

# Development of Partial Filter Technology for HDD Retrofit

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## Introduction

Objective - Develop a Level II PM control device which provides > 50% PM reduction along with > 60% HC and CO reductions for retrofit on existing diesel powered vehicles running on LSD and ULSD fuels.

## System Design & Definition

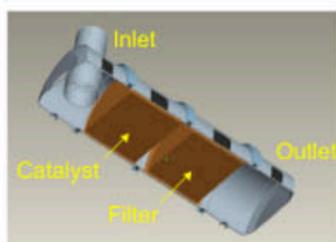
### Modular Design, CRT® System configuration

- Inlet
- Catalyst
- Filter
- Outlet

### Flow Thru Substrate replaces typical DPF

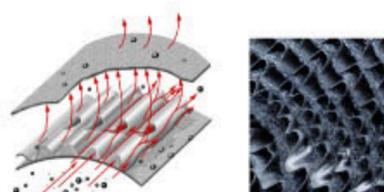
- Emitec PM Filter Cat

### System Concept



The Emitec substrate forces the exhaust through a metal fleece material that captures a portion of the soot which is continuously oxidized by the NO<sub>2</sub> created by the pre-catalyst.

### Emitec PM Filter Cat Substrate



### PM Filter Cat in CRT® System Configuration 1993 Mack Trash Hauler, Vertical Mount



## Test Plan and Results

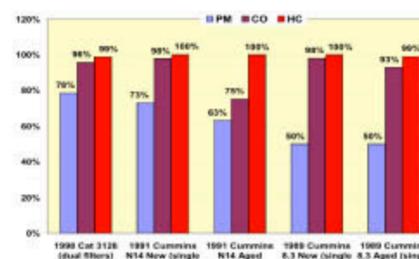
### Emission testing conducted at SwRI and Environment Canada on 3 engines:

- 1998 Caterpillar 3126, 250hp
- 1991 Cummins N14, 350hp
- 1989 Cummins 6CTA8.3, 240hp

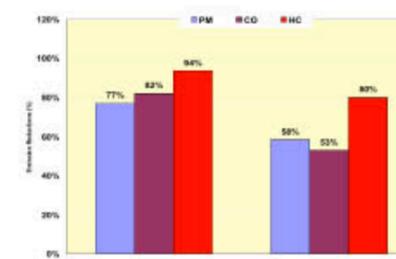
### PM Emissions with Level II System US FTP on ULSD

Engine Out	New Dual Filters	New Single Filter	Aged Single Filter
1998 CAT 3126 250hp	0.071 g/bhp-hr	0.02 g/bhp-hr	Not tested
1991 Cummins N14 350hp	0.149 g/bhp-hr	0.038 g/bhp-hr	0.055 g/bhp-hr
1989 Cummins 6CTA8.3 240hp	0.36 g/bhp-hr	Not tested	0.18 g/bhp-hr

### Emissions Reductions US FTP on ULSD



### Emissions Reductions US FTP on LSD (< 350ppm S)



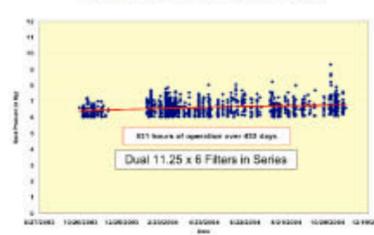
### Field trials conducted in CA on trash haulers using ULSD (< 15ppm S)

- 1989 and 1993 Mack E7, 300hp
- 1991 Volvo TD73, 250hp
- 1989 Caterpillar 3208T, 250hp

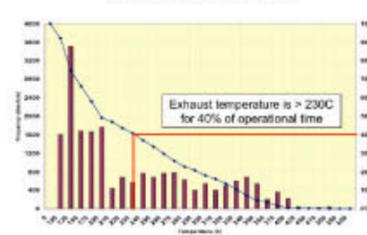
### CA Sanitation Truck Field Trial with ULSD 1989 and 1993 Mack E7 Dual Filters in Series



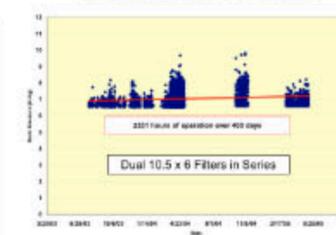
### Peak On-Road Pressure 1993 Mack E7 Trash Hauler, ULSD



### Exhaust Temperature Profile 1993 Mack E7 300hp ULSD



### Peak On-Road Back Pressure 1989 Mack E7 Trash Truck, ULSD



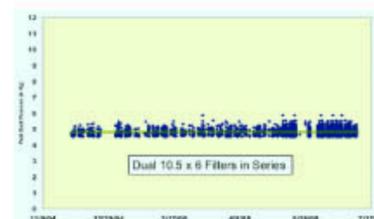
### Field trial in Philadelphia on school bus with LSD (< 350ppm S)

- 2001 International DT466, 190hp

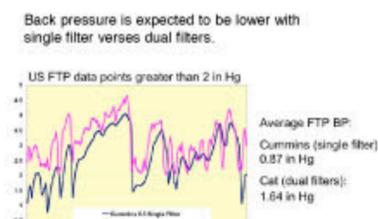
### Philadelphia School Bus Field Trial with LSD 2001 International DT466 190hp



### Peak On-Road Back Pressure 2001 International DT466 190hp, LSD



### Back Pressure Comparison 3126 with Dual Filters vs. C8.3 with Single Filter



## Conclusion

### Level II PM reduction devices bridge the gap between Level I (25%) and Level III (85%)

- Enables higher PM reductions on older dirtier engines compared to just a DOC
- Tolerant to engine upset conditions and wear and tear due to engine ageing.

Substrate pockets hold a certain amount of PM, while the rest of the exhaust bypasses the system without a significant increase in back pressure. The soot in the pockets is continuously combusted by passive NO<sub>2</sub> regeneration. Emission testing results show that greater than 50% PM reduction is achieved using a single filter running on both ULSD and LSD fuels. Dual filters provide greater than 70% PM reduction. Single filter reduces back-pressure when compared to dual filters in series.

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- Single filter reduces back pressure when compared to dual filters in series

Filter is adaptable to a wide range of engines

Future work includes:

- Revised filter design to further reduce back pressure while increasing PM trapping efficiency
- Chassis dynamometer testing of Level II systems current involved in field trial

### Acknowledgments:

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