

**EXPLORING LOW EMISSION DIESEL ENGINE OILS
WORKSHOP, Jan 30 - Feb 1, 2000 Scottsdale, AZ**

DIESEL EMISSION CONTROLS : NO_x AND PARTICULATE

Presented By

Dr. JOHN H. JOHNSON, Presidential Professor

MICHIGAN TECHNOLOGICAL UNIVERSITY

Jan 30, 2000



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Michigan Technological University**

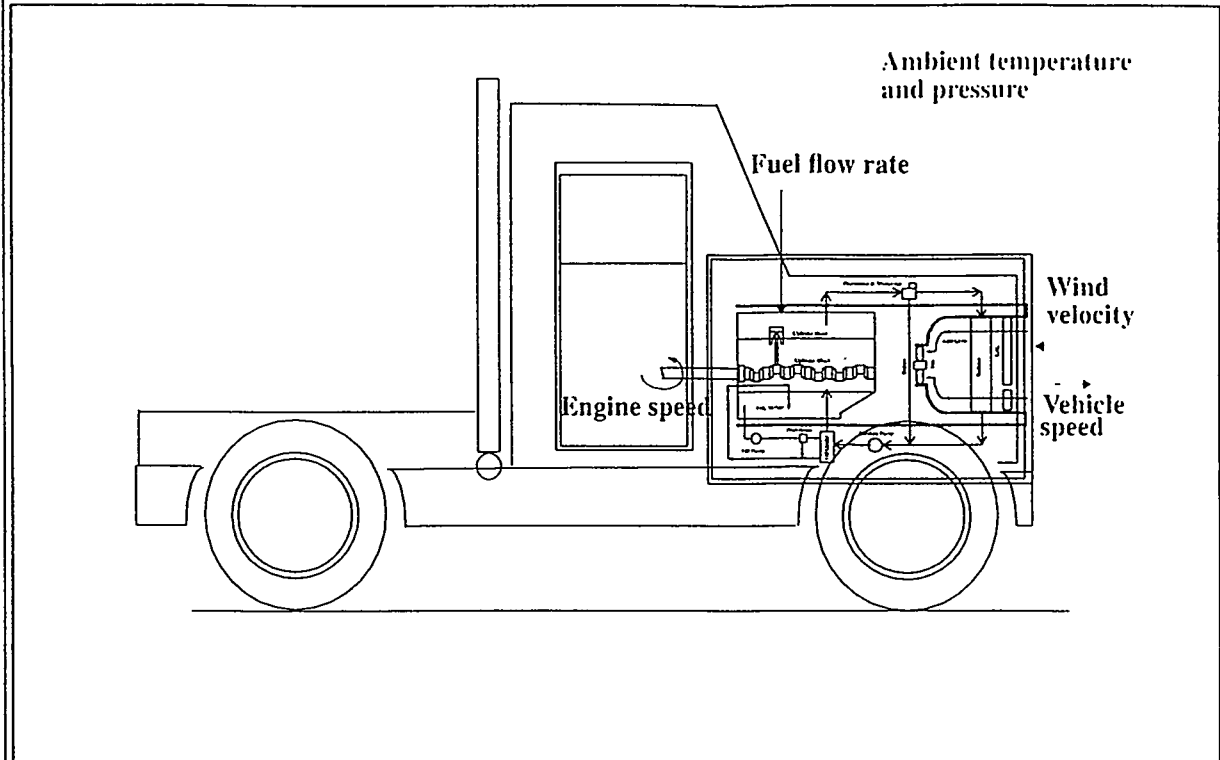
OVERVIEW

- **Overall Approach**
- **EGR System**
- **Catalyst Systems**
- **Recuperator**
- **Catalyzed Filters**
- **Modeling**



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VECSS OVERVIEW



Vehicle Engine Cooling System Simulation (VECSS) Research Group
Michigan Technological University, Houghton

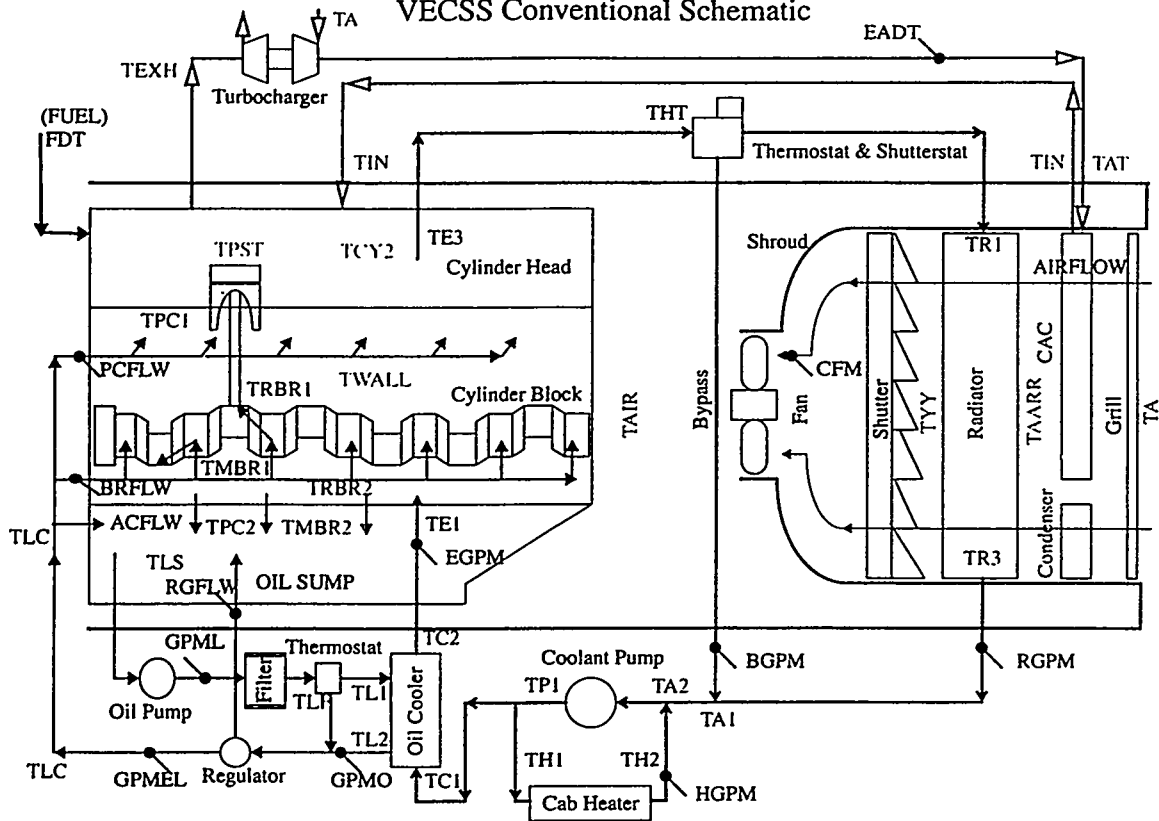
CONFIGURATION OF THE VECSS (ver. 8.1)

Component	Model No./ type	Manufacturer
Engine	Series 60, 12.7 L	Detroit Diesel Corporation
Radiator	405-16366-001	Behr McCord
Condenser	BM 19757	Behr McCord
Charge air cooler	01-23132-00	Allied Signal
Coolant thermostat	-	Detroit Diesel Corporation
Fan	DST variable speed clutch	Kysor Cooling Systems
Oil Cooler	-	Harrison Division-GMC
Oil thermostat	-	Detroit Diesel Corporation
Turbocharger	-	Garrett Automotive



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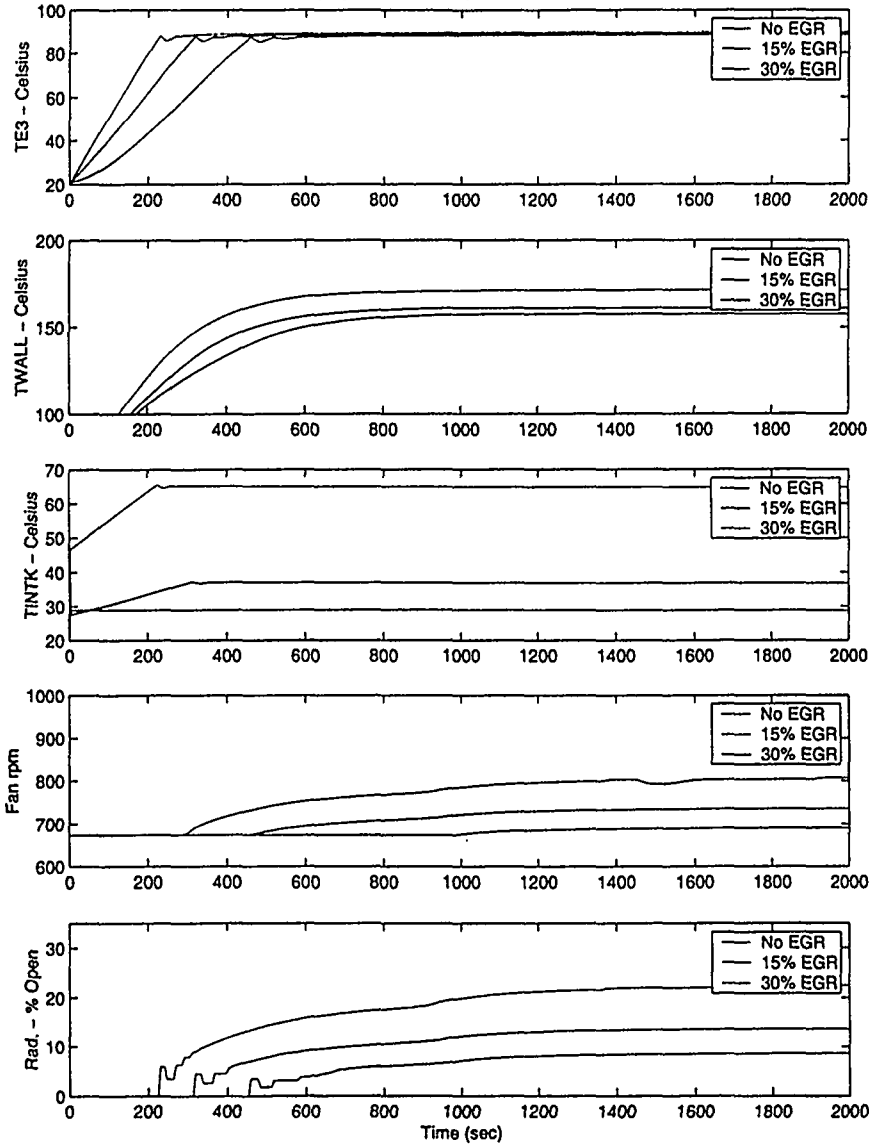
VECSS Conventional Schematic



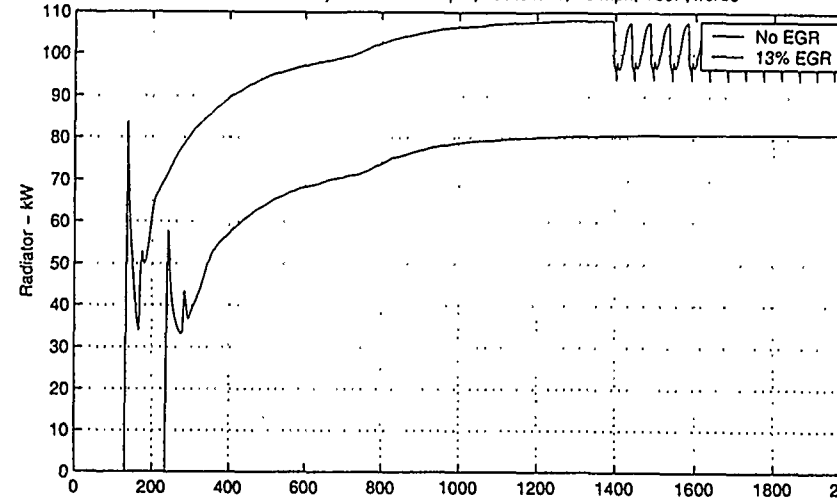
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Vehicle Engine Cooling System Simulation-VECSS Group
Department of Mechanical Engineering-Engineering Mechanics

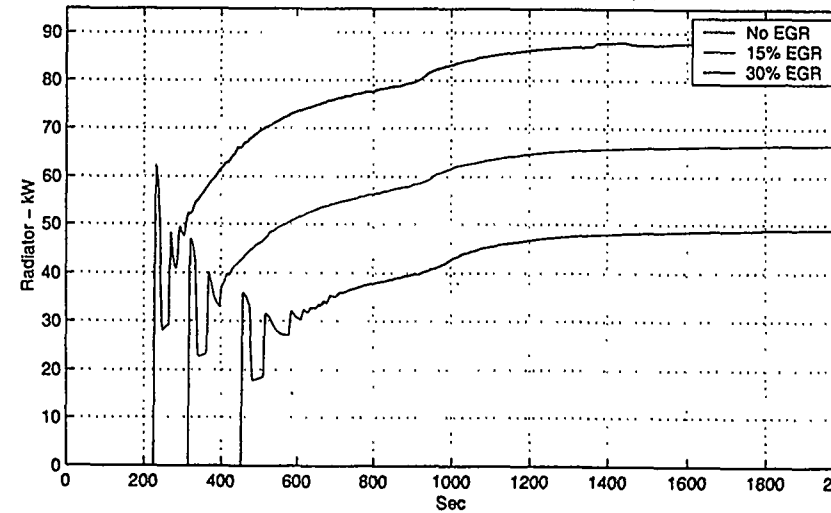
Comparison of Varying EGR at 1500 rpm, 50% load, 55 mph, 70F, 12/19/99

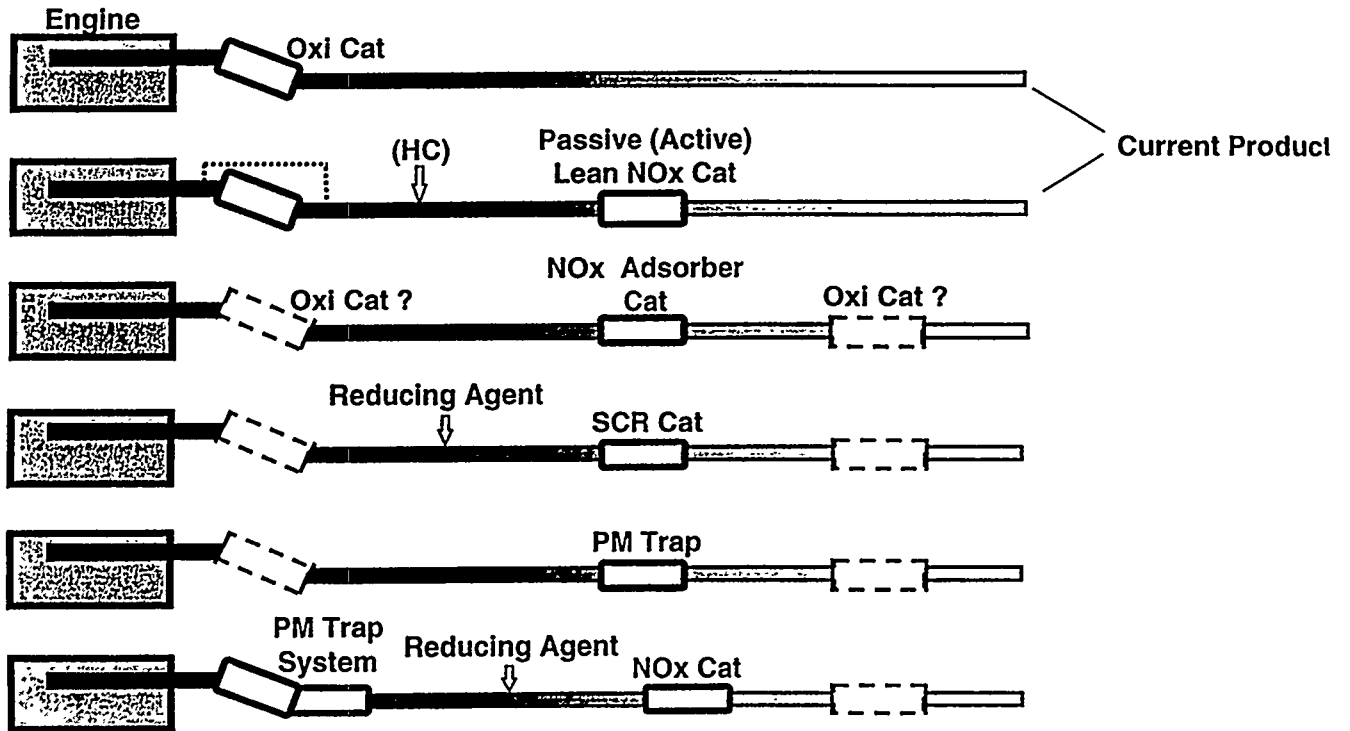


Radiator Heat Rejection at 1500 rpm, 100% load, 20 mph, 100F, 1/9/00



Radiator Heat Rejection at 1500 rpm, 50% load, 55 mph, 70F





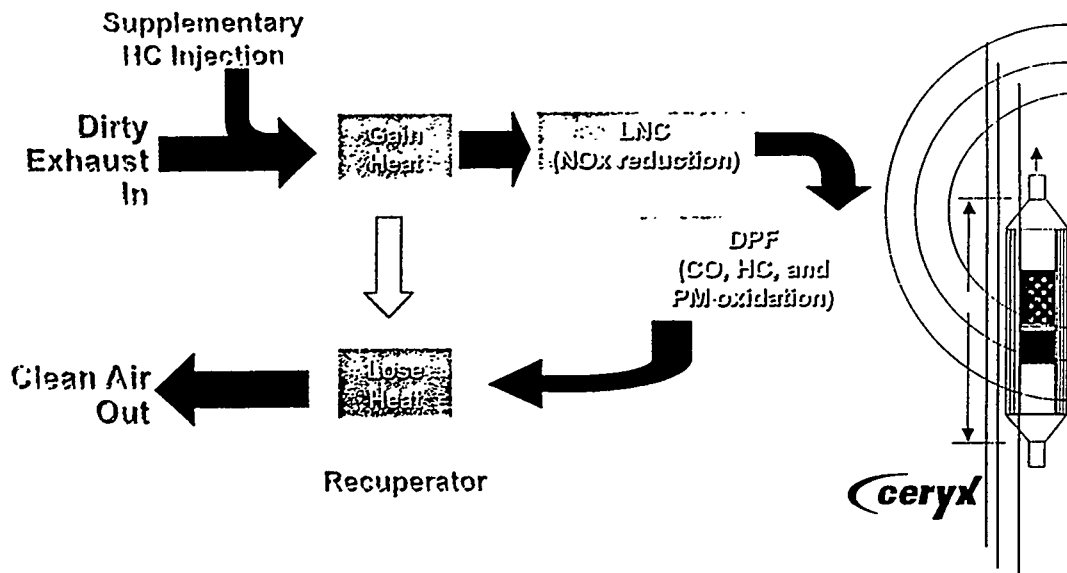
Wisconsin_06_99 page 12



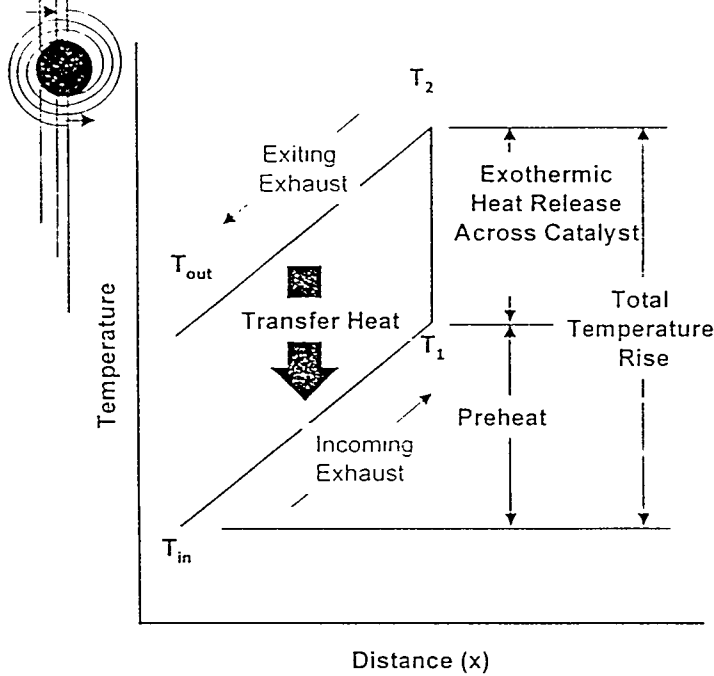
QuadCAT Flow Schematic



- Integrate heat transfer and chemistry for simultaneous reduction of NOx, CO, HC, & PM



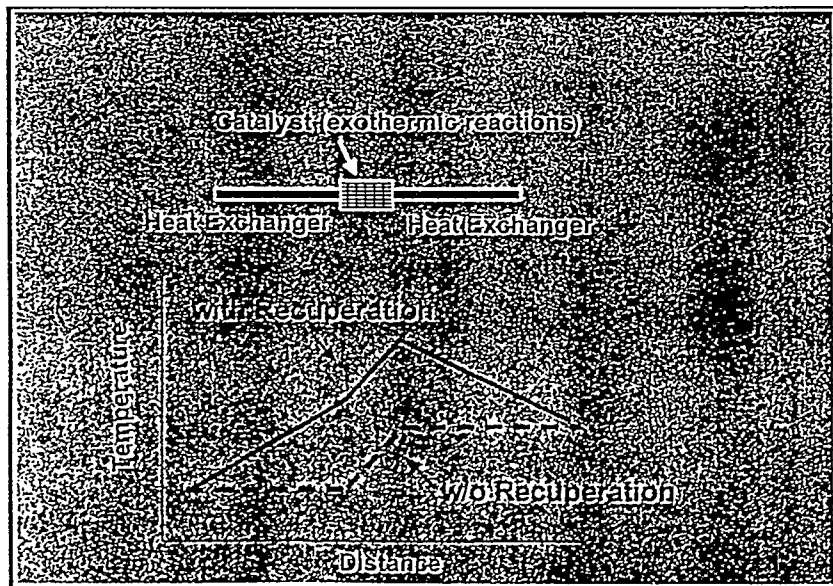
Heat Recuperator Platform



- ◎ Recycle heat from exothermic reactions
- ◎ Increase catalyst and filters temperatures with minimum fuel penalty

ceryx

Heat Recuperation Elevates Catalyst Temperatures



ceryx

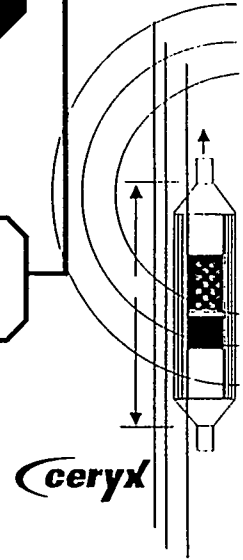
Integration Makes Full Use of Resources



Injecting supplementary HC provides:

Energy source for DPF regeneration
 $\text{HC} + \text{O}_2 \rightarrow \text{Heat}$

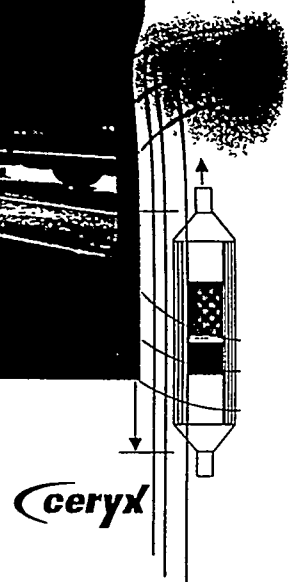
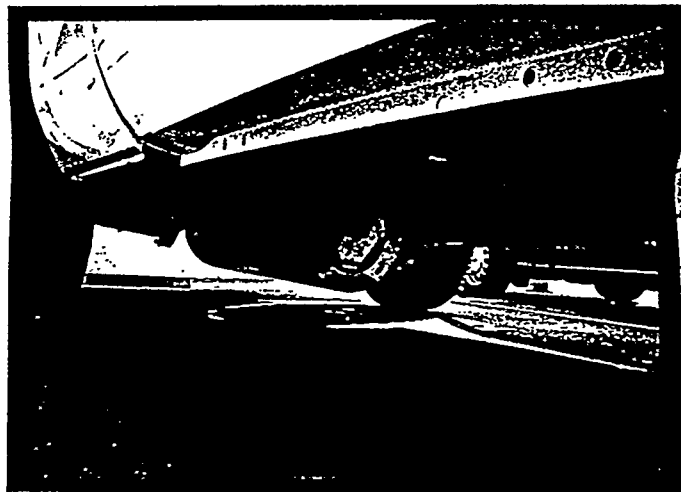
Reducing agent for NOx catalyst
 $\text{HC} + \text{NOx} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{N}_2$



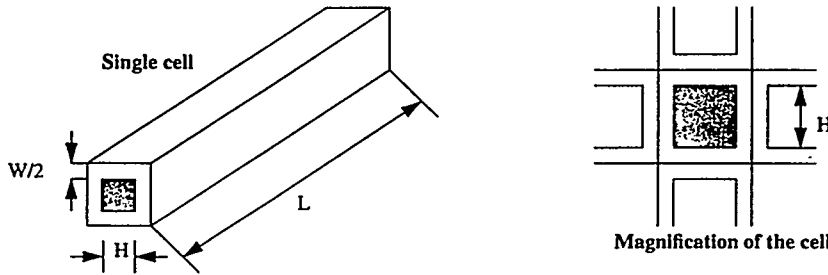
Light-Duty QuadCAT Converter



© A QuadCAT Converter field unit installed on a Ceryx test vehicle



CPF DIMENSION NOMENCLATURE



CPF Specifications

EX 80 - 100 Cell Density
 Engelhard Catalyst
 Diameter - 10.5 inches
 Length - 12 inches
 Volume - 17 liters

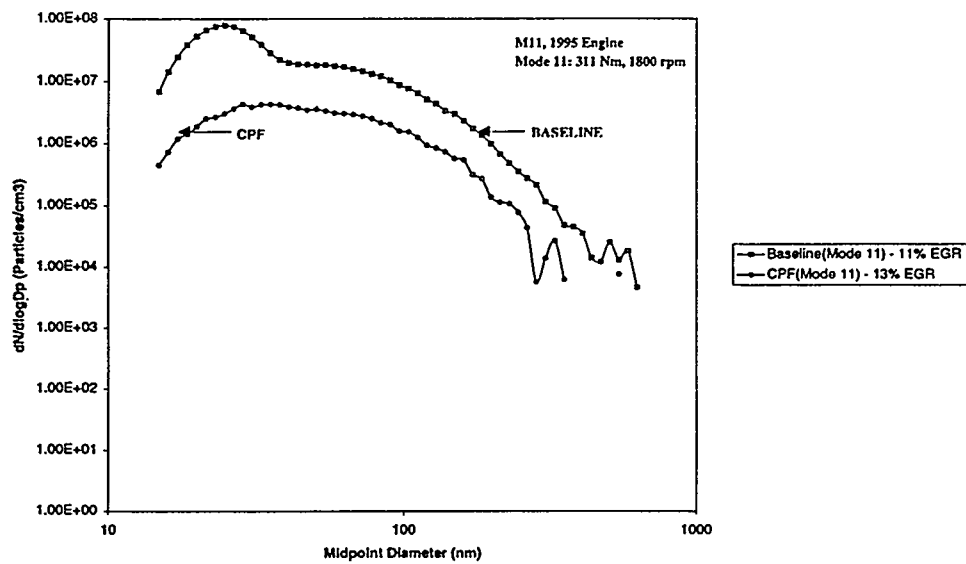
W- Porous wall thickness = 0.017 inches
 H- Cell width = 0.083 inches
 L- Cell length = 12 inches



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CATALYZED FILTERS

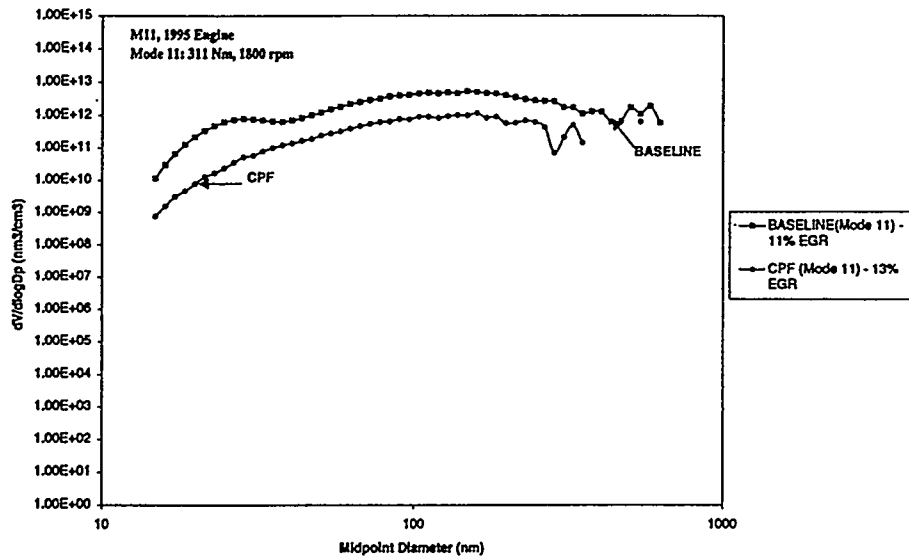
Normalized Number Distribution



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CATALYZED FILTERS

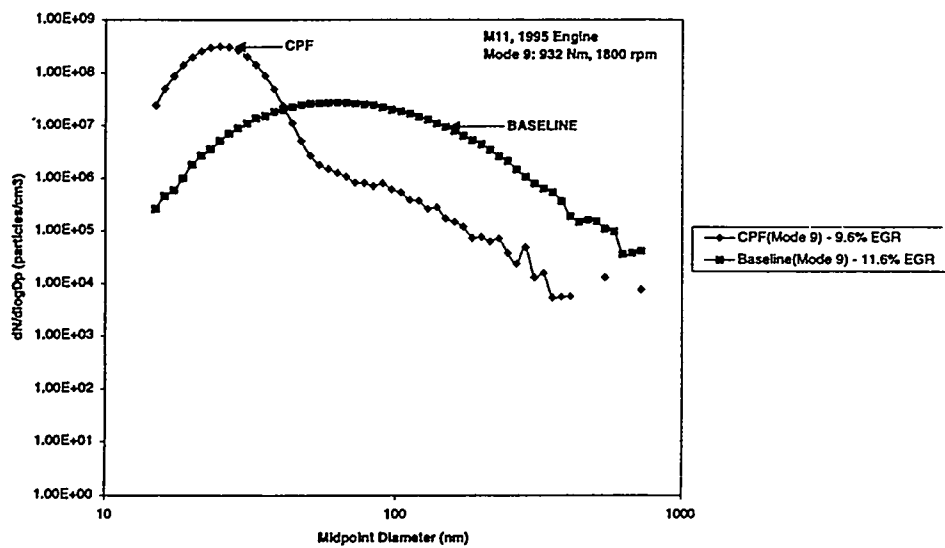
NORMALIZED VOLUME DISTRIBUTION



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CATALYZED FILTERS

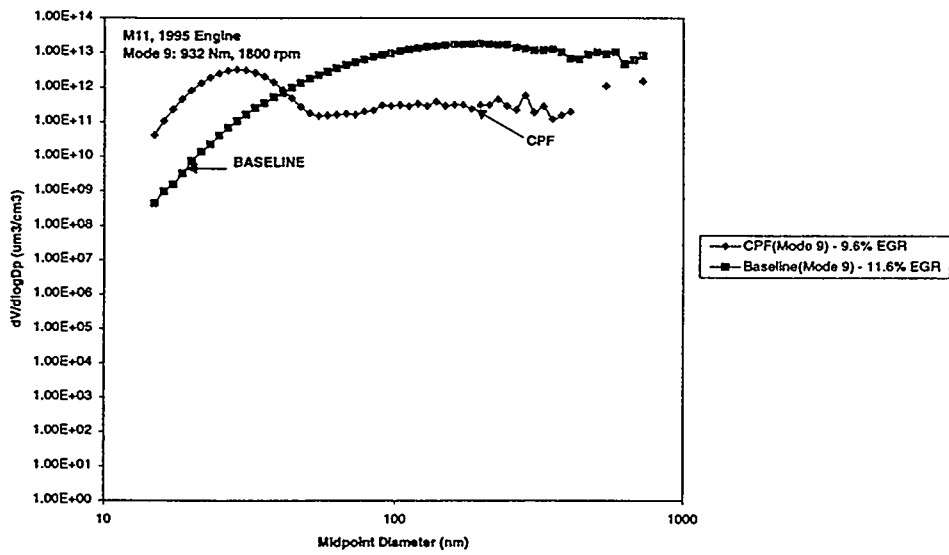
Normalized Number Distribution



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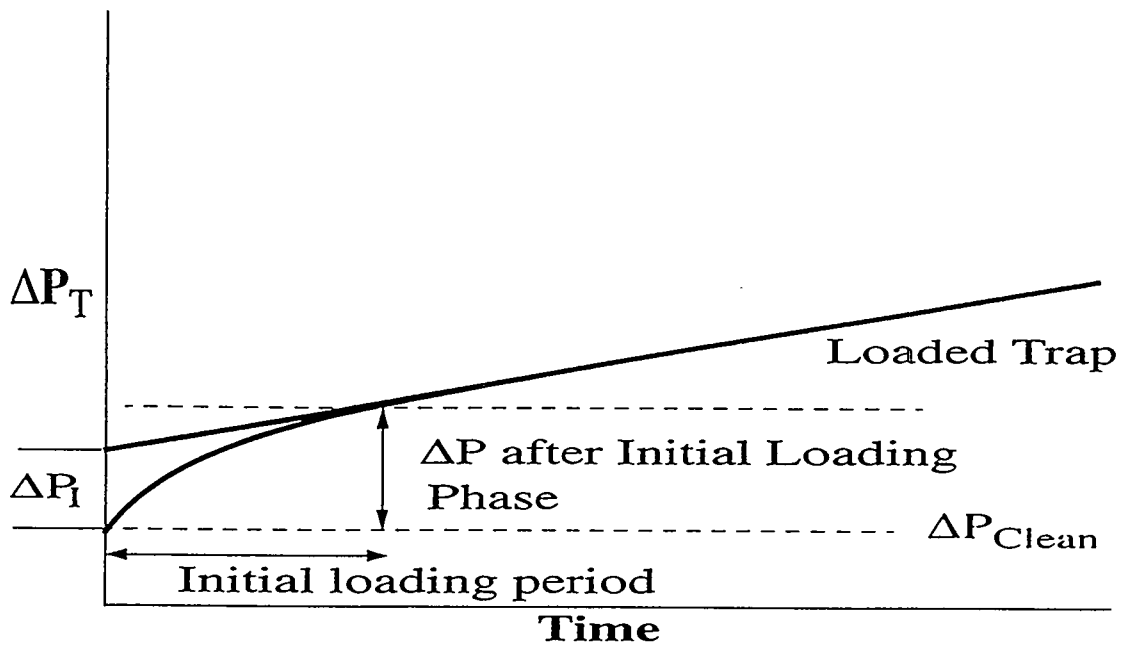
CATALYZED FILTERS

Normalized Volume Distribution



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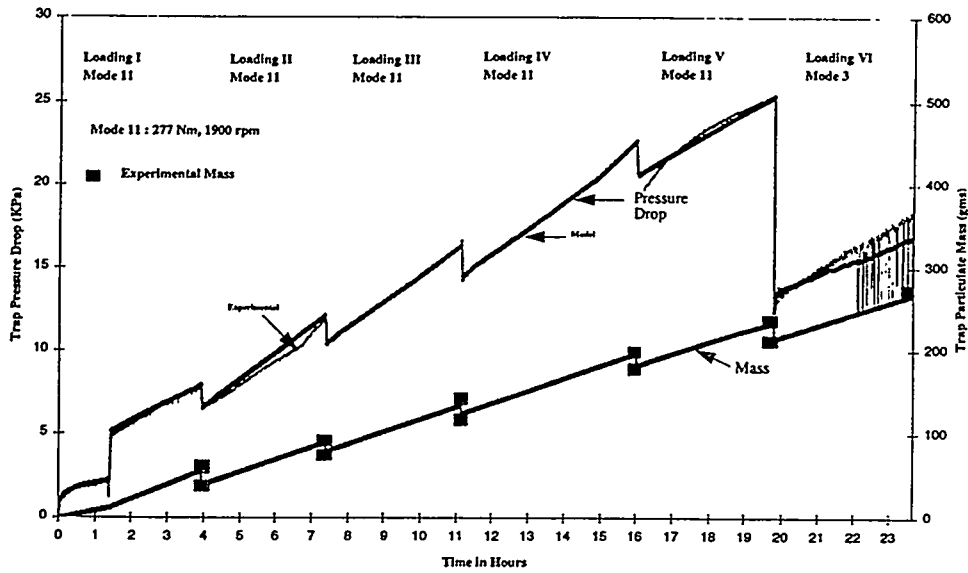
MODELING



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MODELING

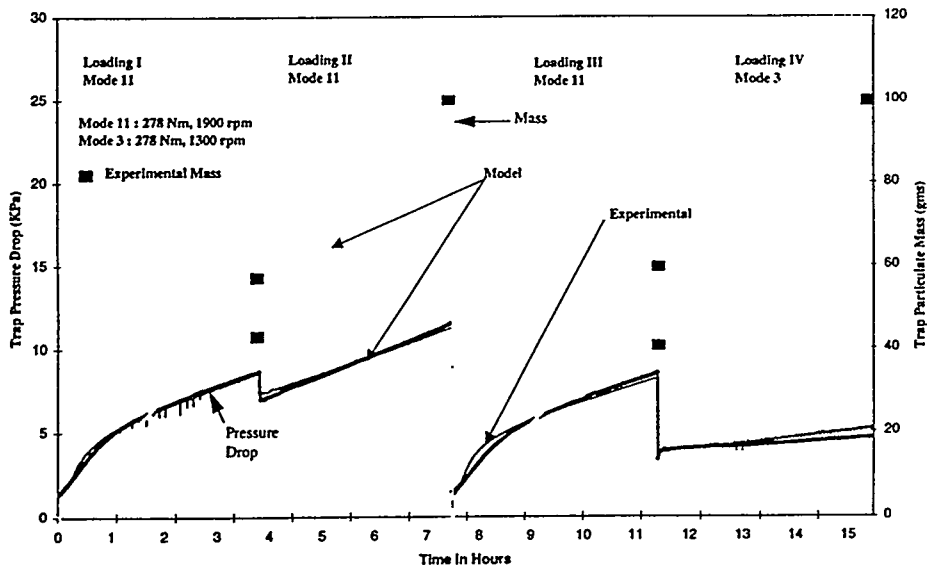
COMPARISON OF EXPERIMENTAL & MODEL DATA - EX 80 (100 CD)



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MODELING

EX 66 - COMPARISON OF EXPERIMENTAL AND MODEL DATA



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