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ADVANCED EMISSION CONTROLS®

# Diesel Particulate Filters

## *Myths & Facts*



# Comparison of Retrofit Technologies

The images below are actual PM collection samples from a CARB and EPA approved, CFR compliant engine testing laboratory used to collect and measure diesel particulate matter (PM) emissions. In this test, the visual difference is dramatic between the DPF and DOC, yet a difference is hardly noticeable between the DOC and the uncontrolled diesel exhaust.

## Retrofitted with a Diesel Particulate Filter (DPF)

**PM Reduction: Excellent**

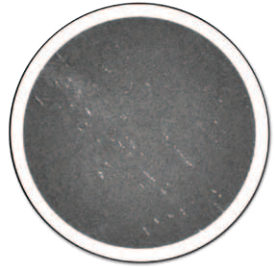
- Verified at 85%+ PM removal
- >85% black carbon removal
- >85% ultrafine PM removal
- >85% lube oil ash removal



## Retrofitted with a Diesel Oxidation Catalyst (DOC)

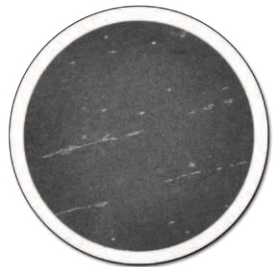
**PM Reduction: Marginal/Poor**

- Verified at 25% PM removal
- Little black carbon removal
- Little ultrafine PM removal
- Does not remove lube oil ash



## No Retrofit System Uncontrolled Diesel Exhaust

**PM Reduction: None**



**Test Conditions** – Test Cycle: UDDS (Urban Dynamometer Driving Cycle; Test Distance: 5.5 miles over 17 minutes; Fuel Consumed during the Test: 1.1 gallons; Test Vehicle: Heavy-duty truck with a 370 hp Cummins engine (1999 model year).

## **MYTH 1: All diesel particulate filters (DPF) rely on high temperatures and specific duty cycles to effectively reduce PM emissions.**

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- **Fact:** While passive DPF systems require certain exhaust temperature to regenerate or “self clean,” DPFs with active regeneration do not rely on engine exhaust temperature to regenerate. DPFs with active regeneration use fuel burners, catalytic burners, or plug-in electric power to heat and combust collected particulate matter. These systems are ideally suited for colder applications running lower miles and having significant periods of idle. As of October 2010, there are ten DPFs verified by CARB or EPA with active regeneration.<sup>1</sup>
- **Fact:** DPFs are physical filters that trap diesel particulate matter (PM) and provide non-stop filtering regardless of the engine duty cycle or exhaust temperature. Diesel oxidation catalysts (DOC) are not filters and do not remove any PM when the exhaust is below a certain temperature threshold.<sup>2</sup>

**Source:** <sup>1</sup> EPA: <http://www.epa.gov/otaq/retrofit/verif-list.htm> , <http://www.epa.gov/cleandiesel/publications.htm> CARB: <http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm> ; <sup>2</sup> EPA: <http://epa.gov/cleandiesel/publications.htm>

## **MYTH 2: Compared to DOCs, DPFs have limited on-road and non-road application.**

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- **Fact:** For over a decade, DPFs have been successfully used to retrofit in-use diesels powering tens of thousands of in-use on-road vehicles<sup>3</sup> like transit buses, school buses, refuse trucks, delivery trucks, intermodal trucks, utility trucks, municipal vehicles, recycling trucks, shuttle buses and more.
- **Fact:** Since 2007, over 2 million new diesel powered light, medium and heavy-duty trucks manufactured in the U.S. have been built with DPF emission control systems.<sup>4</sup>
- **Fact:** For over a decade, DPFs have been successfully deployed to retrofit thousands<sup>3</sup> of in-use non-road diesel powered machines like wheel loaders, cranes, excavators, graders, scrapers, bulldozers, drills, fork lifts and more.

**Source:** <sup>3</sup> Manufacturers of Emission Controls Association (MECA) <http://www.meca.org/>; <sup>4</sup> Rhein Associates Inc. <http://www.rheinreport.com/>

### **MYTH 3: DPFs are unreliable and maintenance intensive.**

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- **Fact:** CARB and EPA have instituted rigorous programs to “verify” emissions performance and product reliability before they enter the marketplace. All manufacturers must meet these stringent performance, reliability and durability standards to become CARB or EPA verified.<sup>5</sup>
- **Fact:** Because DPFs are so effective at capturing diesel PM emissions, they require de-ashing or cleaning every 12-18 months to remove noncombustable materials that have accumulated during normal operation. This de-ashing process is easily integrated into normal vehicle maintenance. Unfortunately, poor engine maintenance practices can lead to increased soot production and engine oil consumption resulting in more frequent DPF regeneration and de-ashing.<sup>6</sup>

**Source:** <sup>5</sup> EPA: <http://www.epa.gov/otaq/retrofit/verif-list.htm> , <http://epa.gov/cleandiesel/publications.htm> and CARB: <http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm>; <sup>6</sup> EPA : <http://www.epa.gov/otaq/diesel/retrofit-tips.htm#cleaning> and <http://epa.gov/cleandiesel/publications.htm>

### **MYTH 4: DPFs aren't effective, only new engines can meet low PM emission levels.**

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- **Fact:** Unlike DOCs, a DPF retrofit can bring an older engine (1960-2006) to 2007/2010 PM emissions levels. DPF retrofits are far less costly than purchasing new vehicles or machines.<sup>7</sup>
- **Fact:** To meet stringent 2007/2010 PM emission requirements, U.S. truck manufacturers have used DPF technology on over 2 million new light, medium and heavy-duty diesel trucks produced since 2007.<sup>8</sup>

**Source:** <sup>7</sup> EPA: <http://www.epa.gov/otaq/retrofit/verif-list.htm> and

CARB: <http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm> ; <sup>8</sup> Rhein Associates Inc. <http://www.rheinreport.com/>

## **MYTH 5: DPFs are experimental, only a few companies have verified DPF products.**

- **Fact:** More than ten different manufacturers have received EPA or CARB verification to the highest level of PM reduction (85%+) for 29 DPF products, compared to only 18 DOCs (or DOC & Closed Crankcase Filter).<sup>9</sup>
- **Fact:** DPFs are verified with broader coverage on engines built between 1960 and 2006, while DOCs are only verified for engines built between 1988 and 2006.<sup>9</sup>

**Source:** <sup>9</sup>EPA: <http://www.epa.gov/otaq/retrofit/verif-list.htm> and CARB: <http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm>

### **PM Reduction Capability Chart**

Type of PM	DPF (85-90% PM reduction by mass)	DOC (20-40% PM reduction by mass)
PM10	Excellent	Marginal
PM2.5	Excellent	Marginal
Ultrafine PM	Excellent	Poor
Black Carbon	Excellent	Poor

**Source:** <http://www.epa.gov/otaq/retrofit/verif-list.htm> ; <http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm> ; <http://epa.gov/cleandiesel/publications.htm>

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ADVANCED EMISSION CONTROLS®

Cleaire designs, develops and manufactures retrofit diesel particulate filters for in-use on-road and off-road diesel engines. All our diesel particulate filters have been verified by the California Air Resources Board (CARB) and are compliant with both US EPA and CARB requirements to provide maximum PM emission reductions (85%+) for a wide range of diesel applications. Furthermore, Cleaire provides proven solutions to diesel emissions compliance while extending the operating life of existing equipment and avoiding costly replacement. Our unmatched network of dealers throughout North America provide local pre- and post-sale support, including grant writing assistance, installation and training. Cleaire is headquartered in San Leandro, California, with manufacturing operations in San Diego, California.

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