


“EPA Nonroad Engine Programs” as presented  
to the Mobile Sources Technical Review  
Subcommittee on 4/12/00




# EPA Nonroad Engine Programs

## Office of Transportation and Air Quality

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## Overview

- Nonroad Engine Categories
- Aircraft
- Locomotives
- Statutory authority for other nonroad programs
- Lawn & garden engines
- Marine engine programs
- Industrial SI engines
- Recreational engines
- Nonroad diesel

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## Nonroad Engine Categories

Category	Sales per year	Final Rules
Aircraft engines	1,000	1982, 1997
Land-based nonroad diesel	360,000	1994, 1998
Locomotives	600	1998
Marine diesel --commercial	15,000	1999
Marine SI --outboard &PWC	800,000	1996
Recreational marine --diesel and SD/I gasoline	120,000	2001
Lawn & Garden SI < 19 kW	15,000,000	1995, 1999
Industrial SI > 19 kW	150,000	2001
Recreational vehicles --snowmobiles, motorcycles	800,000	2001

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## Aircraft Emission Standards

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## Aircraft Authority

- CAA section 231 gives EPA authority to set emission standards
- CAA section 232 gives FAA authority to enforce these standards
- CAA section 233 preempts states from setting aircraft standards


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## Aircraft Emission Standards

- HC, NO<sub>x</sub>, and CO standards are for jet engines greater than 26.7 kilonewtons of thrust (most mid to large commercial engines)
- Smoke standards for jet and turboprop engines
- EPA aligned with international standards (ICAO) in 1997.
  - HC standards for all engines produced after 1983 (already adopted by EPA)
  - CO standards for all engines produced after July 1997
  - NO<sub>x</sub> standards for newly designed engines after 1995 and all engines produced after 2000
- More stringent NO<sub>x</sub> standards adopted by ICAO in 1999, to be implemented for newly designed engines after 2003
  - We plan to align with these standards in the future

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# Locomotive Emission Standards

## Final Rule April 1998

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# Emission Standards

- Three tiers of standards:
  - Tier 0: Applies to 1973 - 2001 MY locomotives when they are remanufactured (33 % NOx reduction)
  - Tier 1: Applies to new 2002 - 2004 MY locomotives (48 % NOx reduction)
  - Tier 2: Applies to new locomotives 2005 MY and later (62 % NOx reduction; 50 % HC and PM reduction)
  
- Standards apply for whole service life, including remanufacturing

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## Compliance Program

- Production-line testing
  - Manufacturers routinely test production engines to show compliance
- In-use testing
  - Manufacturers must test a sampling of their locomotive engines at 50 to 75 percent of the useful life
  - Large railroads must test some of their locomotives at or beyond the useful life
- Final rule clarified the Act’s preemption of certain state and local emission control requirements

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## Statutory Authority

- Section 213(a)(1) of the Act requires that EPA study the emissions from all categories of nonroad engines and equipment to determine whether these emissions “cause or significantly contribute to air pollution which may reasonably be anticipated to endanger public health and welfare.”
- Section 213(a)(2) further requires EPA to determine whether the emissions of CO, VOC, and NOx found in the above study significantly contribute to ozone or CO concentrations in more than one ozone or CO nonattainment area.

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## Statutory Authority, cont.

- EPA completed this study in 1994, concluding that NO<sub>x</sub>, HC, and CO emissions from nonroad engines contribute significantly to ozone and CO concentrations in more than one nonattainment area.
- Given this determination, EPA must set emission standards for those classes or categories of new nonroad engines that cause or contribute to such air pollution.
- EPA has completed this finding for every nonroad category except two:
  - Industrial SI engines
  - Recreational SI engines

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## Small SI Engines

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## Small SI Final Rules

- EPA adopted Phase 1 standards in 1995
  - standards didn't consider deterioration
  
- Nonhandheld Phase 2 final rule adopted March 1999
  - Emissions reduced 60 percent below Phase 1 levels
  - Standards based on full-life emissions
  
- Handheld Phase 2 final rule adopted March 2000
  - Emissions reduced 70 percent below Phase 1 levels
  - Standards based on full-life emissions

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## Commercial Marine Diesel Engines

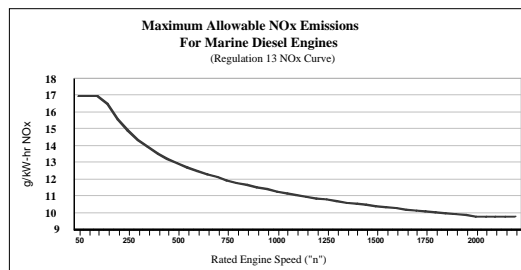
- IMO MARPOL Annex VI
- U.S. EPA Final Rule

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## CI Marine--MARPOL

- MARPOL Annex VI was adopted by IMO in September 1997 for marine diesel engines over 130 kW
  - The Annex will go into force internationally when 15 states representing 50% of the gross tonnage of the world’s merchant shipping have ratified it
- The Regulation 13 engine emission limits are only for NOx
  - Applicable to (1) Engines installed on vessels constructed on or after 1 January 2000, and (2) Engines that undergo a major conversion on or after 1 January 2000



## CI Marine--EPA

- EPA’s national marine diesel engine requirements:
  - Final Rule published 12/29/99 for engines over 37 kW (64 FR 73300)
  - Smaller marine diesel engines were in the nonroad diesel Tier 2 rule (10/23/98; 63 FR 56967)
- This applies to new engines installed on U.S.-flagged vessels
  - Up to 30 liters/cylinder
  - Commercial only
  - Propulsion and auxiliary
- This doesn’t apply to:
  - Engines made before the standards apply (most remanufacturing is unaffected)
  - Recreational engines
  - Engines on foreign-trade vessels



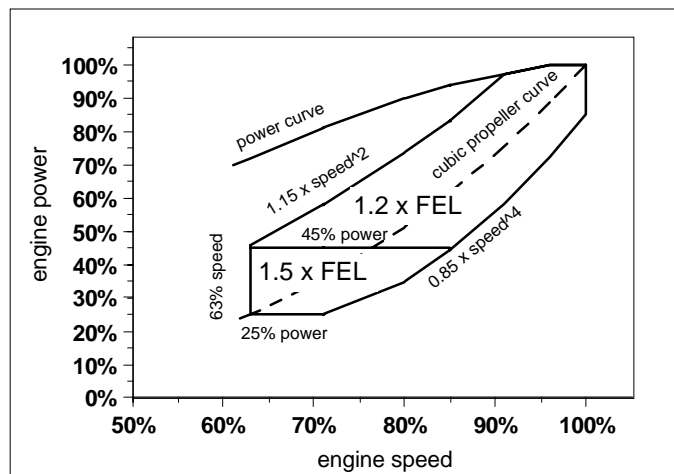
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## EPA--Emission Standards

- Category 1
  - All new engines < 5 liters/cylinder
  - Standards comparable to land-based Tier 2 levels
- Category 2
  - All new engines 5 to 30 liters/cylinder
  - Standards comparable to locomotive levels
- Includes not-to-exceed provisions
- Estimated reductions:
  - 24 percent NOx
  - 12 percent PM


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## Illustration of Not-to-Exceed Zone



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## Recreational Marine NPRM

Due November 17, 2000

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## Recreational Marine



- Recreational diesel:
  - Aiming for technologies comparable to commercial marine
    - » Optimized fuel injection, turbocharging, improved aftercooling
- Sterndrive and inboard gasoline
  - Test program will evaluate potential for electronic fuel injection, EGR, and small catalyst
- Not-to-exceed testing and standards based on development testing
- Lots of small business issues
  - Allow for simplified certification, flexibility on lead time

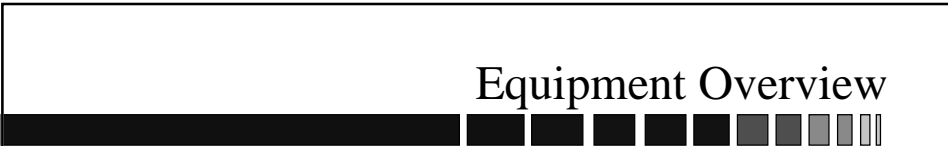
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## Large SI NPRM: Due September 29, 2000

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## Equipment Overview

- Equipment types:
  - forklifts, airport equipment, sweepers, aerial lifts
  - generators, pumps, compressors, saws, chippers
- Engine types
  - Large majority are derived from automotive engines
  - A few are air-cooled industrial engines
- Fuel types
  - 70 percent of engines use LPG
  - Gasoline is the alternative fuel
  - Fuel conversions and dual-fuel engines are common

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## Regulatory History

- California ARB adopted a final rule in October 1998
  - 3 g/hp-hr NO<sub>x</sub>+NMHC standard phases in from 2001 through 2004
  - Projected technology includes electronic fuel systems with 3-way catalyst
  - Compliance program includes production-line and in-use testing by manufacturers
- EPA proposal will likely be consistent with ARB, with a few remaining issues
- Anticipating 80 to 90 percent reduction (NO<sub>x</sub> + HC)


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## Remaining Major Issues

- Level of the standards
- Transient duty cycle
- Not-to-exceed provisions
- Basic engine diagnostics
- Evaporative emissions

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## Land-based Recreational Engines

NPRM Due September 29, 2000

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## Background

- Three main types of recreational vehicles
  - Off-Road Motorcycles
  - All-Terrain Vehicles
  - Snowmobiles
  
- California has adopted emission standards for motorcycles and ATVs--not for snowmobiles
  
- Anticipated control technologies:
  - Upgrading two-stroke engines to direct injection
  - Converting to four-stroke technology

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## Emission Contribution

- EPA’s proposed finding estimated recreational vehicle contribution to be 10 to 20 percent of mobile source CO and VOC
  - Commenters suggested changes that would reduce emission estimates
  
- Other environmental problems are also prominent
  - Personal exposure to CO and toxic emissions
  - High PM emission rates from two-stroke engines
  - Snowmobile emissions degrade water quality

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## Rulemaking Issues

- Adopt chassis-based test and standards for motorcycles?
- Match stringency of existing standards?
  - EPA highway or California nonroad
- Adopt different standards for snowmobiles and motorcycles/ATVs?
- Exemptions for competition models?
  
- Outreach to users will be essential

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## Contacts

- For additional information--
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  - Recreational vehicles: [wehrly.linc@epa.gov](mailto:wehrly.linc@epa.gov)
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