



Diesel Retrofit Technology FAQ

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Introduction

Emission control technologies are commercially available today that can greatly reduce air pollutants emitted from existing diesel engines. These systems can be installed on a wide variety of in-use vehicles, including school buses, transit buses, long-haul trucks, municipal/utility vehicles, construction equipment, port trucks and equipment, airport ground support equipment, and mining and material handling equipment, as well as stationary internal combustion engines. Diesel retrofit technologies can significantly reduce particulate matter (PM) emissions, oxides of nitrogen (NOx), carbon monoxide (CO), hydrocarbons (HCs), and air toxics.

Why retrofit?

The primary reason for installing retrofit emission control devices is to protect human health. Studies have shown that diesel exhaust poses a public health concern. Retrofit emission controls offer an effective means of reducing the air pollution emitted from an in-use diesel engine. Controlling harmful emissions is especially important when diesel engines are operated in confined or restricted space where workers may be exposed to high exhaust concentrations. Controlling emissions in urban environments is also important where inhabitants may be exposed to elevated concentrations over long periods. Cleaning up diesel engine exhaust can also help reduce soiling of buildings and improve visibility. In addition, recent studies have shown that black carbon from diesel exhaust has global-warming potential; diesel particulate filters can reduce black carbon by >85%.

What types of retrofit emission control technologies are available for in-use diesel engines?

Retrofit Emission Control Technologies for PM Reduction

- Diesel Particulate Filter
 - Wall-flow device that physically traps PM in exhaust stream on surface of substrate; PM burned off through regeneration (passive or active)
 - >85% PM reduction
- Flow-Through Filter
 - Wire-mesh substrate or metal foil-based substrate with sintered metal sheets that traps a portion of the PM; passive regeneration with catalyst
 - 50-75% PM reduction
- Diesel Oxidation Catalyst
 - Flow-through device with catalytic coating on substrate that oxidizes soluble organic fraction of PM
 - 25-50% PM reduction
- Closed Crankcase Ventilation System
 - Replaceable filter that reduces engine blow-by emissions
 - >90% PM reduction (crankcase emissions)

Retrofit Emission Control Technologies for NOx Reduction

- Selective Catalytic Reduction
 - Flow-through device that reduces NOx with injection of a reductant (urea) over the catalyst
 - 60-90% NOx reduction
- Exhaust Gas Recirculation
 - Engine-based method that recirculates a portion of the cleaned exhaust back into the combustion chamber to lower temperature in-cylinder
 - 40-60% NOx reduction
- Lean NOx Catalyst
 - 25-40% NOx reduction
 - Flow-through device that reduces NOx with injection of a reductant (diesel fuel) over the catalyst
- Lean NOx Adsorber Catalyst
 - Emerging retrofit device that stores NOx under lean conditions and releases and catalytically reduces the stored NOx under rich conditions
 - 60-90% NOx reduction

Notes:

- PM and NOx retrofit technologies that use a catalyst also achieve reductions in CO and HC emissions
- PM and NOx retrofit technologies require the use of ultra-low sulfur diesel fuel (low sulfur diesel fuel for some DOCs)
- PM and NOx retrofit technologies are generally compatible with biodiesel (typically B20 or less)
- NOx reduction technologies are typically paired with a PM reduction technology

How do I know if a diesel retrofit device will work as advertised?

Both the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (ARB) verify the performance of diesel retrofit devices through a verification process. The goal of the verification process is to ensure that emission control systems perform as a manufacturer claims. EPA maintains a list of verified technologies on their website at:

www.epa.gov/otaq/retrofit/verif-list.htm. ARB's list of verified technologies can be found at:
www.arb.ca.gov/diesel/verdev/vt/cvt.htm.

How do I determine if a particular retrofit device is appropriate for my vehicle?

When deciding if a particular retrofit device is appropriate for your vehicle, several factors must be considered, including:

- Engine must have been properly maintained (intake air filter condition, exhaust peak opacity within specified limits, exhaust system integrity, absence of visual signs of engine oil or diesel fuel in exhaust system, absence of turbocharger seal leaks, absence of excessive crankcase emissions)
- Engine characteristics must meet terms and conditions of the retrofit device verification letter (model year, engine family, engine configuration)
- Engine duty-cycle and resultant exhaust gas temperatures must comply with terms of the verification letter
- Vehicle integration (direct muffler replacement, below- or above- or in-chassis installation)
- Vehicle safety (operator visibility, location of device relative to fuel and hydraulic lines, structural framework, heat issues)

All of the above items should be discussed with the technology provider prior to retrofit device installation.

It is important to understand the exhaust temperature profile of a vehicle application before applying a retrofit device. In the case of a passive DPF, insufficient temperatures may lead to premature plugging and increased maintenance to keep the filter clean and the engine running. A data-logger is used to record the exhaust temperature during engine operation. The recorder is typically operated for several days under normal vehicle operating conditions to provide a reasonable snapshot of the exhaust temperature profile. Engine duty-cycle plays a big role in exhaust temperatures and is influenced by factors such as vehicle speed, load, idling, geography, ambient temperatures, and driver tendencies.

After performing a vehicle pre-assessment, the technology provider will work with the fleet or vehicle owner to recommend the best retrofit solution for the customer. Proper matching of a retrofit technology with the appropriate application is a critical step in ensuring the success of a retrofit installation.

How do I maintain a diesel retrofit emission control system?

Engines equipped with retrofit devices should receive routine maintenance just as other engines would. Particular attention should be given to fuel injectors and turbochargers to ensure they are operating properly. For engines equipped with DPFs, backpressure should be monitored using monitoring equipment supplied with the DPF. If the backpressure becomes excessively high, the filter should be cleaned according to the procedures specified by the filter supplier. Retrofit systems should be regularly inspected to ensure that exhaust installation hardware remains in good condition. Inspections should include checking for warning lights on the backpressure monitor, inspecting the mounting brackets for looseness or damage, checking for signs of soot on the inside of the exhaust pipe and, and inspecting backpressure sensor tubing for any signs of condensation. As part of any retrofit device installation, manufacturers provide recommendations on the care and maintenance of their products.

How can I get more information on diesel retrofit technology?

For additional information on diesel retrofit technology, please visit MECA's diesel retrofit website at: www.dieselretrofit.org, or contact MECA's Antonio Santos at: asantos@meca.org.