Nonroad Mobile Source Compliance Management Program in the U.S.

The 4th SINO-US Workshop on Motor Vehicle Pollution Prevention and Control

U.S. Environmental Protection Agency
Office of Transportation and Air Quality

Nonroad Diesel Engines

- Sector encompasses engines used in non-road equipment, including stationary applications
  - Engines are certified independent of equipment
  - Sizes range from less than 8 kW up to 4 MW
  - Broad mix of technologies – mechanical and electronic fuel control, aftertreatment
- Sector represents 10% of the total mobile-source emissions (combined pollutants – 2009 data)
- Comparatively large number of manufacturers
  - 60+ engine manufacturers and production volumes exceeding 1M units each year
  - More than 65% of volume is produced outside the U.S.
  - 550+ certificates issued each year
  - 1000+ equipment manufacturers participating in Transition Program for Equipment Manufacturers (TPEM)
Wide Range of Diesel Equipment

- genset 15 kW
- skid steer loader 60 kW
- 2WD tractor 97 kW
- light tower 7 kW
- backhoe loader 60 kW
- combine 212 kW
- utility vehicle 13 kW
- mining truck 746 kW

Phase-In of Nonroad Diesel Engine Programs

- Tier 1: Similar to highway 1998
- Tier 2: Similar to highway 2004
- Tier 3: Early Tier 4 focused on smaller engines
- Tier 4
  - "interim" focused on NOx
  - "final" focused on NOx
  - Similar to highway 2007-2010 (advanced aftertreatment)
**Land-Based Nonroad Standards**

Standards shown here represent 130-560 kW engines. Standards and implementation dates vary by engine power.

**Phase-In to Nonroad Diesel Tier 4**

- **<19 kW**: 2008 (no AT) △ DPFs expected △ NOx aftertreatment (AT) expected
- **19-56 kW**:
  - 2008 (no AT) △ Tier 4f (no NOx AT)
  - today
- **56-130 kW**: △ Tier 4i △ Tier 4f
- **130-560 kW**: △ Tier 4i △ Tier 4f
- **>560 kW**: △ Tier 4i △ Tier 4f

- >900 kW gensets only
- <900 kW gensets too

June 10, 2014 U.S. Environmental Protection Agency 5
Transition Program for Equipment Manufacturers (TPEM)

• Typically, if new engine-based emission standards apply in a given model year, equipment manufactured in that calendar year must have engines certified to the new standards
  – Given significant engine design changes with transition to Tier 4 (i.e., addition of aftertreatment controls), was important to provide time/flexibility to downstream equipment manufacturers to adapt their equipment designs
• TPEM allows nonroad equipment manufacturers to produce equipment with engines subject to less stringent emission standards after the Tier 4 emission standards begin to apply
  – Flexibility provided over a 7 year transition period
  – Manufacturers given a certain number of previous Tier engine allowances to manage over transition period (e.g., 700 units or 80 percent of production)
  – Enables manufacturers to focus redesign efforts on most critical equipment models first
• Absent such a flexibility program, would likely have needed to adopt delayed regulatory schedule for implementing Tier 4 emission standards

How OTAQ Ensures Compliance

OTAQ makes use of multiple compliance tools within our regulatory framework

• Prior to engine production
  – Detailed review of manufacturers’ application for certification
  – Ensure pollution prevention through proper emission control design
  – Confirmatory testing
    • Ensure test results for certification engines are accurate
  – Review of reporting results and compliance testing performance from previous model years
• At time of engine production
  – Selective enforcement audits (SEAs) of manufacturers’ engine production lines
  – Ensure conformity of production engines to certification engine/application
  – Includes audit of manufacturers’ labs to ensure compliance with testing requirements
• After engine introduced into commerce
  – EPA-run in-use testing (engine dynamometer and in-situ PEMS)
  – Ensure engines comply with standards in real-world operating conditions (field testing)
  – Emission-related defect and recall reporting
    • Ensures emission defects identified and corrected as needed
    • Provides poor quality deterrent and encourages future improvements
Diesel Engine Compliance Program

- EPA Issues Certificate of Conformity
- EPA Follow-up (Defect and Recall Reports, Mfr. In-Use Testing, EPA Testing)
- EPA Test Data Review/Analysis
- CARB Coordination (Warranty Reporting)
- OECA Coordination (Enforcement)
- PLT, TPEM, ABT, and Production Report Review

EPA Confirmatory Testing
EPA Review of Manufacturer Application
EPA Selective Enforcement Audit
EPA In-Use Surveillance Testing

End of Useful Life (Varies by subsector)

- Pre-Production Certification Process
  - Review information requirements
    - Emissions data collected over appropriate test cycles
      - Nonroad Transient Cycle (NRTC) – transient test (cold/hot starts)
      - Discrete-Mode or Ramped Modal Cycle (NRSC) – steady-state test (hot starts)
    - Not-to-Exceed (NTE) testing
      - Engine speed/load conditions not represented above
      - Expanded ambient conditions
    - Infrequent regeneration adjustment factors
    - Deterioration factors
      - Service accumulation over portion of regulatory useful life
      - In-use representative durability cycle
    - Emission control strategies (Auxiliary Emission Control Devices or AECDs)
      - For strategies that reduce effectiveness of emission controls, manufacturers must justify why they are approvable (i.e., not a defeat device)
        - Substantially included in a test cycle
        - Limited to engine starting only
        - Necessary for engine/equipment protection (for operation outside the NTE zone)

Full Useful Life:
- On-highway: up to 10 years / 435,000 miles
- Nonroad: up to 10 years / 8,000 hours
- Marine: up to 10 years / 20,000 hours
- Locomotive: up to 10 years / 32,000 MW-hours

Pre-Production Certification Process

- Review information requirements
  - Emissions data collected over appropriate test cycles
    - Nonroad Transient Cycle (NRTC) – transient test (cold/hot starts)
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  - Not-to-Exceed (NTE) testing
    - Engine speed/load conditions not represented above
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5
Certification Test Cycles

NRTC

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NTE Control Area

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Pre-Production Certification Process (cont.)

- Adjustable parameters
  - Ensure against tampering outside of compliant settings
- Maintenance intervals
- On-board diagnostics (OBD)
  - Not applicable for nonroad engines
- Collect application fees
  - EPA collects fees for each certificate issued
  - Allows EPA to recover reasonable costs associated with certification and compliance
- Issue certificate of conformity

Confirmatory Testing

- Manufacturers do bulk of emission certification testing at their labs
- EPA audits (or confirmatory tests) a subset of those engines at NVFEL, contract labs, or manufacturers labs
  - Provides manufacturers incentive to perform accurate tests
- Tests conducted
  - Nonroad Transient Cycle (NRTC) – transient test (cold/hot starts)
  - Discrete-Mode or Ramped Modal Cycle (NRSC) – steady-state test (hot starts)
  - Not-to-Exceed (NTE) testing
- If manufacturer fails confirmatory test, certificate of conformity is withheld until manufacturer addresses root cause of noncompliance
Selective Enforcement Audits (SEAs)

- EPA selects engines off the manufacturers production line for emission testing
  - Typically requires testing of 5-6 engines minimum to come to pass/fail decision
  - Ensures that production engines comply with emission standards and conform to the engine design indicated in the certification process
  - Provides a measure of production variability
  - Allows for audits of manufacturers test labs
  - If manufacturer fails SEA, certificate of conformity can be suspended until manufacturer addresses root cause of noncompliance
- Note: Certificates are conditioned upon manufacturers granting EPA access to production facilities to conduct audits

Production Line Testing (PLT)

- Manufacturer-run version of SEAs
  - Not applicable for land-based nonroad industry
- Manufacturer selects engines off their production line for emission testing throughout the year
  - Sample size is typically small percentage (e.g., 1%) of U.S.-directed production
  - Ensures that production engines comply with emission standards and conform to the engine design indicated in the certification process
  - Provides a measure of production variability
  - If manufacturer fails PLT, certificate of conformity can be suspended until manufacturer addresses root cause of noncompliance

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In-Use Testing

• EPA’s evaluation of engine compliance extends beyond the pre-production certification process to ensure engines comply with emission standards during their full useful life

• Manufacturer-run in-use
  – Under the program, manufacturers test fleet or customer-owned in-use equipment
  – No program currently in place nonroad industry – currently discussing schedule for development with industry

• EPA-run in-use
  – EPA procures and tests nonroad equipment already introduced into commerce
  – Includes in-situ testing (PEMS) as well as pulling engines for lab testing
    – EPA will be starting in-situ testing of nonroad equipment this year

• If manufacturer fails any testing, EPA can order recall of engines introduced into commerce

Emissions Warranty and Defects

• Emissions Warranty
  – Manufacturers must warrant the following to purchasers regarding engine and all parts of its emission-control system:
    • It is designed, built, and equipped so it conforms at the time of sale to applicable regulations
    • It is free from defects in materials and workmanship that may keep it from meeting applicable regulations
  – Warranty period: up to 3,000 hours / 5 years

• Emission-related defects
  – Manufacturers must investigate any indication that engines introduced into commerce have incorrect, improperly installed, or otherwise defective emission-related component
    • Includes defects in design, materials or workmanship
    • Must file reports for defects affecting typically 20 or more engines
  – Can lead to EPA ordering recalls by manufacturer if determined that a substantial number of properly maintained and used engines do not conform to regulations during their useful life
    • Manufacturer required to submit plan to remedy nonconformity
    • Manufacturer encouraged to conduct voluntary recalls
Compliance Reporting

- Manufacturers are required to report certain information to EPA on a periodic basis
- Examples:
  - Engine Production Volume Reports (Annual)
  - Emissions Averaging, Banking, and Trading Reports (Annual)
  - Defect / Voluntary Recall Reports
- EPA audits information to ensure conformance to regulatory requirements
  - Delinquent reporting can result in denial of certification in future model years

Interacting with Regulated Manufacturers

- Providing compliance assistance to industry is critical to ensuring that products comply throughout their useful life
- Recommendations:
  - Annual certification preview meetings with manufacturers
  - Regular interactions throughout the year
    - Conference calls
    - Exchanges of information by e-mail
  - Issuance of guidance documents
    - See http://www.epa.gov/otaq/cert/dearmfr/dearmfr.htm for examples
  - Intermittent workshops or web-conferences
Strategy to Address Growth in Size and Complexity of Program

- Prioritize work using risk-based approach
- Establish agile strategy that periodically shifts focus among sectors and compliance activities
- Target compliance activity on emerging as well as traditional priorities
- Use technology to automate and streamline certification and record-keeping processes
- Work early and collaboratively with stakeholders to establish guidance and policy, and to provide technical assistance
- Use tracking and reporting to inform public about compliance results

Appendix
Recent Compliance Issues

• Nonroad engine confirmatory testing
  – Validates (or refutes) results submitted by engine manufacturer at time of certification
  – Prevents non-compliant engines from making their way into the marketplace – certificates are not issued
  – Important for engines that may be difficult to track down in the field for recall purposes
  – Especially important for new entrants that have not been subject to EPA regulation or testing

• Results from recent testing:
  – Indicate that particular manufacturers are submitting false results in their certification applications
  – Some manufacturers choose not to certify engine families after test orders are issued
  – Other manufacturers exit the market under one company name and attempt to certify the same engine under a different company name – necessitates vigilance in testing

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U.S. Environmental Protection Agency

SCR-Related Issues

• EPA has developed guidance regarding proper maintenance and adjustment of SCR systems
  – Diesel Exhaust Fluid (DEF) level monitoring and low level inducements
    • Warn operators of low DEF level and provide inducements (e.g., vehicle speed limitation, engine shutdown) to ensure DEF tanks are refilled
  – DEF quality monitoring and poor quality inducements
    • Warn operators of poor quality DEF and provide inducements (e.g., vehicle speed limitation, engine shutdown) to ensure appropriate specification DEF is utilized
  – SCR component tampering and inducements
    • Alert operators of SCR component tampering (e.g., disconnected dosing module) and provide inducements (e.g., vehicle speed limitation, engine shutdown) to problems are fixed

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SCR-Related Issues

- **DEF Infrastructure**
  - Addressed with manufacturer at time of certification
  - Ensure reducing agent available at dealerships and truck-stops or non-road distributors
  - Have a back-up plan, such as a toll-free phone number, if customers are unable to obtain DEF
  - Education and outreach for potential owners and service industry

- **DEF Quality**
  - Manufacturers adopted ISO 22241-1 quality standard for DEF
  - API DEF Quality Licensing Program widely utilized
    - Includes audit and enforcement functions
    - www.apidef.org