Technical Bulletin

Diesel Particulate Filter General Information

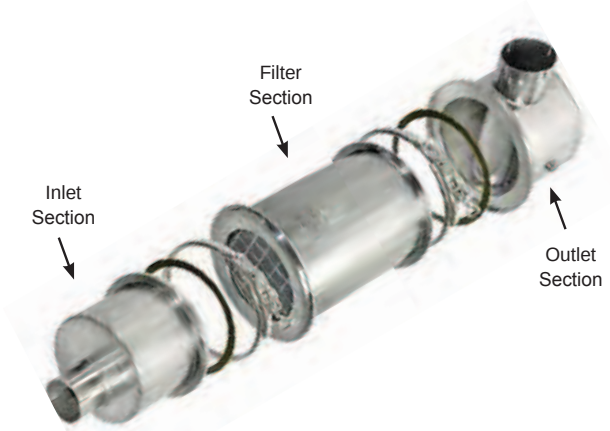
National Clean Diesel Campaign
www.epa.gov/cleandiesel

Technical Overview

Diesel Particulate Filters, also known as DPFs, are exhaust aftertreatment devices that significantly reduce emissions from diesel fueled vehicles and equipment. DPFs typically use a porous ceramic or cordierite substrate or metallic filter, to physically trap particulate matter (PM) and remove it from the exhaust stream.

After it is trapped by the DPF, collected PM is reduced to ash during filter regeneration. Regeneration occurs when the filter element reaches the temperature required for combustion of the PM. "Passive" regeneration occurs when the exhaust gas temperatures are high enough to initiate combustion of the accumulated PM in the DPF, without added fuel, heat or driver action. "Active" regeneration may require driver action and/or other sources of fuel or heat to raise the DPF temperature sufficiently to combust accumulated PM. The frequency of regeneration is determined by the engine's duty cycle, PM emission rate, filter technology and other factors. When using an active filter, it is particularly important to follow the manufacturer's instructions for regeneration.

In addition to regeneration, the filter must be periodically cleaned to remove noncombustible materials and ash. It is important to avoid excessive PM and ash accumulation in a DPF, so proper maintenance and cleaning instructions should be followed closely. Cleaning of DPFs is typically required every 6 to 12 months. The cleaning process involves manually removing the filter element from the vehicle and placing it in a cleaning station designed for this purpose. An engine emitting excessive PM or inadequate filter regeneration will cause a DPF to require more frequent cleaning. Diagnostics should be performed to identify the cause for more frequent cleaning intervals. A backpressure monitoring system should always be used with a DPF and periodic inspection of the monitoring system should be performed to confirm proper operation.



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Emissions Reduction

The United States Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) evaluate the emission reduction performance of DPFs and identify engine operating criteria and conditions that must exist for DPFs to achieve those reductions.

DPFs verified by EPA and CARB are typically effective at reducing emissions of PM by 85 to 90 percent or more. EPA's Verified Technology List also shows that certain DPFs reduce emissions of hydrocarbons and CO by 70 to 90 percent. DPFs generally do not reduce oxides of nitrogen (NOx) emissions. DPFs can be combined with crankcase ventilation systems for additional emission reductions.

EPA is aware of concerns that catalyzed DPFs may increase the nitrogen dioxide (NO2) fraction of total NOx emissions. Some DPFs generate NO2 as a means to help filter regeneration at lower temperatures. The NO2 produced by a DPF is dependent on the catalyst formulation. EPA and CARB have established a limit on increases in NO2 emissions from diesel retrofit devices and all DPFs on the lists of verified products comply with this limit.

Application

Verified DPFs are available for nonroad and highway heavy-duty diesel engines including those on buses, trucks, construction equipment, auxiliary power units and stationary generators.

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Each DPF is verified for use with specific engines and/or with specific configurations over a range of model years. In addition to vehicle and engine specifications, the intended application should be evaluated for exhaust temperature, duty cycle, fuel sulfur levels, lubrication oil consumption and engine-out PM emission levels. Exhaust temperature data logging should be performed with each installation over a range of vehicle duty cycles and, if possible, over a range of ambient temperatures. A copy of results and analysis from data logging should be retained by the fleet for each installation. EPA and CARB's lists of verified diesel retrofit technologies define the specific engine operating criteria required to successfully apply a particular retrofit technology: www. epa.gov/otaq/retrofit/verif-list.htm.

Fuel

DPFs are verified for use with Ultra Low Sulfur Diesel fuel (ULSD), which contains up to 15 parts per million sulfur. Fuel additives should not be used unless explicitly approved by the DPF manufacturer.

Cost

DPFs generally cost between $5,000 to $15,000 or more, including installation, depending on engine size, filter technology and installation requirements. Active DPF systems are more expensive than passive DPF systems and can cost up to $50,000 for a large piece of nonroad equipment. Vehicle inspection, data logging and backpressure monitoring systems are required with each installation and these costs are typically included in the cost of the DPF. Because a DPF is likely to be heavier than a muffler, it is likely that special mounting is necessary. Costs for cleaning stations or cleaning services should also be considered when purchasing DPFs.

Longevity

When properly installed and maintained, DPFs should remain effective for the life of the vehicle, generally five to ten years or 10,000 or more hours of operation. Engine problems with fuel control or oil consumption may quickly deteriorate the performance of a DPF. Consequently, regular engine maintenance is essential to DPF performance.

Warranty coverage is typically part of the commercial contract negotiated between the product suppliers and their customers. Such warranties typically cover defects in materials or workmanship for a specified period defined in years, miles and/or operating hours.

As part of their verification program, CARB has established detailed warranty periods for CARB-verified retrofit technologies as shown in the following table.

California Air Resources Board Warranty Period

Vehicle Category	Warranty Period
GVWR > 33,000 lbs. hp > 250 hp and miles/ year > 100,000 Vehicle miles < 300k	Two years; unlimited mileage
GVWR > 33,000 lbs. hp > 250	Five years or 150,000 miles
GVWR 19,500 to 33,000 lbs.	Five years or 100,000 miles
GVWR < 19,000 lbs.	Five years or 60,000 miles