Recreational Marine Engines

Nonroad Large SI Engines

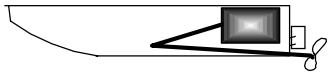
Office of Transportation and Air Quality

January 2001

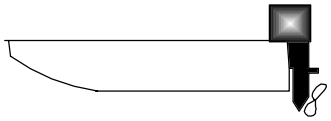
Recreational Marine

(Rulemaking **will not** include outboards/personal watercraft)

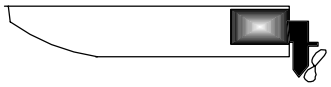
inboard
(direct drive)



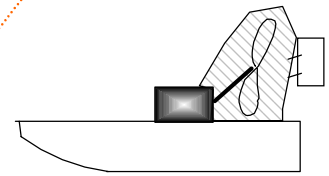
inboard
(with V-drive)



outboard



stemdrive
(inboard/outboard)



air boat

jetdrive
(used in personal watercraft)

Marine--Regulatory History

- We proposed standards for all marine engines in 1994
  - 1996 final rule included standards only for outboard and personal watercraft
  - Sterndrive/Inboard excluded from 1996 rule
    - they appeared to be a clean alternative to outboards
    - technology for reducing emissions needed further investigation
- We finalized standards for commercial marine diesel engines in 1999
  - Recreational engines excluded for concern over small-business impacts and greater design challenge
- California ARB aiming for final sterndrive/inboard standards in Spring 2001

Marine--Product Overview

- Annual sales mix
  - recreational marine diesel: 11,000
  - sterndrive/inboard gasoline: 110,000
- Many recreational boats come with gasoline/diesel option
  - regulating both at same time maximizes ability to consider competitive issues
- Engine manufacturing
  - Diesel: adjusted calibration is the only difference from commercial marine engines, which are also used in land-based applications
  - Gasoline: most manufacturers make dedicated marine engines by marinizing base automotive engines
- Scope
  - Gasoline engines would also include jet boats and airboats
  - Need to refine personal watercraft definition to separate them from larger craft included in this proposal

Marine Diesel Issues

- **Standards**: data support proposing emission standards from the commercial marine diesel final rule
  - 7.2 to 7.5 g/kW-hr HC+NOx, 0.2 to 0.4 g/kW-hr PM
- **Lead time**: may need additional lead time beyond 2004, when standards start for most commercial marine diesel engines
- **Compliance program**: most provisions would match those for commercial marine diesel engines
- **Off-cycle**: requesting comment on not-to-exceed provisions
- **Useful life**: typical lifetime is 500 hours or more

Sterndrive/Inboard Issues

- **Emission standards**: requesting comment on standards with and without catalysts (5 to 10 g/kW-hr HC + NOx)
- **Lead time**: Requesting comment on implementing standards in 2005 or 2006 model year
- **Off-cycle**: requesting comment on not-to-exceed provisions
- **Useful life**: typical lifetime is 500 hours or more
- **Small business provisions**: most engine marinizers and boat builders qualify as small businesses
- **Evaporative emissions**: requesting comment on controlling gasoline vapor losses

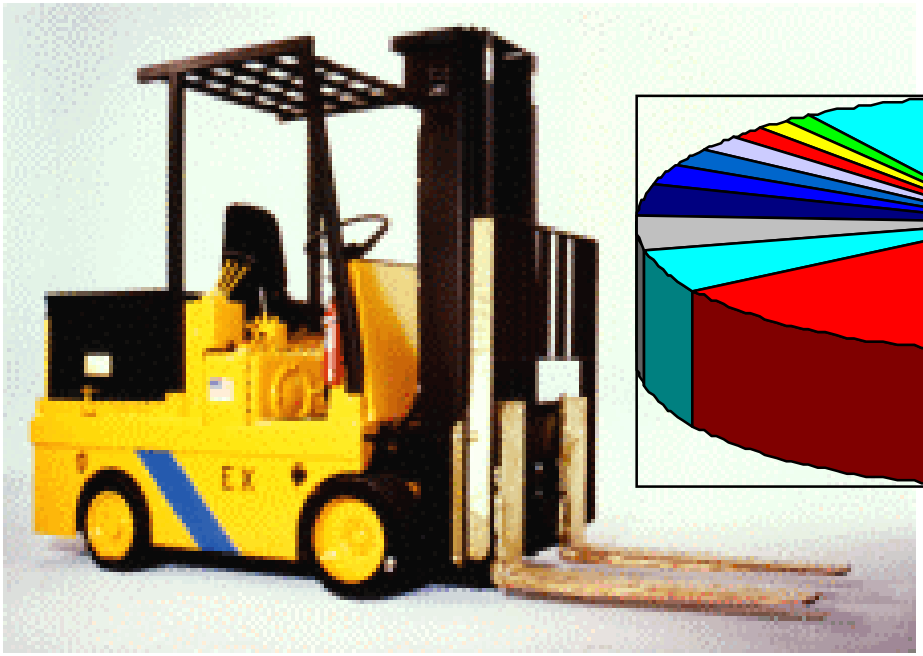
Large SI

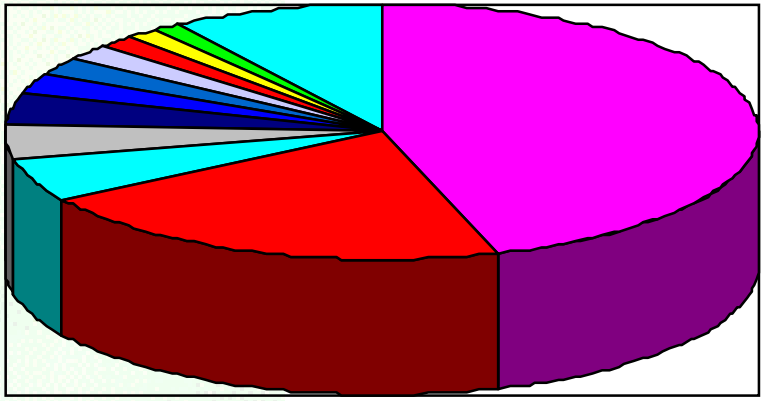
Large SI--Product Overview

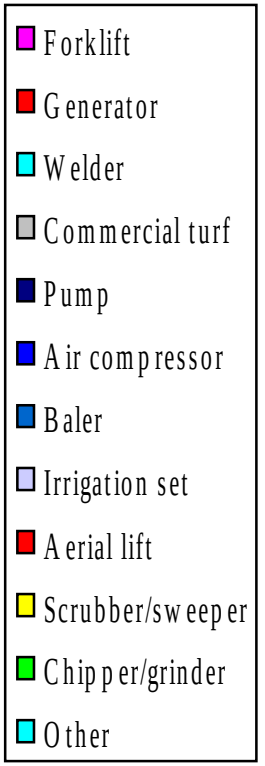
- Equipment types:
  - Vehicles: forklifts, airport equipment, sweepers
  - Portable equipment: generators, pumps, compressors, saws
- Engine types
  - Most are derived from automotive engines
  - A few are air-cooled industrial engines--more challenging to control
- Fuel types
  - 70 percent of engines use LPG
  - Most of the rest are gasoline-fueled
  - Fuel conversions and dual-fuel engines are common

Large SI--Applications

Total annual sales = 100,000







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Large SI--Regulatory History

- California ARB adopted a final rule for Large SI engines in October 1998
  - 4 g/kW-hr NOx+NMHC standard phases in from 2001 through 2004 (50 g/kW-hr CO)
  - Standards were set to ensure feasibility based on limited deterioration data
  - Projected technology includes electronic fuel systems with 3-way catalyst
  - Compliance program includes production-line and in-use testing by manufacturers

Large SI Issues

- **Emission standards**:
  - Propose California ARB standards for 2004 model year
  - Data show engines can meet more stringent standards
  - Aiming to propose 1.5 to 2.5 g/kW-hr HC+NOx standard for 2007 model year
- **Test procedure**: developing transient duty cycle
  - testing over normal forklift operation shows high emissions variability
- **Off-cycle**: potential not-to-exceed provisions would be tailored to Large SI technology/operation
- **Diagnostics**: pursue basic engine diagnostics to keep engines at stoichiometry
- **Evap**: explore possible steps to address evaporative emissions
  - fuel boiling, diurnal losses, fuel permeation