

# Diesel Engine Major Monitors

- Fuel System
- Misfire
- EGR System
- Boost Pressure Control System



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# Fuel System Monitoring

- Original Proposal: Require following faults to be detected before emissions exceed 1.5x standards:
  - fuel pressure
  - fuel injection quantity
  - multiple fuel injection performance
  - fuel injection timing
- Was required starting in the 2007 model year



# Fuel System Monitoring (cont'd)

- Current Proposal:
  - Require a functional check of the closed-loop fuel system: detect a malfunction when the system has reached its control limits such that it cannot achieve the target fuel pressure
  - Electronic components monitored under comprehensive component requirements
- Implementation:
  - Required for the 2007 model year
  - Original proposal still required for 2010



# Fuel System Monitoring Approach

- 2007 Requirement
  - Compare target and actual pressure using pressure sensor
- 2010 Requirement
  - Fuel Pressure
    - Compare target and actual pressure using pressure sensor
  - Fuel Injection Quantity, Multiple Injection Performance, and Fuel Injection Timing
    - Measure crankshaft speed fluctuations using crankshaft speed sensor



# Misfire Monitoring

- Original Proposal:
  - Must detect misfire occurring continuously in one or more cylinders during idle
  - Required for the 2007 model year
- Current Proposal:
  - Unchanged
- Misfire Monitoring Approach
  - Measure crankshaft speed fluctuation with crankshaft speed sensor



# EGR System Monitoring

- Original Proposal: Require following faults to be detected before emissions exceed 1.5x standards:
  - EGR Flow Rate
  - EGR Response Rate
  - EGR Cooling System
- Electronic components monitored under comprehensive component requirements
- Was required starting in the 2007 model year



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# EGR System Monitoring (cont'd)

- Current Proposal:
  - Require a functional check of the EGR system: detect a malfunction when the system has reached its control limits such that it cannot achieve the target EGR flow
  - Require a functional check of the EGR cooling system for proper cooling
  - Electronic components monitored under comprehensive component requirements



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# EGR System Monitoring (cont'd)

- Implementation
  - Required for the 2007 model year
  - Original proposal still required in 2010



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# EGR System Monitoring Approach

- 2007 Requirement
  - Compare target and actual flowrate and/or valve position using MAF sensor and/or valve position sensor
  - EGR Cooling System
    - Monitor cooling effectiveness using EGR temperature sensors or IMT sensors



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# EGR System Monitoring Approach (cont'd)

- 2010 Requirement
  - EGR Flowrate
    - Compare target and actual flowrate and/or valve position using MAF sensor and/or valve position sensor
  - Response Rate
    - Measure time to achieve desired flowrate using same sensors
  - EGR Cooling System
    - Monitor cooling effectiveness using EGR temperature sensors or IMT sensors



# Boost Pressure Control Monitoring

- Original Proposal: Require following faults to be detected before emissions exceed 1.5x standards:
  - Under and over boost malfunctions
  - Slow response (VGT systems only)
  - Charge air under cooling
  - Electronic components monitored under comprehensive component requirements

- Was required starting in 2011



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# Boost Pressure Control Monitoring (cont'd)

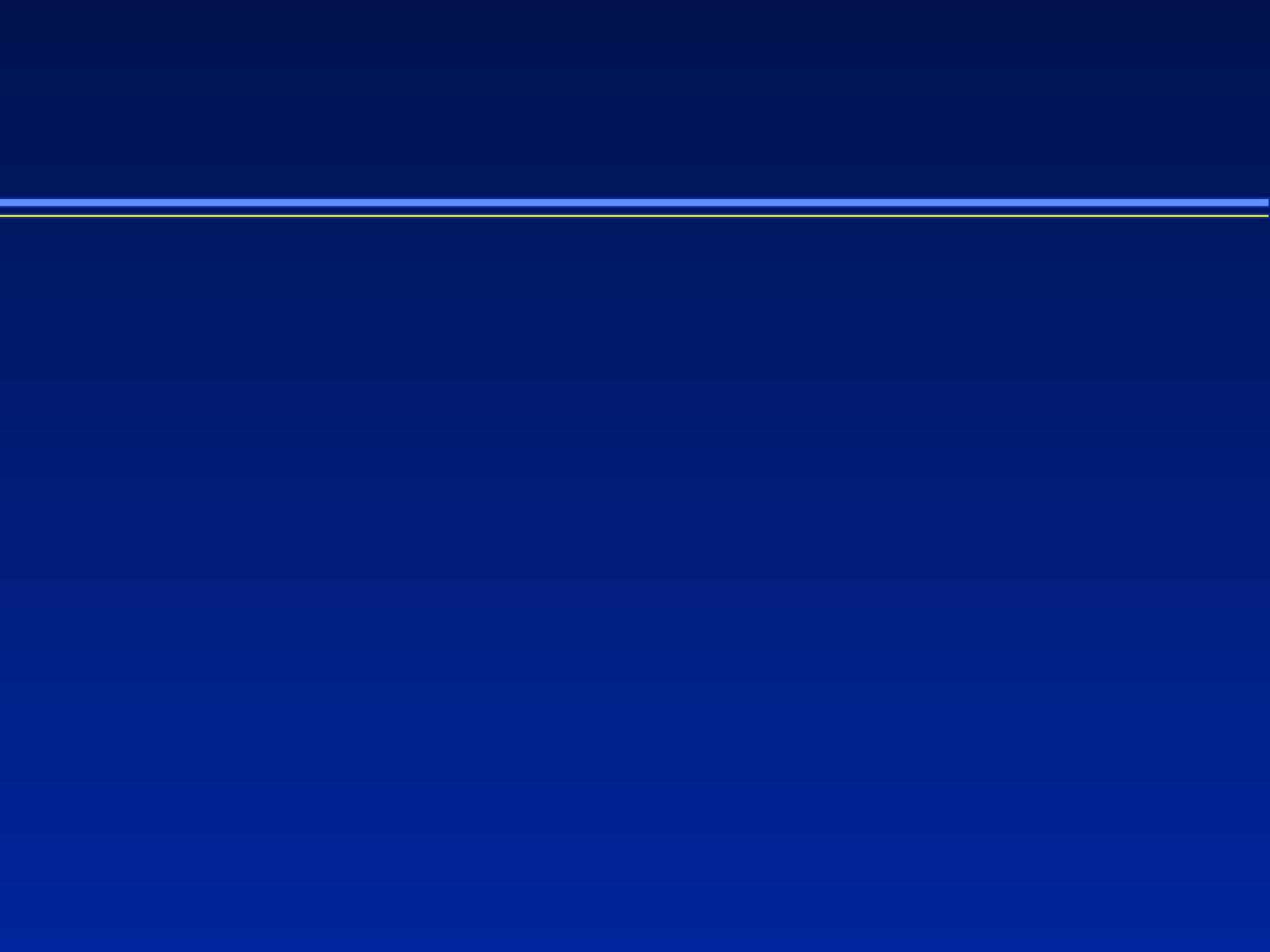
- Current Proposal:
  - Require a functional check of the boost pressure control system: detect a malfunction when the system has reached its control limits such that it cannot achieve the target boost pressure
  - Electronic components monitored under comprehensive component requirements
- Required for the 2007 model year
- Original proposal still required in 2010



# Boost Pressure Control Monitoring Approach

- 2007 Requirement
  - Compare target and actual boost pressure using boost pressure sensor
- 2010 Requirement
  - Under and over boost malfunctions
    - Compare target and actual boost pressure using boost pressure sensor
  - Slow response (VGT systems only)
  - Charge air under cooling
    - Monitor cooling effectiveness using IMT sensors





# Diesel Engine Aftertreatment Monitors

- Oxidation Catalyst
- Lean NOx Catalyst
- SCR Catalyst
- NOx Trap
- PM Trap



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# Oxidation Catalyst Monitoring

- Original Proposal: Require following faults to be detected before emissions exceed 1.75 x standards:
  - NMHC conversion
  - PM conversion
- Was required starting in the 2007 model year



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# Oxidation Catalyst Monitoring (cont'd)

- Current Proposal: Require a functional check of the oxidation catalyst system: signal a malfunction when no detectable amount of NMHC or PM conversion capability occurs
- Required for the 2007 model year
- Original proposal still required in 2010



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# Oxidation Catalyst Monitoring Approach

- 2007 Requirement
  - Exhaust Temperature sensor
- 2010 Requirement
  - Oxygen or A/F sensor



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# Lean NOx Catalyst Monitoring

- Original Proposal: Require following faults to be detected before emissions exceed 1.75 x standards:
  - NOx conversion
- Was required starting in the 2007 model year



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# Lean NOx Catalyst Monitoring (cont'd)

- Current Proposal:
  - Require a functional check of the lean NOx catalyst system: signal a malfunction when no detectable amount of NOx conversion capability occurs
  - Reductant injection monitoring
    - Confirm actual reductant
    - Monitor reductant level (empty tank) if separate tank is used
    - Confirm injection of desired quantity is achieved (closed-loop system only)



# Lean NOx Catalyst Monitoring (cont'd)

- Implementation
  - Required for the 2007 model year
  - Original proposal still required in 2010



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# Lean NOx Catalyst Monitoring Approach

- 2007 Requirement

- Functional check of lean NOx catalyst system
  - NOx sensor(s) or exhaust temperature sensor
- Reductant injection monitoring
  - Confirm actual reductant with a temperature sensor or NOx sensor
  - Reductant level sensor
  - Control limits of reductant injection system are reached

- 2010 Requirement

- Lean NOx catalyst performance calibrated to 1.75 x standards
  - NOx sensor
- Reductant injection monitoring



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# SCR Catalyst Monitoring

- Original Proposal: Require following faults to be detected before emissions exceed 1.75 x standards:
  - NO<sub>x</sub> conversion
- Was required starting in the 2007 model year



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# SCR Catalyst Monitoring (cont'd)

- Current Proposal:
  - Require a functional check of the SCR catalyst system: signal a malfunction when no detectable amount of NO<sub>x</sub> conversion capability occurs
  - Reductant injection monitoring
    - Confirm actual reductant
    - Monitor reductant level (empty tank) if separate tank is used
    - Confirm injection of desired quantity is achieved (closed-loop system only)
- Required for the 2007 model year
- Original proposal still required in 2010



# SCR Catalyst Monitoring Approach

- 2007 Requirement
  - Functional check of SCR catalyst system
    - NOx sensor/s or exhaust temperature sensor
  - Reductant injection monitoring
    - Confirm actual reductant with a temperature sensor or NOx sensor
    - Reductant level sensor
    - Control limits of reductant injection system are reached
- 2010 Requirement
  - SCR catalyst performance calibrated to 1.75 x standards
    - NOx sensors



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# NOx Trap System Monitoring

- Original Proposal: Require following faults to be detected before emissions exceed 1.5 x standards:
  - NOx trapping/adsorption
- Discern temporary loss of performance due to sulfur poisoning
- Was required starting in the 2007 model year



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# NOx Trap System Monitoring (cont'd)

- Current Proposal:
  - Require a functional check of the NOx trap system: detect a malfunction when no detectable amount of NOx trapping occurs
  - Discern temporary loss of performance due to sulfur poisoning from real malfunctions
- Required for the 2007 model year
- Original proposal still required in 2010



# NOx Trap System Monitoring Approach

- 2007 Requirement
  - Functional check of the NOx trap
    - NOx sensors or A/F sensors
- 2010 Requirement
  - NOx trap performance calibrated to 1.5 x standards
    - NOx sensors or A/F sensors



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# PM Trap Monitoring

- Original Proposal: Require following faults to be detected before emissions exceed 1.5 x standards:
  - Trapping Performance
  - Regeneration
- Was required starting in the 2007 model year



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# PM Trap Monitoring (cont'd)

- Current Proposal: Require a functional check of the PM trap system: signal a malfunction when no detectable amount of PM trapping or regeneration occurs
- Required for the 2007 model year
- Original proposal still required in 2010



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# PM Trap Monitoring Approach

- 2007 Requirement

- Functional check of the PM trap system

- Pressure sensors and/or temperature sensors to confirm trapping and regeneration

- 2010 Requirement

- Trapping performance calibrated to 1.5 x standards

- Pressure sensors

- Regeneration performance calibrated to 1.5 x standards

- Pressure sensors and/or temperature sensors



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# Cooling System Monitoring

- Required to monitor cooling system (e.g., thermostat, ECT sensor) for proper performance:
  - must reach minimum temperature necessary to enable other OBD monitors or any emission control strategy within a reasonable time
  - must reach near thermostat-regulating temperature within a reasonable time



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# Cooling System Monitoring (cont.)

- Will likely require engine manufacturers to have upper and lower bounds on cooling system-build specs provided to coach builders
- May require engine manufacturers to set upper and lower bounds on amount of heat that coach builders may take out of system during warm-up



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# Comprehensive Component Monitoring

- Required to monitor electronic powertrain components that:
  - can cause a measurable emissions increase during any reasonable driving conditions, OR
  - are used for other OBD monitors
- Required to monitor input components for circuit and rationality faults
- Required to monitor output components for functional faults
- Monitors not tied to emission thresholds



# Comprehensive Component Monitoring (cont.)

- Engine manufacturer, transmission manufacturer, and other powertrain system suppliers (e.g., hybrid powertrain supplier) will each need to monitor all components it uses/commands (e.g., electronic components)



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