

Diesel Retrofits

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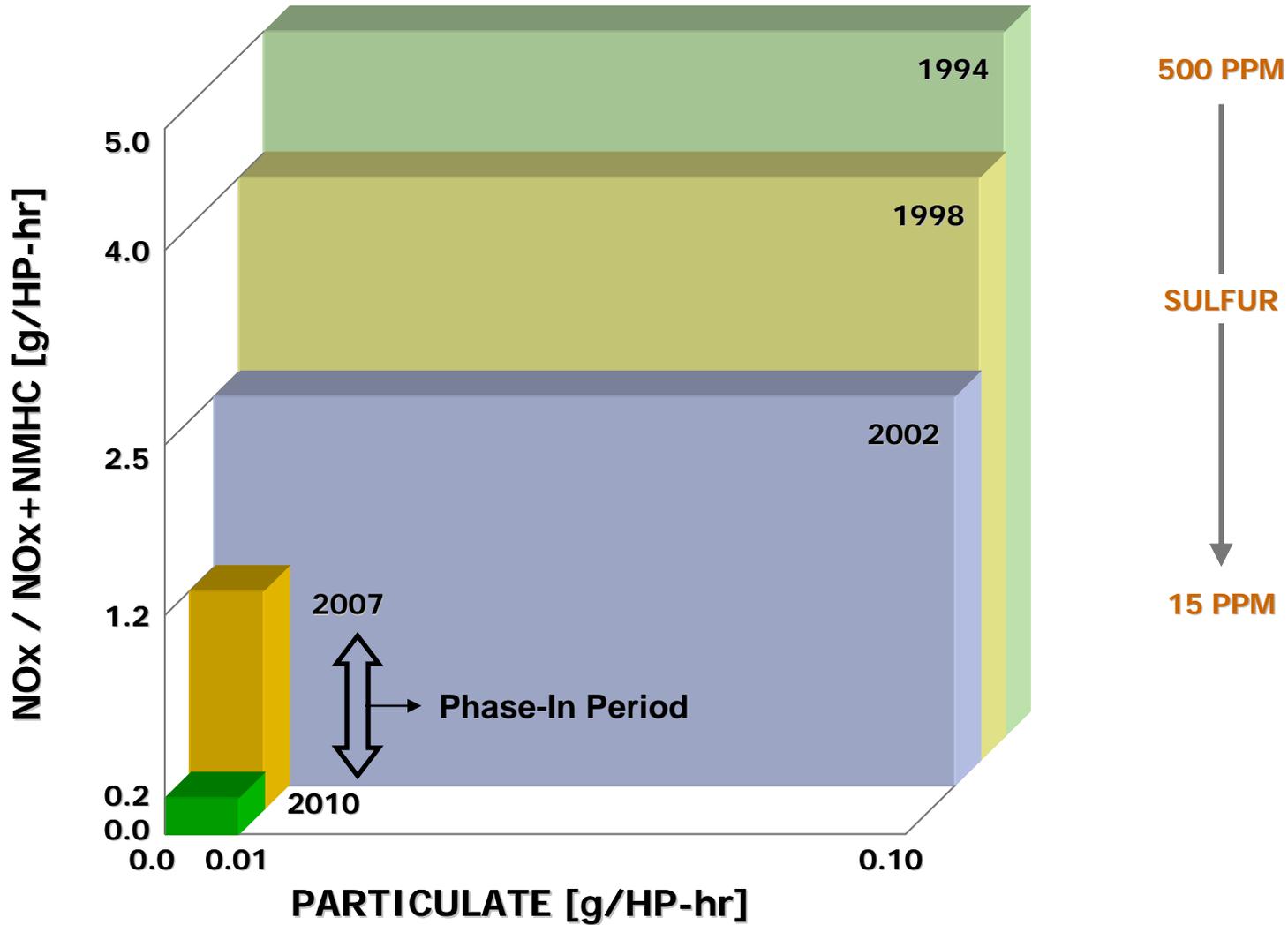


Northeast

Retrofit Technology definitions

- DOC (Diesel Oxidation Catalyst)
- PCRT (Partial Filter)
- DPF (Diesel Particulate Filter)
- CCRT (Continuously Regenerating Technology)
- EPF (Electronic Particulate Filter)
- SCR (Selective Catalyst Reduction)
- CCV (Closed Crankcase Ventilation)

EPA emission standards



PM Control Devices



Retrofits utilize Passive Technology

- NOT 2007 technology on MD / HD engines
- Retrofits are 'field-installed' on vehicles in operation today
- Passive technology requires exhaust temperature to work
- Data-logging of current fleet necessary to determine application of appropriate technology

Diesel Oxidation Catalysts

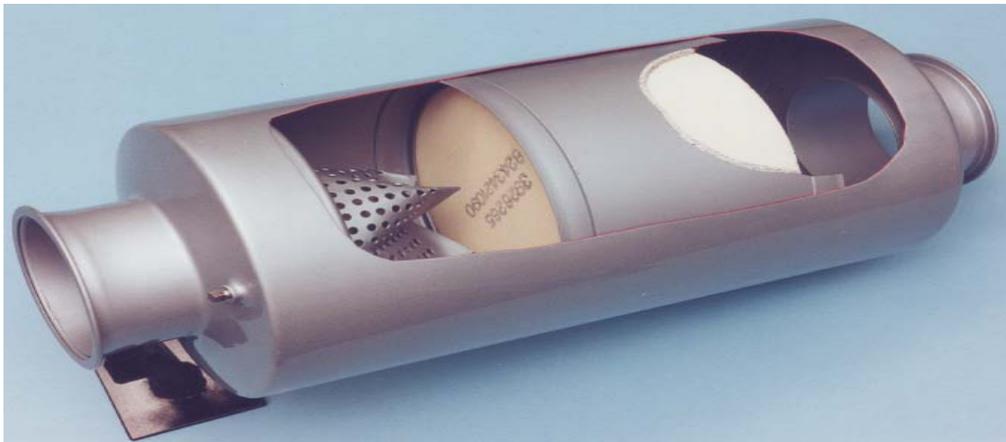
- PM \geq 20%
- CO \geq 90%
- HC \geq 90%

Versatile Installations

Fuel Tolerant

No Maintenance

Low Cost Solution



Retrofit examples - DPW Trucks



High Performance DOC/Partial Filter

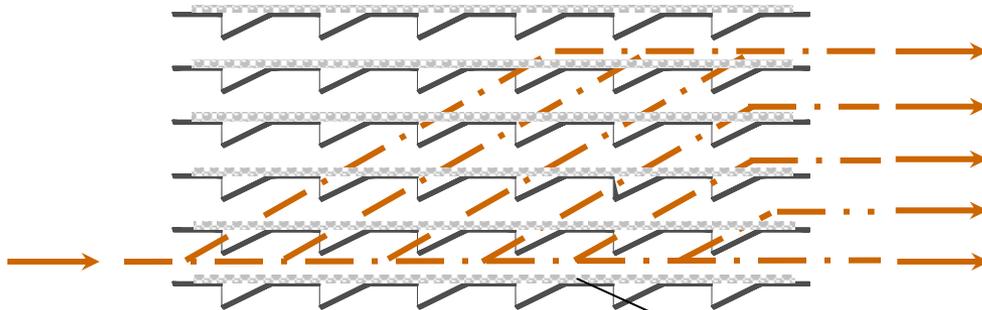
Use engine exhaust heat to get the catalyst on the substrate hot enough to reduce the soluble organic fraction

- > 90 % HC and CO reduction
- > 50% PM reduction
- Flow through with notches
- Targeted for high PM, older engines where a passive filter cannot be used

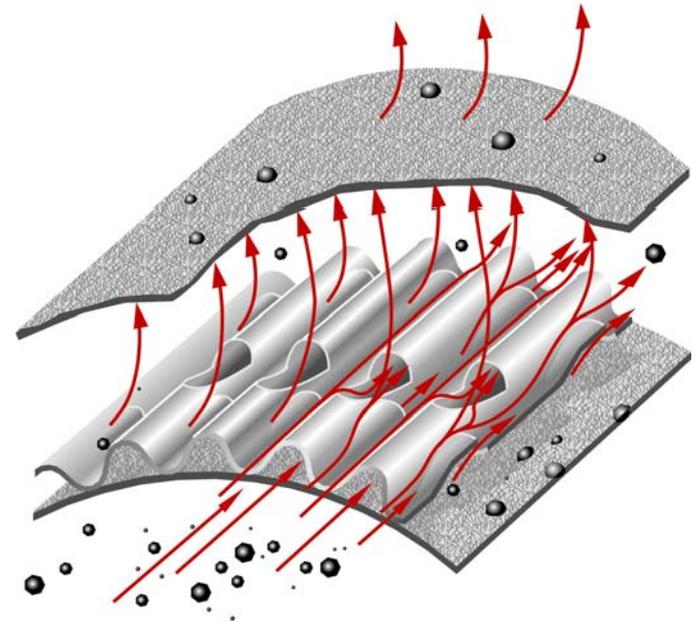
PCRT - How it works



Step to filtration activity:



porous layer made of sintered metal fiber fleece



Passive Regeneration Filter (DPF)

- PM $\geq 85\%$
- CO $\geq 90\%$
- HC $\geq 90\%$

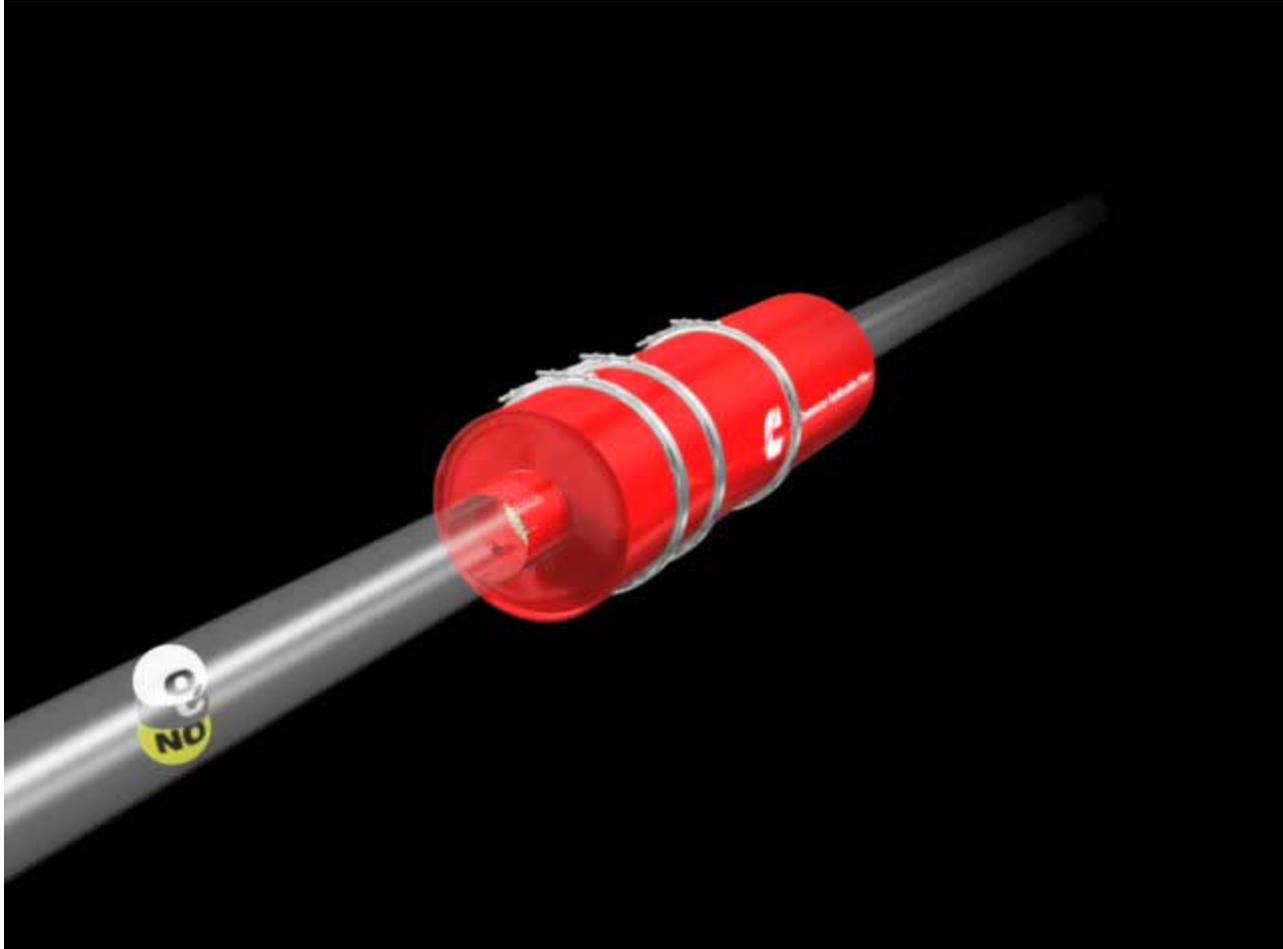
Temperature Requirements

Cleaning and Monitoring Required

Requires ULSD

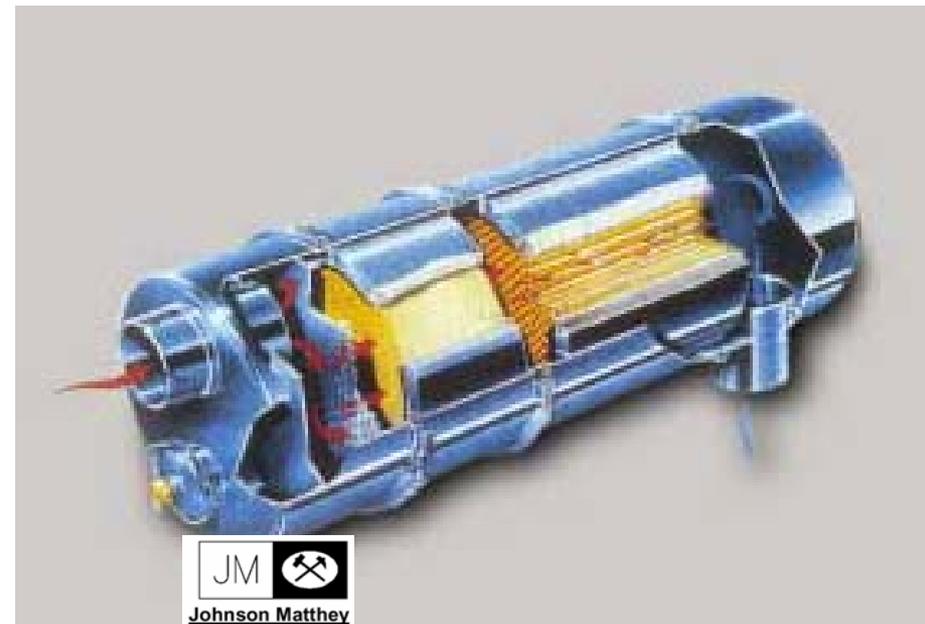


How DPFs work



CRT™ / CCRT™ Particulate Filter

- Passive system
- Contains a Platinum (Pt) catalyst and a particulate filter
- ULSD required (50 ppm max.)
- Capable of converting > 85% of PM, HC and CO.
- Lightly catalyzed version requires 240 C / 40% time
- Highly catalyzed version requires 200 C / 40% time,



Filter Cleaning



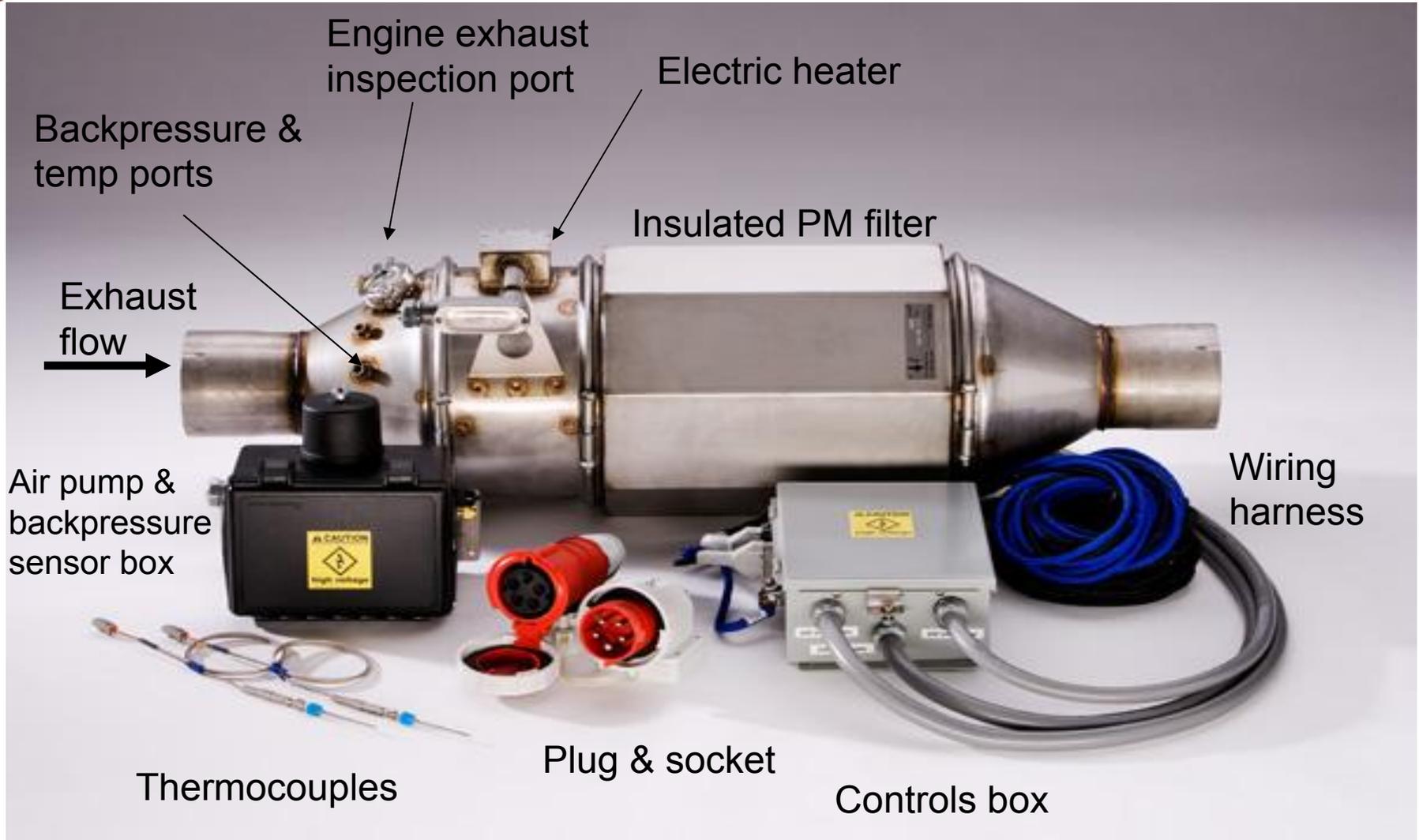
Retrofits – School Buses



Electronic Particulate Filter

- Active diesel particulate control system (electrically regenerated)
- PM control >85%, no HC or CO reduction
- Un-catalyzed particulate filter using Silicon Carbide filter substrate
- Works with any fuel, biodiesel up to B20
- Temperature insensitive
 - No minimum exhaust temperature
 - No data logging

Electronic particulate Filter



Infrastructure Requirements

“Shore” Power

- 208 1-phase supply power
- 15-20 amp nominal draw
- 15 kW-hr consumption per regeneration
- \$1.50 per regeneration
- Annual: \$78 (weekly) to \$390 (daily)
 - (@\$0.10/kW-hr)



Integrated NOx & PM

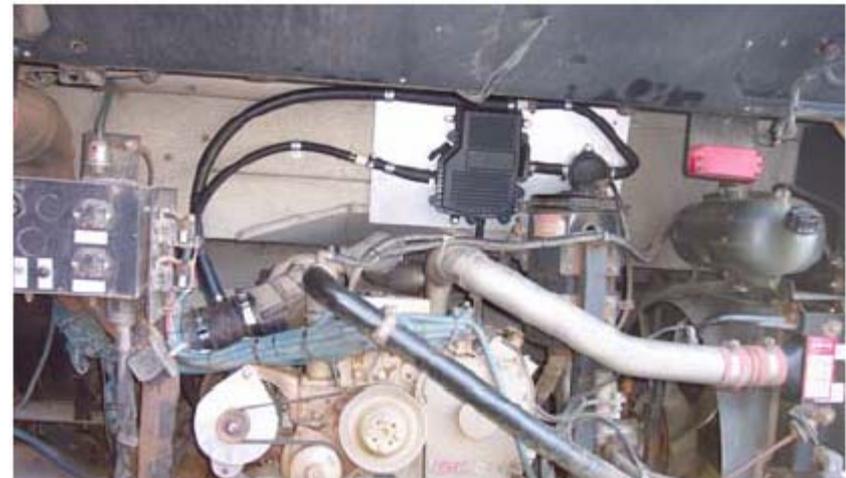
Longview

- Modular device contains NOx catalyst and filter sections
- Monitor-Logger-Controller (MLC) data logs and determines precise amount of diesel fuel to inject
- Requires adequate exhaust temperatures
 - 260 C / 25% time
- Requires periodic cleaning to remove ash



Closed Crankcase Ventilation System (CCV)

- Removes emissions from open crankcase systems
- 3-5 % PM Reduction
- Also helps reduce drips and oil consumption
- Crankcase Breather > CCV filter > Air Intake/Drain
- Filter changes per manufacturer's requirements
- Verification with DOC



Future Retrofit Technologies

- Mobile SCRT
 - In field testing phase by Johnson Matthey
 - Testing is showing PM, HC, CO >90%, NOx 70-90%

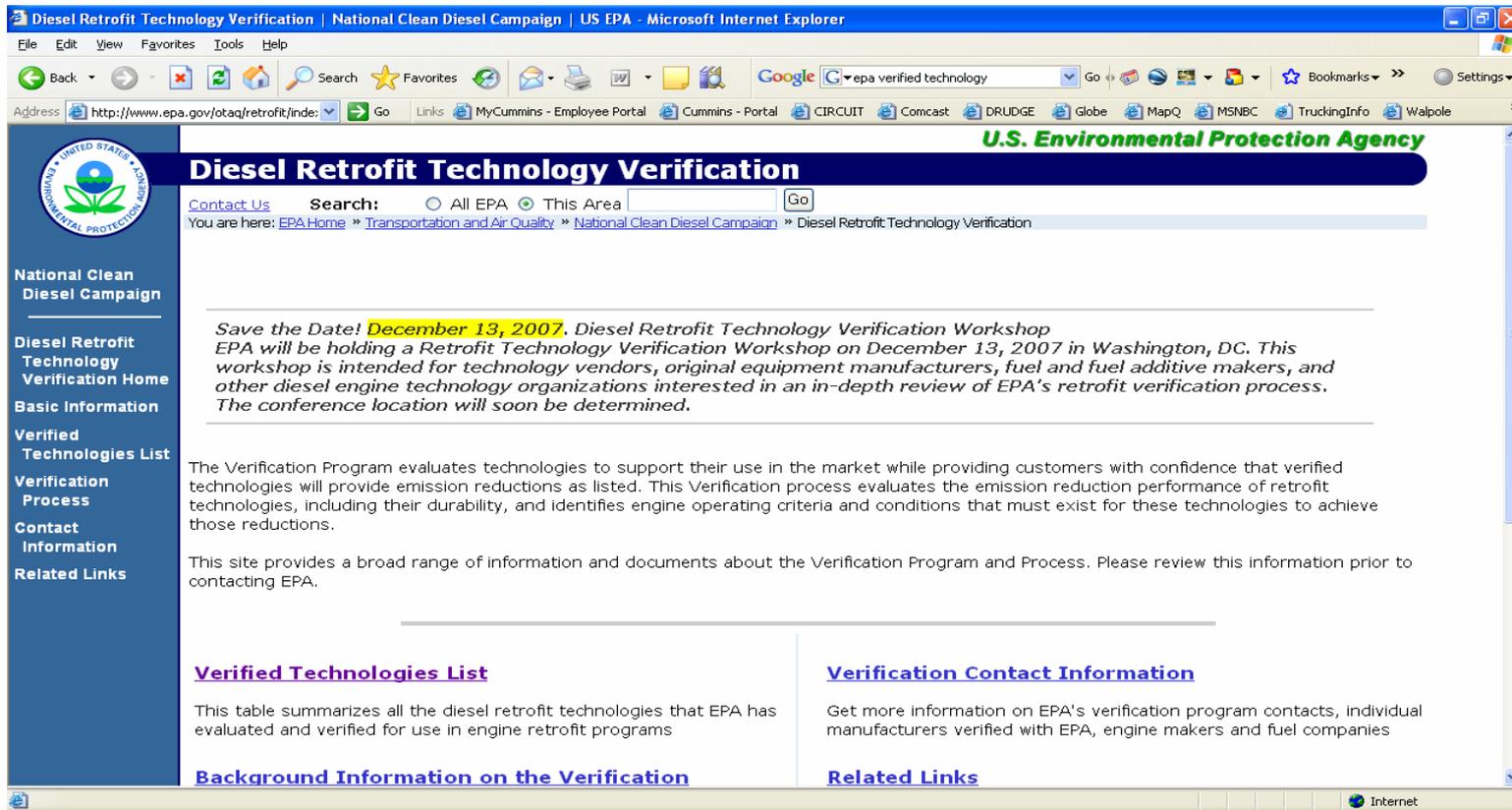
Retrofit reduction summary

	DOC	PCRT	DPF
Design	Passive diesel Oxygen Catalyst	Passive DOC with Wall Flow PM filter	Passive DOC with Flow through PM filter
PM filter	N/A	Ceramic Substrate	Metallic Substrate
Emission Reduction	PM >20% HC > 50% CO > 50%	PM >50% HC > 90% CO > 90%	PM >85% HC > 90% CO > 90%
Temperature Requirements	None	240° C @ 40%	240° C @ 40%
Monitor Required	No	No	Yes
Maintenance	No	No	60-100K level 1 cleaning

Retrofit reduction summary

	CCRT	EPF	Longview
Design	Passive DOC with Wall Flow PM filter	Active diesel particulate control system (electrically regenerated)	Modular device contains NOx catalyst and filter sections & Fuel Dosing
PM filter	Ceramic Substrate	Silicon Carbide	Silicon Carbide
Emission Reduction	PM >85% HC > 90% CO > 90%	PM > 85 % No CO or HC	PM > 85% NOx > 25%
Temperature Requirements	200° C @ 40%	No	260° C @ 25%
Monitor Required	Yes	Yes	Yes
Maintenance	60-100K level 1 cleaning	No	Yes

EPA Verified Technology



The screenshot shows a Microsoft Internet Explorer browser window displaying the EPA Diesel Retrofit Technology Verification website. The browser's address bar shows the URL: <http://www.epa.gov/otaq/retrofit/index>. The website header includes the EPA logo and the text "U.S. Environmental Protection Agency". The main heading is "Diesel Retrofit Technology Verification". Below this, there is a search bar with options for "All EPA" and "This Area". A navigation breadcrumb trail reads: "You are here: EPA Home » Transportation and Air Quality » National Clean Diesel Campaign » Diesel Retrofit Technology Verification".

The left sidebar contains a menu with the following items: "National Clean Diesel Campaign", "Diesel Retrofit Technology Verification Home", "Basic Information", "Verified Technologies List", "Verification Process", "Contact Information", and "Related Links".

The main content area features a highlighted announcement: "Save the Date! **December 13, 2007**. Diesel Retrofit Technology Verification Workshop. EPA will be holding a Retrofit Technology Verification Workshop on December 13, 2007 in Washington, DC. This workshop is intended for technology vendors, original equipment manufacturers, fuel and fuel additive makers, and other diesel engine technology organizations interested in an in-depth review of EPA's retrofit verification process. The conference location will soon be determined."

Below the announcement, there are two paragraphs of text:

- The first paragraph states: "The Verification Program evaluates technologies to support their use in the market while providing customers with confidence that verified technologies will provide emission reductions as listed. This Verification process evaluates the emission reduction performance of retrofit technologies, including their durability, and identifies engine operating criteria and conditions that must exist for these technologies to achieve those reductions."
- The second paragraph states: "This site provides a broad range of information and documents about the Verification Program and Process. Please review this information prior to contacting EPA."

At the bottom of the page, there are four columns of links:

- [Verified Technologies List](#): This table summarizes all the diesel retrofit technologies that EPA has evaluated and verified for use in engine retrofit programs.
- [Verification Contact Information](#): Get more information on EPA's verification program contacts, individual manufacturers verified with EPA, engine makers and fuel companies.
- [Background Information on the Verification](#)
- [Related Links](#)

Retrofit - Cat Loader



Retrofit - John Deere Loader

