

DPF Regen Overview

Regeneration, a filter renewal process, purges soot from the filter and cleans it to lower exhaust backpressure. In all DPFs, this process involves oxidizing or burning the combustible black carbon soot out of the filter. Passive regeneration takes place when natural exhaust heat and chemical reactions regenerate the filter through natural exhaust heat and chemical reactions in the DOC from the NO, HC, and CO. No driver intervention is required, and the process is carried out without any noticeable change in engine operation. Some OEMs display information on a driver information display unit to inform the driver that passive or active regeneration is taking place with some instructions. The other method to regenerate a filter involves Heating the DPF with diesel fuel or another heat source, such as electric heating elements. This process is initiated by the ECM and is called an active, forced, or service regeneration.

Passive Regeneration

Passive regeneration occurs if the engine is operated under sufficient load to increase exhaust temperatures to at least 482°F. Oxygen in the exhaust will combine with soot to convert it to CO₂ and H₂O. Catalyst material in the DPF walls helps lower the temperature normally required to combust the soot. Passive regeneration also uses nitric oxide produced in the combustion chamber. Converting nitric oxide to nitrogen dioxide releases heat. The nitrogen dioxide combines with soot to produce carbon dioxide and nitrogen and a clean exhaust.

The most common method to actively regenerate a DPF is to spray fuel into the exhaust stream through an injector, where it will burn without a flame in the oxidation converter and raise exhaust temperatures to as much as 1,200°F. Most DPFs will operate at just below 1,000°F (550°C) when regenerating normally. The process of adding fuel to the exhaust to increase exhaust temperature is referred to as HC dosing.





Active regenerations take place when an excessive soot load condition in the filter is detected or a fault code for excessive soot loading is set because accumulations of soot have exceeded an anticipated threshold value. If passive regeneration cannot maintain or reduce the soot level in the DPF and an excessive soot load condition or fault is detected, then the engine may be forced to perform an active regeneration. Conditions that commonly prevent passive regeneration from lowering DPF soot levels include driving for only short trips; extended vehicle idling; prolonged low-speed, low-load operation; or delivery vehicles making frequent short trips.

ACTIVE/SERVICE REGENERATION TYPES

During active or service regeneration, the supplemental heating and burning soot will cause the DPF's temperature to rise to about 1,000°F. Active regeneration can take place under 3 circumstances:

- Automatically while driving (automatic regen).

- When an OEM-scheduled safety regeneration takes place after a specific distance has elapsed.
- During an operator- or technician-forced event (forced, parked, or service regeneration).

	<p>Malfunction Indicator Lamp (MIL) for HD-OBD CHECK ENGINE LAMP- Emission non-compliance indicator for EMO. Lamp ILLUMINATED when conditions are correct as set by the ECM diagnostic software</p>
	<p>DPF Lamp--This lamp is normally off, except during startup to make sure it is working. DPF warning lamp to alert the driver that a regeneration needs to take place. It also alerts the driver that the need for the driving mode to change like increasing RPM or speed.</p>
	<p>HEST (high exhaust system temperature lamp) indicator lamp. The HEST lamp will illuminate when the exhaust system is too hot to safely contact and will most likely only illuminate under 5 MPH. The parameters of when this light will illuminate vary from manufacturer to manufacturer.</p>
	<p>DEF (diesel exhaust fluid) light may indicate a low DEF tank fluid level or it may illuminate if an SCR related fault is logged in the ECM (engine control module) or ACM (aftertreatment control module).</p>



DPF warning lamp on. This lamp is normally off, except during startup to make sure it is working. The DPF lamp alerts the driver that passive regeneration is taking place. It also alerts the driver of the need for the driving mode to change, like increasing RPM or speed.

Automatic regenerations can happen when the vehicle is operating and an excessive soot load is detected. The DPF lamp will illuminate during a passive regeneration. The degree of soot load that triggers the regeneration, warnings begin at 80% of filter capacity. An active/service regeneration can take place after the warning and soot loading continues to accumulate. A DPF with a maximum safe load of 40 grams of estimated soot load will typically initiate an automatic regeneration at 90% load, which means at 36 grams.

The ECM will initiate the regeneration and continue the regeneration event until the soot load has been reduced to close to 0%. Although there may not be any noticeable change in engine performance, a slight to moderate decrease in instantaneous observed fuel economy will take place during the regeneration event. To increase exhaust temperatures, automatic transmissions will drop one gear and operate out of overdrive until the regeneration has finished. At idle or when stopped at an intersection, the engine speed may increase.

Active/service regeneration events, also called forced, stationary, or parked regenerations, are set by a technician or vehicle operator (on some applications). If a vehicle cannot be regenerated during a driving cycle or because the engine power is derated due to excessive soot, a service regeneration may be done using an EST (electronic service tool) like the Diesel Laptops computer. A specific menu item available from the EST will allow a technician to initiate a service regeneration.

Several prerequisite conditions must be performed before the regeneration. The DPF cannot be excessively loaded, which often means no more than 120% of capacity or 5 grams/liter of DPF volume, for a regeneration to begin. If there is too much soot, the DPF catalysts could melt from the excessive heat produced when soot is burned. Such an event is called a thermal runaway. In the situation where the DPF is too full, it must be removed and replaced with another filter. The soot-loaded filter can instead be salvaged by baking it in an oven to more gradually oxidize soot.

After the regeneration event begins, the engine speed will increase anywhere from 800 to 2500 RPM. If excessive exhaust temperatures are detected or if the exhaust temperatures failed to reach anticipated values within a specific time frame, the regeneration event will end. Any DTCs detected during the regeneration event, such as excess coolant temperature or a problem with the EGR system or intake air throttle, will also end the regeneration. Forced/service regenerations may take anywhere from 10, depending on the amount of soot loading. The temperature differential across the DPF measured by the EGT sensors will initially be quite high between the DPF inlet and outlet when the regeneration begins

Warning Light and Messages For DPF



DPF operation indicator

The DPF (diesel particulate filter) lamp is normally off, except during startup to make sure it is working. The DPF warning lamp alerts the driver that passive regeneration is taking place. Prolonged low-load operation, which prevents the DPF from passively regenerating, also requires a warning to the driver to change driving style. The minimum vehicle speed of 30 mpg required for any passive regeneration may not be enough in some vehicles for regeneration after the DPF has been heavily soot loaded. A warning light or message in the driver's information center alerts the driver to increase engine speed and load as shown below. This is done by driving faster than 45 mph for 20-30 minutes to quickly regenerate the filter and lower the soot load. If the filter becomes excessively soot loaded, a power derate will progressively increase from 15% to 30% until the point when the engine shuts down.



Driver instructions





















Condition	EMD	HD-OBD	De-Rate	Deactivate Warning & Derate
10% Full	NONE	NONE	NONE	NONE
10% Full	DEF solid 	DEF solid 	NONE	Fill DEF tank to minimum of 10% above stage 1
Minimum 5% full	DEF flash 	DEF flash 	NONE	Fill DEF tank to minimum of 10% above stage 2
2.5% to before tank empty	DEF flash, Amber solid  	DEF flash, Amber solid  	NONE	Fill DEF tank to minimum of 10% above stage 3
NO DEF detected by loss of prime	DEF flash, Amber solid  	DEF flash, Amber solid   	25% torque derate	Fill DEF tank to minimum of 10% above stage 3
Empty, after engine shut down intentionally or in extended idle	DEF flash, Amber solid   	DEF flash, Amber solid    	25% torque derate vehicle speed limited to 5 mph	System will return to stage 3 after dozer is able to build pressure

Table 2: Warning lamp thresholds

The DPF warning light or message is normally off. If it is on, at typically around 80% of maximum safe soot load, it alerts the driver to change the engine's duty cycle, or driving mode, to increase the exhaust system's natural, load-dependent heating. This means you need a steady moderate speed rather than stop-and-go driving or short-trip operation. If a change in engine operation is not possible, an active regeneration is possible. The regeneration event can take place automatically or be initiated by the operator or by a technician using an electronic service tool. On a few late-model medium-duty vehicles, such as pickups and delivery vans, an operator can initiate a regeneration event. There can be a regeneration inhibit switch that is

toggled to activate a stationary active regeneration to occur. Sometimes a combination of cruise control switches on the steering wheel enables an operator to initiate an active regeneration.

The high exhaust system temperature (HEST) warning light is an optional original equipment manufacturer (OEM) light that indicates higher than normal exhaust temperatures during regeneration. For example, if the exhaust temperature is greater than 750° F (400°) and the vehicle is operating at less than 5 mph, then if equipped, the HEST warning light will illuminate. The HEST lamp helps prevent injuries to pedestrians inadvertently passing the exhaust outlet, grass and brush fires, or igniting materials found in waste transfer or manufacturing facilities if the vehicle is operated indoors.