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)

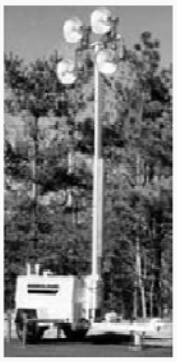
Wide Range of Diesel Equipment

genset 15 kW

skid steer loader 60 kW

2WD tractor 97 kW

light tower 7 kW



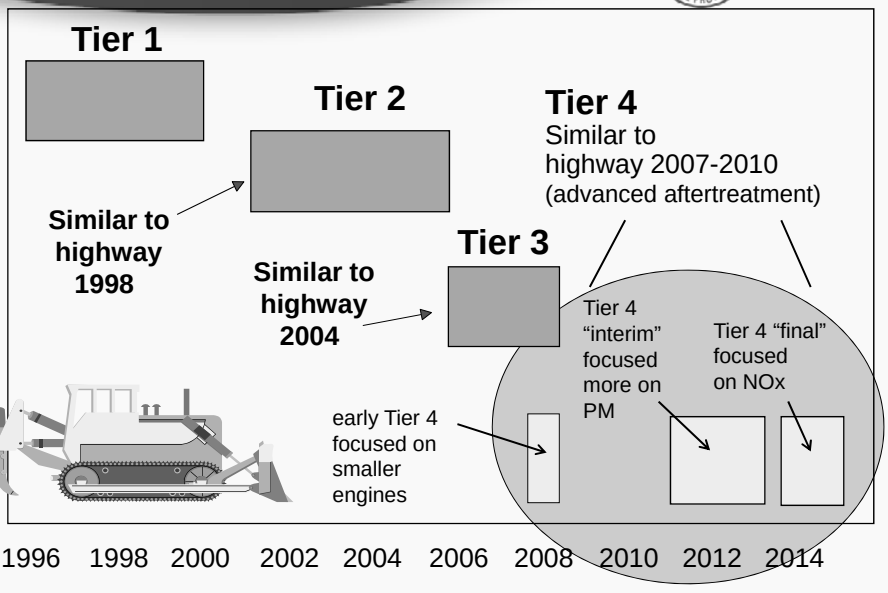
backhoe loader 60 kW

combine 212 kW

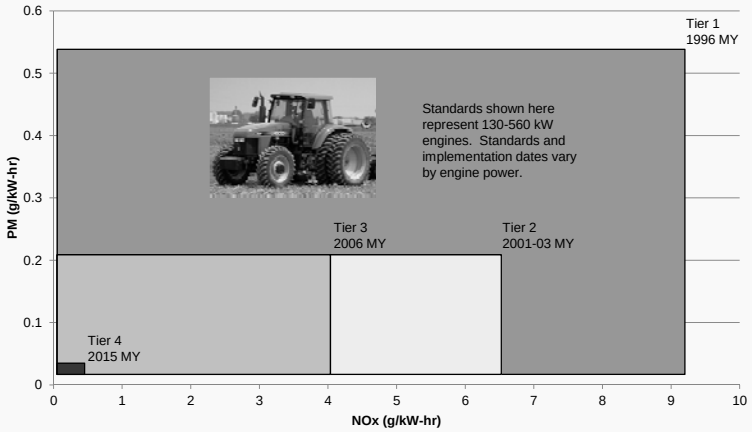
utility vehicle 13 kW

mining truck 746 kW

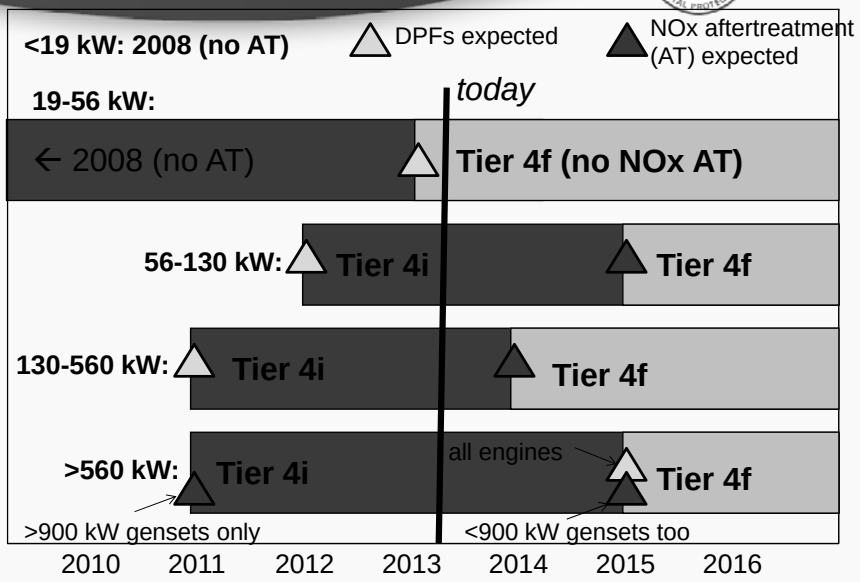
Phase-In of Nonroad Diesel Engine Programs



Land-Based Nonroad Standards



Phase-In to Nonroad Diesel Tier 4



Transition Program for Equipment Manufacturers (TPEM)

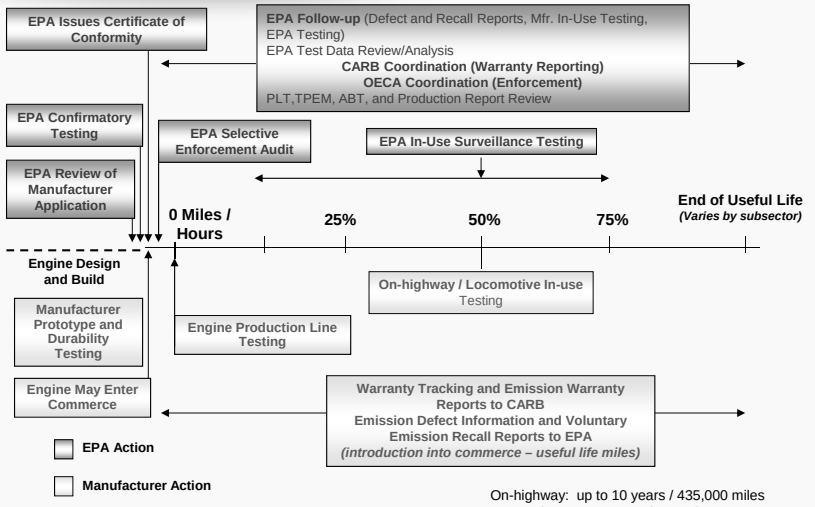
- Typically, if new engine-based emission standards apply in a given model year, equipment manufactured in that calendar year must have engines certified to the new standards
  - Given significant engine design changes with transition to Tier 4 (i.e., addition of aftertreatment controls), was important 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



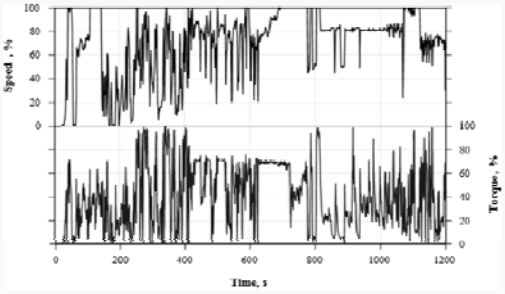
Full Useful Life:

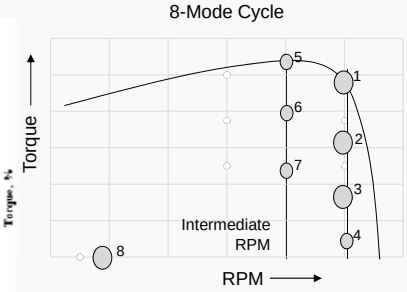
On-highway: up to 10 years / 435,000 miles
Nonroad: up to 10 years / 8,000 hours
Marine: up to 10 years / 20,000 hours
Locomotive: up to 10 years / 32,000 MW-hours

Pre-Production Certification Process

- Review information requirements
  - Emissions data collected over appropriate test cycles
    - Nonroad Transient Cycle (NRTC) – transient test (cold/hot starts)
    - 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)

Certification Test Cycles

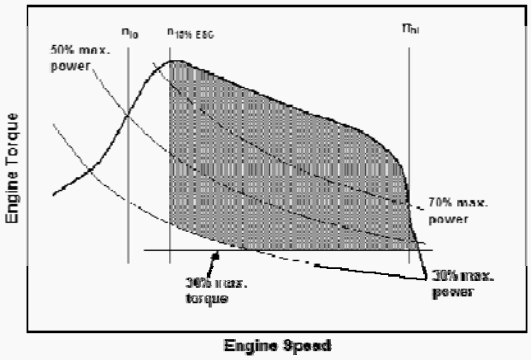




NRTC

NRSC

NTE Control Area



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

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

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

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