM.
- PCM limits the engine torque output.

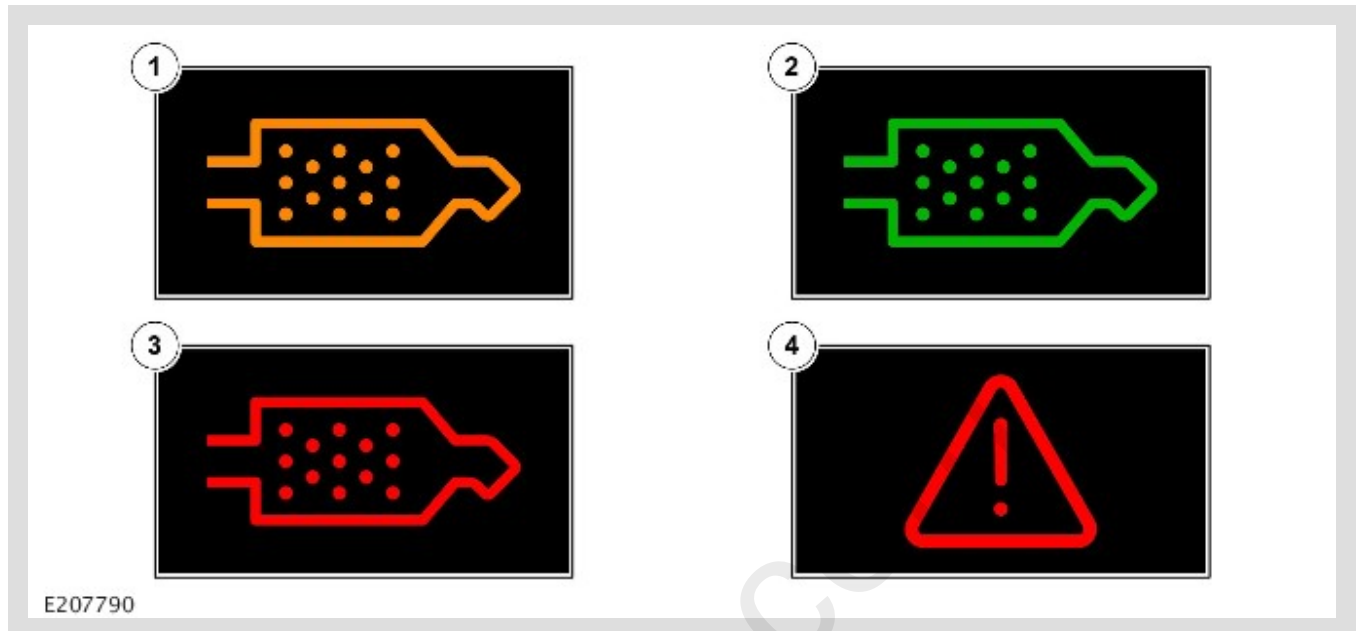
6. More than high level 3 GPF soot load.

- Red triangle warning indicator displayed in the IC.
- Warning message displayed in the IC message center.
- PCM operates the engine in 'limp home mode'. PCM limits the engine torque output to 30% of the maximum.
- No active regeneration.

INSTRUMENT CLUSTER

The Instrument Cluster (IC) displays a warning indicator and messages in the IC message center for the Gasoline Particulate Filter (GPF).

Instrument Cluster Gasoline Particulate Filter Warning Indicator



ITEM	DESCRIPTION
1 - Amber	Gasoline Particulate Filter (GPF) soot load is high (between high level 1 and high level 2).
2 - Green	The GPF has been regenerated by active regeneration and the GPF soot load is low.
3 - Red	GPF is full (soot load between high level 2 and high level 3).
4 - Red	GPF soot load is more than high level 3.

Amber Gasoline Particulate Filter Warning Indicator

Active regeneration of the Gasoline Particulate Filter (GPF) is required.

Driver to follow the Instrument Cluster (IC) message center instructions to enable active regeneration of the GPF by the Powertrain Control Module (PCM). The IC message center will alternate between a warning indicator and an instruction message.

NOTE:

When safe to do so, drive the vehicle at between 48 km/h (30 mph) and 80 km/h (50 mph).

Release the accelerator pedal, while the vehicle is still moving. Allow the vehicle speed to reduce by 16 kph (10 mph) before acceleration.

If the minimum vehicle speed is not maintained the Gasoline Particulate Filter (GPF) temperature will be too low to regenerate the GPF.

When following instructions in the message center to regenerate the GPF, the amber GPF warning indicator will change to green after a period of time. The message in the message center will change to 'Exhaust filter self-cleaning complete'. The GPF soot load will now be low and the active regeneration of the GPF will be stopped by the PCM.

If the driver does not follow the instructions in the IC message center the soot load in the GPF may continue to increase. Passive regeneration of the GPF can continue to reduce the soot load if the conditions in the GPF allow.

Red Gasoline Particulate Filter Warning Indicator - System Status

- Active regeneration of the Gasoline Particulate Filter (GPF) is required.
- Follow the Instrument Cluster (IC) message center instructions to enable active regeneration of the GPF by the Powertrain Control Module (PCM). The IC message center will alternate between a warning indicator and an instruction message.
- The maximum available engine power output will be reduced.

NOTE:

When safe to do so drive the vehicle at between 48 km/h (30 mph) and 80 kph (50 mph).

Release accelerator pedal, while the vehicle is still moving. Allow the vehicle speed to reduce by 16 kph (10 mph) before acceleration.

If the minimum vehicle speed is not maintained the Gasoline Particulate Filter (GPF) temperature will be too low to regenerate the GPF.

When following the instructions in the message center to regenerate the GPF, the red GPF warning indicator will change to green after a period of time. The text message in the IC message center will change to 'Exhaust filter self-cleaning complete'. The GPF soot load will now be low and the active regeneration of the GPF will be stopped by the PCM.

If the driver does not follow the instructions in the IC message center the soot load in the GPF may continue to increase. Passive regeneration of the GPF can continue to reduce the soot load if the conditions in the GPF allow.

Red Triangle Warning Indicator

- Active regeneration of the Gasoline Particulate Filter (GPF) is not possible.
- The Instrument Cluster (IC) message center displays a warning message.
- The Powertrain Control Module (PCM) operates the engine in 'Limp home mode'. The PCM significantly limits the engine power output.

CAUTION:

The vehicle should be driven with caution to a local retailer for investigation.

**NOTE:**

The red warning indicator triangle also illuminates if there is a fault with the Gasoline Particulate Filter (GPF) system.

EXHAUST BACK-PRESSURE SENSOR

The exhaust back-pressure sensor measures the exhaust system back-pressure and transmits the data to the Powertrain Control Module (PCM). The PCM uses data from other sensors and the exhaust back-pressure sensor to determine if any action is necessary to prevent engine damage. If the PCM determines that the exhaust back-pressure is excessive, the PCM will reduce the engine torque output to protect the engine from damage.

The exhaust back-pressure sensor and data from other sensors can be used to commence an active regeneration of the Gasoline Particulate Filter (GPF). This is only triggered when the PCM model indicates that the exhaust back-pressure is excessive from the engine speed, throttle position and other sensors data.

DIAGNOSTICS

The Powertrain Control Module (PCM) stores each fault as a Diagnostic Trouble Code (DTC). The DTC and associated environmental and freeze frame data can be read using a Jaguar Land Rover (JLR) approved diagnostic equipment.

The JLR approved diagnostic equipment can read:

- Real time data from each sensor.
- The adaption values currently being employed.
- The current fueling settings.
- The current ignition settings.
- The current idle speed settings.

The freeze frame data can vary depending on the fault. Core freeze frame data for every DTC includes Power Mode, time, distance and startup battery voltage. Specific sets of data are linked to each DTC. The selected data set will give the most useful supporting data to diagnose the fault.

If the PCM is replaced, the new PCM will relearn the adaptations as the vehicle is driven. Some components require a reset of adaptations when replaced and this can be achieved using a JLR approved diagnostic equipment.

For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - INGENIUM I6 3.0L Petrol, Description and Operation).