

# MINING DIESEL EMISSIONS CONFERENCE


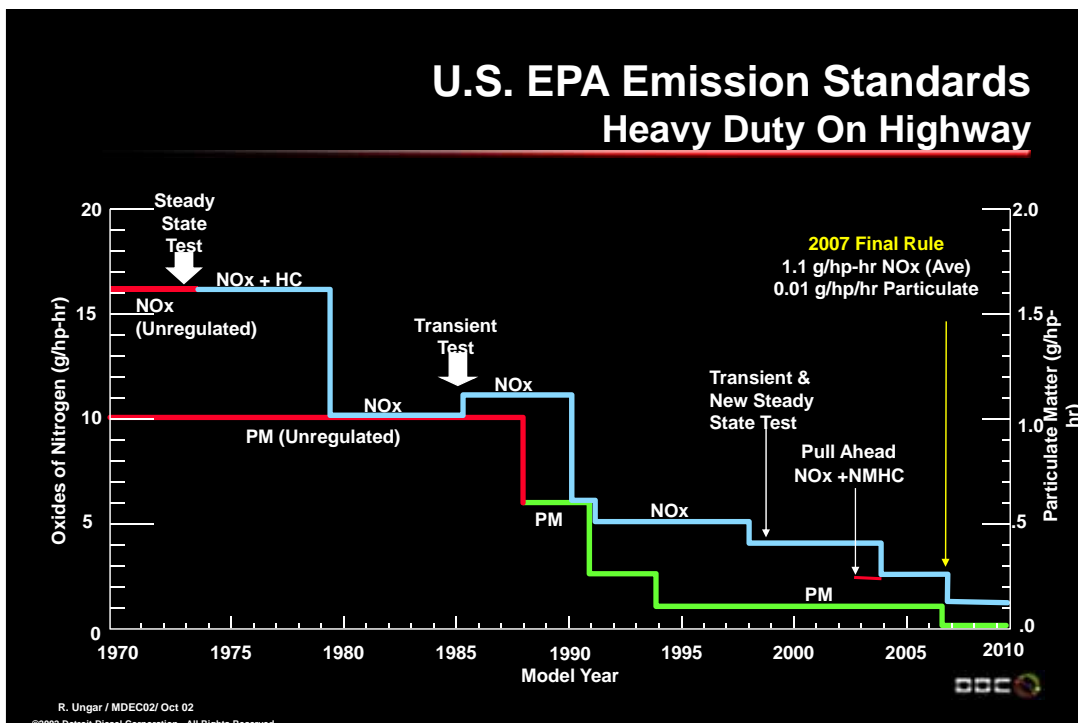
## Detroit Diesel Emissions Perspective

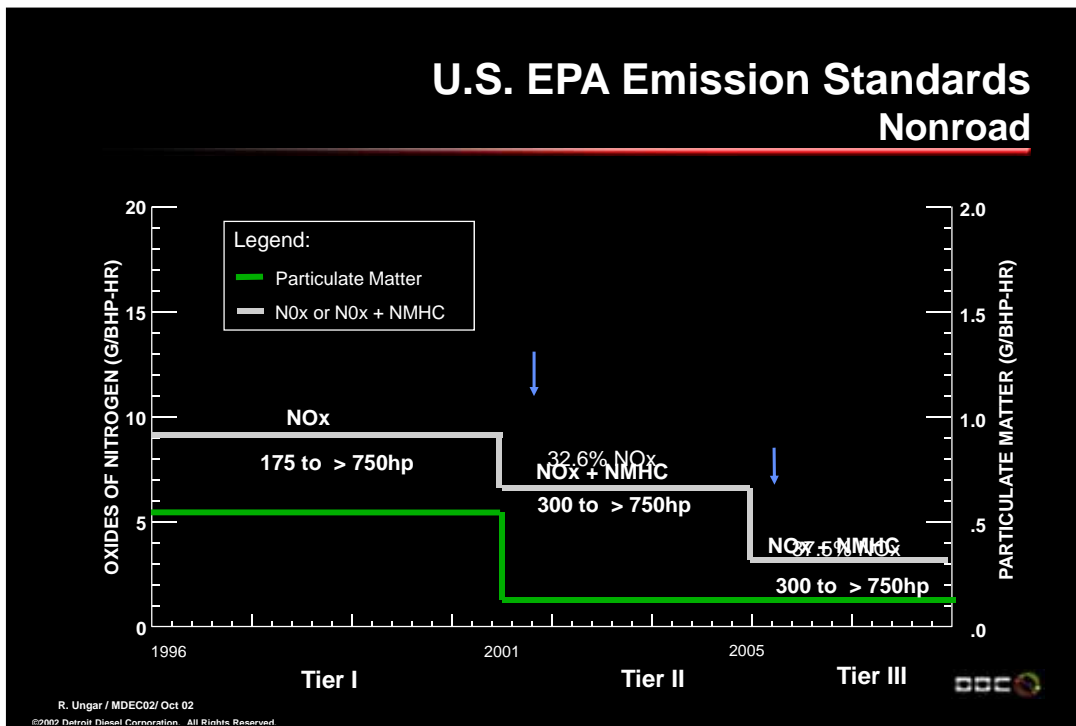
*Presented by:*

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29 Oct 02



### Underground Certified DDC Engines

- Series 700
- Series 900
- Series 40
- Series 50
- Series 60
- Series 2000

- Majority of DDC Engines in Use Underground are Series 50 and Series 60

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## Series 60 / Series 50 Nonroad Ratings

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- EPA Tier II Approved
- EURO Stage II Approved
- MSHA
  - Series 50 Approved
  - Series 60 12.7L Pending Final Approval
  - Series 60 14L Approved

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## Emission Control Strategies

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- **Currently, and in the Near Term, Differences Between Heavy Duty On Highway and Nonroad Fuel Sulfur Content, Emission Standards, and Test Procedures, Have Resulted in Somewhat Diverging Engine Emission Control Strategies**
- **Future Legislated Emission Levels And Reduction in Sulfur Content of Nonroad Fuel Will Likely Result in Eventual Convergence Of Heavy Duty On Highway and Nonroad Engine Emission Control Strategies in the 2010 Timeframe**

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## Current Emission Strategies

- **Heavy Duty On Highway (2002 thru 2004 / 2006)**
  - Calibration Changes
  - EGR Valve / Controls
  - External EGR Cooler
  - Revised Combustion Components
  - Variable Geometry Turbo
  - Internal Hardware Changes
  - New Gear Train
- **Nonroad (Tier II) (2001 thru 2004)**
  - Calibration Changes
  - Internal Hardware Changes
  - Revised Combustion Components

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## Tier III Nonroad Emission Strategy

- **Projected Tier III (2005 thru approx 2010 ) Engine Configuration**
  - Calibration Changes
  - Internal Hardware Changes
  - Revised Combustion Components
  - Possibly Variable Geometry Turbo
  - Possibly Low Level Non Cooled EGR
- **Expect to Have Tier III Engine Configuration Defined by 4<sup>th</sup> Quarter 2003**

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## Particulate Filters

- **Particulate Matter Emissions Increasing in Importance In Underground Mining**
- **Particulate Filters Offer Significant Reduction of Particulate Matter**
- **DDC has Considerable Experience with Particulate Filters (On Highway)**



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## Particulate Filter

- **DDC Supplied (Currently for Highway Applications Only)**
- **Partners Englehard (Treated Substrate) and Nelson (Canner)**
- **Several Options Available**
- **Integral Silencer**
- **Serviceable PM Filter Section**
- **Exhaust Outlet Temperature Sensor Port**



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## Particulate Filter

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- **Backpressure sensor logic for Check Engine Light (CEL) and Stop Engine Light (SEL)**
  - Triggered if above backpressure limit for a set time
  - Remains locked through ignition cycle
  - **Diagnostics**
    - » Display time operated in CEL or SEL condition
    - » Display number of occurrences operated with CEL or SEL on
- **If SEL is Triggered, Engine Will Torque Reduce Until an Acceptable Backpressure Level is Reached**

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## Particulate Filter

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- **Exhaust Temperature Sensor Located at Particulate Filter Exhaust Outlet**
- **Temperature Sensor Logic for Check Engine Light (CEL) and Stop Engine Light (SEL)**
  - Both CEL and SEL triggered if temperature registers above 565 deg C (1050 deg F) for 2 seconds or longer
  - Engine will torque reduce for 30 seconds and then shutdown

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## DDC Particulate Filter Experience

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- **Primarily in Automotive (City Coach) Applications**
- **2+ Years Exposure**
- **Several Hundred Installations Completed**
  - Both new and retrofit
  - Majority on S50 engines at 0.05 g/hp/hr particulate level
- **Particulate Filter Standard on California S50 City Coach Engines (and Available on 49 State Engines) Certified at 0.01 g/hp/hr Particulate Level**

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## Particulate Filter / Fuel Requirements

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- **New (0.01 g/hp/hr Particulate Level) City Coach Installations Require Use of VLSF Fuel**
  - Engines certified using 15 ppm sulfur fuel
- **Installations are Running and Have Been Tested With up to 500 ppm Sulfur Fuel**
  - Different particulate filter formulation necessary

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## Particulate Filter Maintenance

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- **Normal Maintenance / Ash Cleaning**
  - Typical Schedule (Automotive): Once Per Year
  - Localized Equipment
  - Encapsulated, Compressed Air / Vacuum
  - HEPA Filter
  - Commercially Available
- **DD-REMAN Servicing Available**
  - Heavy Soot Removal
  - Oven Process + Compressed Air

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