



## CHRONOLOGY

- ⊗ May 1999 - Datalogging & Duty Cycles
- ⊗ October 1999 - RFPs to Trap Mfgs
- ⊗ May 2000 - Installations of 4 DPF Systems
- ⊗ May 2000 - Nov 2001 - Performance Evaluations
- ⊗ February 2001 - Isolated Zone Study (Ambient Concentrations)
- ⊗ February 2002 - DPFs de-commissioned
- ⊗ September 2002 - Final Bench Testing in Lab at CANMET

# VEHICLES

MT436B Trucks



ST8B Scoops



# FIELD MEASUREMENT

UGAS



NIOSH 5040



NANOMET



DDDL



DATALOGGERS



## ECS CatTrap

- ST8-B Scooptram - VL244
- Detroit Diesel - Series 60 - 325 HP
- Twin ceramic monoliths with base metal catalyst
- Passive regeneration

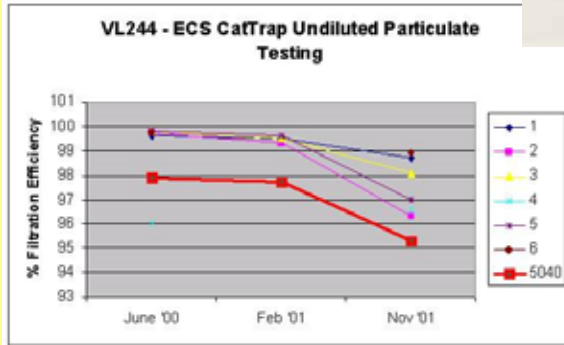
Data From ECM @	Fuel Consumption	Operating Hrs	Idling Hrs
Trap Installation	8034 igals	1005	194.5
Nov 2 <sup>nd</sup> , 2001	35869 igals	4539	969
Jan 24 <sup>th</sup> , 2001	40073 igals	5058	1081
<b>TOTALS</b>	<b>32039 igals</b>	<b>4053 hrs</b>	<b>887 hrs</b>

Fuel Consumption Avg: 7.905 gals/hr  
 Percent @ Idle : 21.89%

# ECS CatTrap

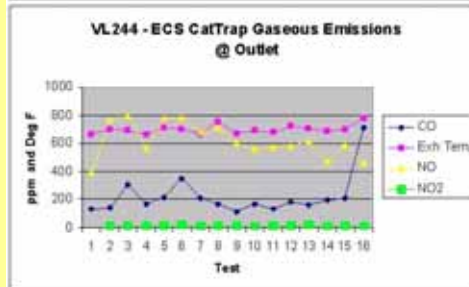
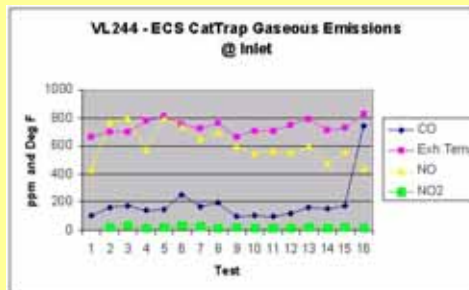
## Performance Evaluations

- ⊗ Full throttle – Full Torque Converter Stall
- ⊗ Snap Acceleration – Free No Load (Sets of 3)
- ⊗ Snap Acceleration – Full Torque Converter Stall (Sets of 3)
- ⊗ Idle – No Load
- ⊗ Full Throttle – No Load
- ⊗ Full Throttle – Full Torque Converter Stall



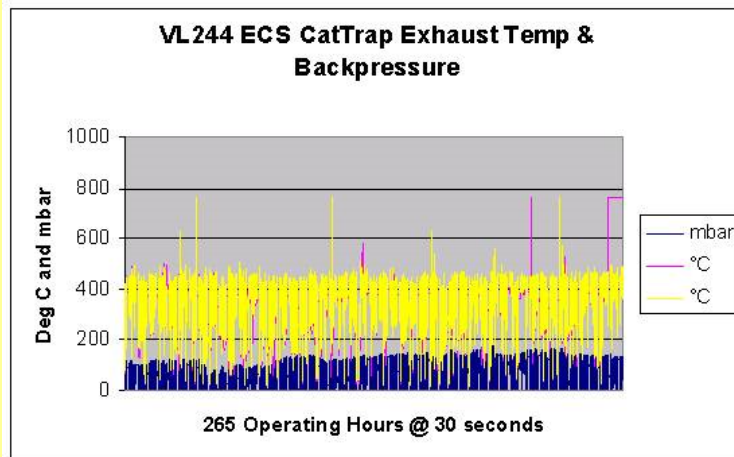
# ECS CatTrap

## Gaseous Emissions



# ECS CatTrap

## Exhaust Temperature and Backpressure

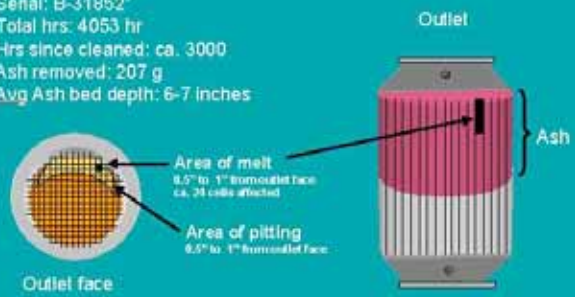


# ECS CatTrap

## Post-Field Test Inspection

### Boroscope Analysis of Cattraps

Top filter in manifold:  
 Model: CT 23  
 Serial: B-31952  
 Total hrs: 4053 hr  
 Hrs since cleaned: ca. 3000  
 Ash removed: 207 g  
 Avg Ash bed depth: 6-7 inches



**LUBRIZOL**  
 Engine Control Systems

# DCL

- ST8-B Scooptram - VL247
- Detroit Diesel - Series 60 - 325 HP
- SiC monolith with precious metal catalyst
- Passive regeneration with Active - Electric assist

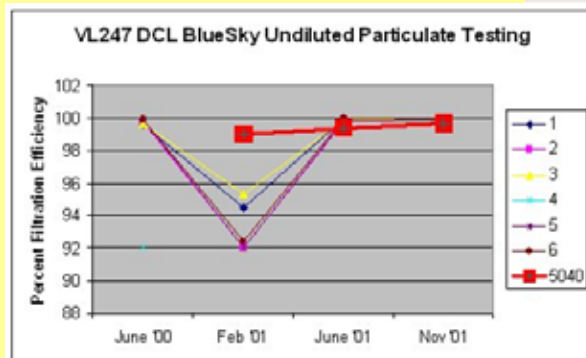
Data From ECM @	Fuel Consumption	Operating Hrs	Idling Hrs
Trap Installation	0.8 igals	0.3	0.2
Trap Removed	1885	293	60
Trap Re- Installed	3713	577	118
June 7, 2001	24141 igals	2999	716
Nov 5 <sup>th</sup> , 2001	32635 igals	4092	944
Jan 24 <sup>th</sup> , 2002	36152 igals	4545	1033
<b>TOTALS</b>	<b>34323 igals</b>	<b>4261 hrs</b>	<b>975 hrs</b>

Fuel Consumption Avg: 8.055 gals/hr  
 Percent @ Idle : 22.88%

# DCL

## Performance Evaluations

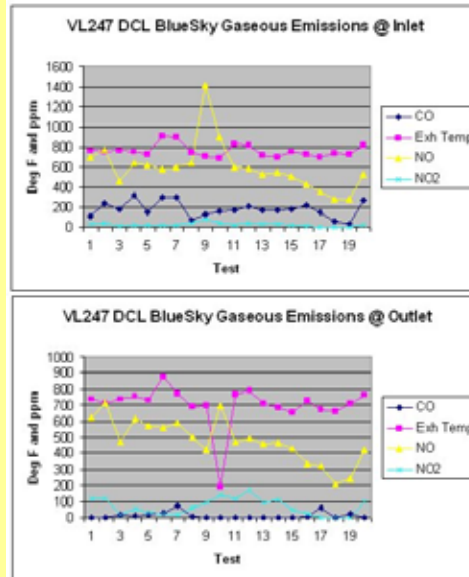
- ⌘ Full throttle - Full Torque Converter Stall
- ✕ Snap Acceleration - Free No Load (Sets of 3)
- ⊙ Snap Acceleration - Full Torque Converter Stall (Sets of 3)
- ⊖ Idle - No Load
- ⊕ Full Throttle - No Load
- ⊗ Full Throttle - Full Torque Converter Stall





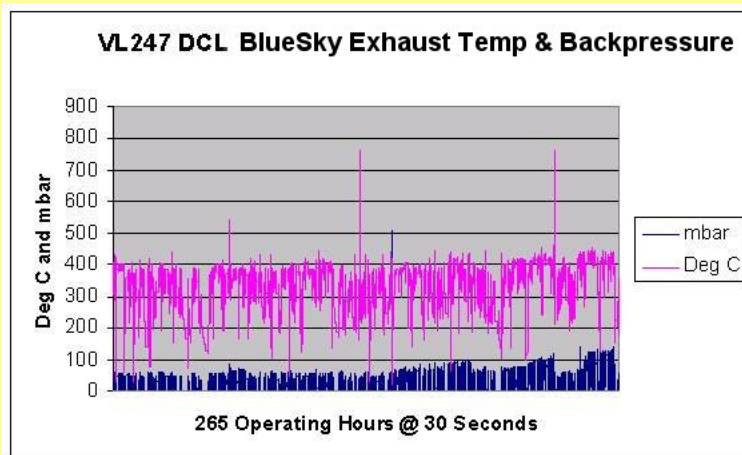
# DCL

## Gaseous Emissions



# DCL

## Exhaust Temperature and Backpressure



# DCL

## Post-Field Test Inspection



# ECS - Octel

- MT436-B Truck - VH183
- Detroit Diesel - Series 60 - 375 HP
- SiC twin monolith with fuel borne catalyst (Octimax 4804)
- Passive regeneration with active fuel borne catalyst

Data From ECM @	Fuel Consumption	Operating Hrs	Idling Hrs
Trap Installation	1382 igals	293	128
<b>Filter Replaced</b>	<b>17249 igals</b>	<b>2763</b>	<b>984</b>
June 7, 2001	18187 igals	2923	1043
Oct 23, 2001	23939 igals	3785	
Jan 24, 2002	28448 igals	4382	1474
<b>1<sup>st</sup> Filter Totals</b>	<b>15867 igals</b>	<b>2470 hrs</b>	<b>856 hrs</b>
<b>New Filter Totals</b>	<b>11199 igals</b>	<b>1619 hrs</b>	<b>490 hrs</b>

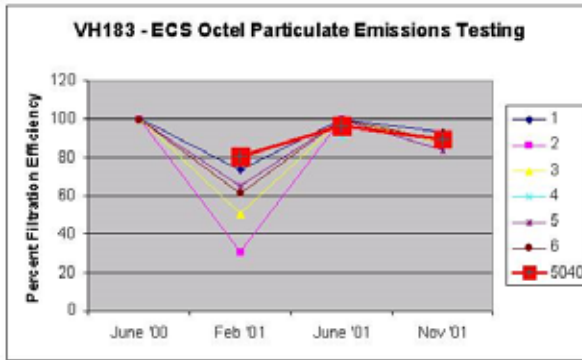
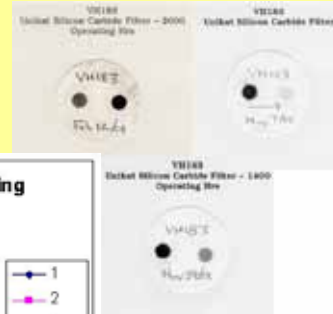
Fuel Consumption Avg: 6.917 gals/hr  
Percent @ Idle : 32.5%



# ECS - Octel

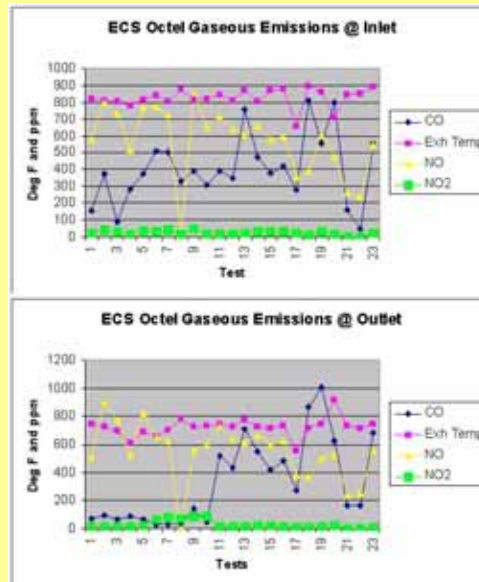
## Performance Evaluations

- ⌘ Full throttle - Full Torque Converter Stall
- ✕ Snap Acceleration - Free No Load (Sets of 3)
- ⊙ Snap Acceleration - Full Torque Converter Stall (Sets of 3)
- ⊙ Idle - No Load
- ⊙ Full Throttle - No Load
- ⊙ Full Throttle - Full Torque Converter Stall



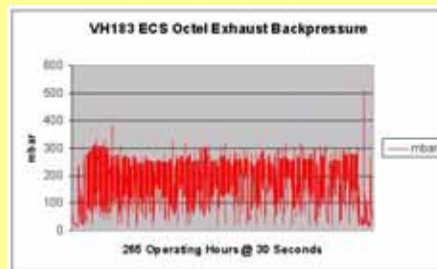
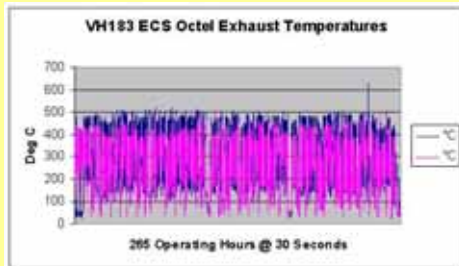
# ECS - Octel

## Gaseous Emissions



# ECS - Octel

## Exhaust Temperature and Backpressure



# ECS - Octel

## Post-Field Test Inspection



# Oberland Mangold - Octel

- MT436-B Truck - VH181
- Detroit Diesel - Series 60 - 375 HP
- Wound Fibre Cartridges with fuel borne catalyst (Octimax 4804)
- Passive regeneration with active fuel borne catalyst

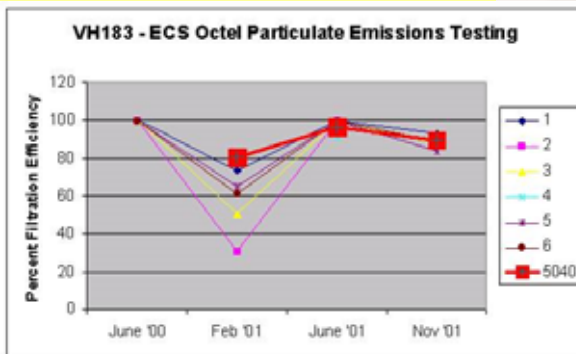
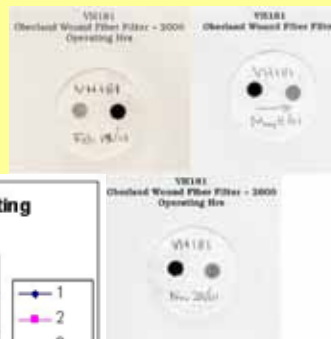
Data From ECM @	Fuel Consumption	Operating Hrs	Idling Hrs
1 <sup>st</sup> Trap Installation	13185 igals	2265	653
2 <sup>nd</sup> Trap Installation	14958 igals	2593	737
June 8, 2001	27663 igals	4096	1207
Oct 23, 2001	33685 igals	5000	
Jan 24, 2002	36732 igals	5491	1658
<b>TOTALS</b>	<b>21774 igals</b>	<b>2898 hrs</b>	<b>921 hrs</b>

Fuel Consumption Avg: 7.513 gals/hr  
 Percent @ Idle : 31.8%

# Oberland Mangold - Octel

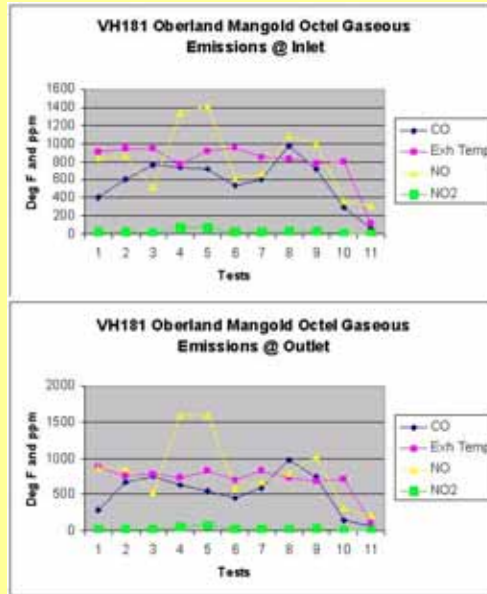
## Performance Evaluations

- ⌘ Full throttle - Full Torque Converter Stall
- ✕ Snap Acceleration - Free No Load (Sets of 3)
- ⊙ Snap Acceleration - Full Torque Converter Stall (Sets of 3)
- ⊖ Idle - No Load
- ⊕ Full Throttle - No Load
- ⊗ Full Throttle - Full Torque Converter Stall



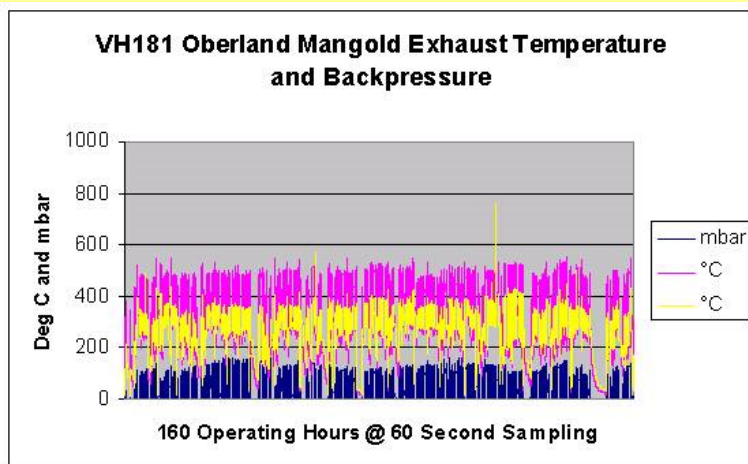
# Oberland Mangold - Octel

Gaseous Emissions



# Oberland Mangold - Octel

Exhaust Temperature and Backpressure



# Oberland Mangold - Octel

## Post-Field Test Inspection



## Recommendations

### SELECTION PROCESS

- Most critical to success
- Application engineering
- Never vehicle/engine specs alone
- Measured duty cycles, specs,  
mine application

## Recommendations

### INSTALLATION

- Retrofits - well engineered kits
- Design for minimized leaks
- Interfaced controls - temp & pressure
- Take advantage of electronic engines
- Engineered at mfgr - not U/G shop

## Recommendations

### MEASUREMENT

- Mine people / mine instruments
- Undiluted DPM & gas emissions
- Temperature & Backpressure
- Ambient DPM concentrations
- Make data based decisions



## Recommendations

### MAINTENANCE

- Condition based maintenance
- Maintain by measurement
- Maintain measurements systems too
- Qualitative - inspection & audit
- Training

## Recommendations

### VERIFICATION

- Continuous process monitoring
- Assign / delegate responsibilities
- Control charts
- Cross check vehicle / ambient
- DPM reduction / capital investment

QUESTIONS

???