

**Summary and Analysis of Comments:  
Control of Emissions of Air Pollution  
from Locomotive Engines and Marine  
Compression Ignition Engines Less than  
30 Liters Per Cylinder**

**Summary and Analysis of Comments:  
Control of Emissions of Air Pollution  
from Locomotive Engines and Marine  
Compression Ignition Engines Less than  
30 Liters Per Cylinder**

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



## TABLE OF CONTENTS

Index of Proposal Commenters	iv
List of Acronyms	viii
1. General	1-1
2. Air Quality and Health Impacts	2-1
3. Emission Standards	3-1
4. Certification and Compliance Program	4-1
5. Costs and Economic Impacts	5-1
6. Benefits	6-1
7. Small Businesses/SBREFA Process	7-1
8. Administrative Requirements and Legal Authority	8-1
9. Marine Remanufacturing Concept	9-1
10. Technical Feasibility	10-1
11. Other	11-1

## INDEX OF PROPOSAL COMMENTERS

<b>Commenter</b>	<b>Abbreviation</b>	<b>Docket ID Number</b>
Aabenraa Motorfabrik		OAR-2003-0190-0549— 0549.3
Alexander/Ryan Marine & Safety Co.		OAR-2003-0190-0661
American Lung Association	ALA	OAR-2003-0190-0592.1 <sup>1</sup> , 0728 <sup>2</sup> , (hearing: OAR- 2003-0190-0509)
American Lung Association of the Northwest	ALA	(hearing: OAR-2003- 0190-0482)
American Lung Association of Metropolitan Chicago		(hearing: OAR-2003- 0190-0518)
American Short Line Railroad Association	ASLRRRA	OAR-2003-0190-0560.1
American Waterways Operators	AWO	OAR-2003-0190-0574.1, 0725 (reman) (hearing: OAR-2003- 0190-0519)
Argillon LLC		(hearing: OAR-2003- 0190-0515, 0515.1)
Association of American Railroads	AAR	OAR-2003-0190-0566.1 (hearing: OAR-2003- 0190-0479, 0510)
ASTM International		OAR-2003-0190-0464, 0465
Baylink Ferry/City of Vallejo		OAR-2003-0190-0581, 0581.1
Bollinger Shipyards Lockport, LLC		(hearing: OAR-2003- 0190-0520)
California Air Resources Board	CARB	OAR-2003-0190-0596.1, 0719 (duplicate)
Carolinas Clean Air Action		OAR-2003-0190-0592.1 <sup>1</sup>
Caterpillar, Inc.		OAR-2003-0190-0580.1, 0591.1 (hearing: OAR- 2003-0190 -0485, -0498)
Chromium Corporation		OAR-2003-0190-0651
CIMAC (Intl. Council on Combustion Engines)		OAR-2003-0190-0548.1
Citizen Action Illinois		OAR-2003-0190-0592.1 <sup>1</sup>
Citizens for Pennsylvania's Future	PennFuture	OAR-2003-0190-0592.1 <sup>1</sup>
Clean Air Task Force	CATF	OAR-2003-0190-0592.1 <sup>1</sup> , (hearing: OAR-2003- 0190-0499)
Clean Air Watch		OAR-2003-0190-0592.1 <sup>1</sup> , 0728 <sup>2</sup> , (hearing: OAR- 2003-0190-0500)
Clean Water Action (National, MA, CT, PA, RI)		OAR-2003-0190-0592.1 <sup>1</sup>
Coalition of Aftermarket Rail and Marine Engine Suppliers	CARMES	OAR-2003-0190-0650
Columbia River Gorge Commission		OAR-2003-0190-0516

<sup>1</sup> Comment OAR-2003-0190-0592.1 was jointly submitted.

<sup>2</sup> Marine remanufacturing comments OAR-2003-0190-0728 were jointly submitted by the American Lung Association, Clean Air Watch, Environmental Defense, and Natural Resources Defense Council.

Commission Centrale pour la Navigation du Rhine	CCNR	OAD-2003-0190-0715
Crowley Maritime Corporation		EPA-HQ-OAR-2003-0190-0641, 0659 (duplicate)
Cummins, Inc.		OAR-2003-0190-0559.1, 0653 (duplicate), 0731 (reman), (hearing: OAR-2003-0190-0501)
Department of Defense (DoD) Clean Air Act Services Steering Committee	CAA SSC	OAR-2003-0190-0568.1
Electro-Motive Diesel, Inc.	EMD	OAR-2003-0190-0594.1-0594.4, 0662, Reman: 0729, (hearing: OAR-2003-0190-0502)
Elliot Bay Design Group		(hearing: OAR-2003-0190-0486)
Engine Manufacturers Association	EMA	OAR-2003-0190-0569.1, 0570.1, 0571.1, 0575.1, 0577.1, 0578.1, 0582.1, 0584.1, 0585.1, 0586.1, 0587.1; Reman: 0726, 0727, 0733; (hearing: OAR-2003-0190-0503, 0545)
Environmental Club of Colorado State University-Pueblo		OAR-2003-0190-0466
Environmental Defense		OAR-2003-0190-0592.1 <sup>1</sup> , 0610-0610.3, 0728 <sup>2</sup> , 0735, C3 comments: -0638 (hearing: OAR-2003-0190-0487, 0546, 0546.1)
Environment Northeast		OAR-2003-0190-0592.1 <sup>1</sup>
Fr. Fassmer GmbH & Co., Germany		OAR-2003-0190-0477
Friends of the Earth		OAR-2003-0190-0609
General Electric Transportation	GE	OAR-2003-0190-0590.1
Group Against Smog and Pollution		OAR-2003-0190-0592.1 <sup>1</sup>
Horiba (labeled as private citizen M. Akard)		OAR-2003-0190-0602
(City of) Houston Department of Health & Human Services		OAR-2003-0190-0561.1
Johnson Matthey		(hearing: OAR-2003-0190-0488)
Kaydon Ring and Seal, Inc		OAR-2003-0190-0654
Kern County Board of Supervisors		OAR-2003-0190-0724
Kim Hotstart Manufacturing Co.		OAR-2003-0190-0588.1
Kirby Corporation	Kirby	OAR-2003-0190-0563.1
Lake Carriers' Association	LCA	OAR-2003-0190-0567.1
Lat-Lon LLC		OAR-2003-0190-0481
Makah Tribal Council		OAR-2003-0190-0472
Manufacturers of Emission Controls Association	MECA	OAR-2003-0190-0572, 0572.1, Reman: 0730, (hearing: OAR-2003-0190-0494, -0504)
Marathon Petroleum Company		OAR-2003-0190-0595.1

Markle Marine Safety Services		OAR-2003-0190-0547, 0547.1
Marine Propulsion Technology, Inc. (w/ <i>PurePower</i> )		OAR-2003-0190-0720
MIRATECH Corporation		(hearing: OAR-2003-0190-0505)
Missouri Department of Natural Resources	MDNR	OAR-2003-0190-0658
MotivePower, Inc.		OAR-2003-0190-0613
MTU Detroit Diesel Corporation, Inc.	MTU	OAR-2003-0190-0573.1
National Association of Clean Air Agencies	NACAA	OAR-2003-0190-0579.1, 0732 ( <i>reman</i> ), (hearing: OAR-2003-0190-0495, -0511)
National Maintenance & Repair, Inc		OAR-2003-0190-0655
National Marine Manufacturers Association	NMMA	OAR-2003-0190-0656 (hearing: OAR-2003-0190-0513, 0513.1)
National Park Service- Pacific West Region		OAR-2003-0190-0480 (hearing)
Natural Resources Defense Council	NRDC	OAR-2003-0190-0592.1, OAR-2003-0190-0728 <sup>2</sup> , (hearing: OAR-2003-0190-0489, -0606)
New Jersey Department of Environmental Protection	NJDEP	OAR-2003-0190-0562.1—0562.3
New Jersey Environmental Federation		OAR-2003-0190-0592.1 <sup>1</sup>
New York State Department of Environmental Conservation	NYDEC	OAR-2003-0190-0583, 0583.1
North Carolina Department of Air Quality	NCDAQ	OAR-2003-0190-0565.1
North Kingston Community Association		(hearing: OAR-2003-0190-0496)
Northeast States for Coordinated Air Use Management	NESCAUM	OAR-2003-0190-0551.1 (hearing: OAR-2003-0190-0512)
Northwest Environmental Defense Center		OAR-2003-0190-0593.1—0593.2
Offshore Marine Service Association	OMSA	OAR-2003-0190-0611.1 (hearing: OAR-2003-0190-0490, 0490.1)
Oregon Department of Environmental Quality	ODEQ	(hearing: OAR-2003-0190-0506)
Oregon Environmental Council		OAR-2003-0190-0652
Overseas Shipholding Group	OSG	OAR-2003-0190-0589.1
Ozone Transport Commission	OTC	OAR-2003-0190-0633.1
Passenger Vessel Association	PVA	OAR-2003-0190-0576—0576.2 (hearing: OAR-2003-0190-0507)
Peninsular Engines, Inc.		(hearing: OAR-2003-0190-0491)
People for Puget Sound		OAR-2003-0190-0649
Port of Seattle		(hearing: OAR-2003-0190-0469, 0469.1, 0497)
Public Citizen Texas Office		OAR-2003-0190-0592.1 <sup>1</sup>
Puget Sound Clean Air Agency		(hearing: OAR-2003-0190-0484)

Pure Power EcoFuel, LLC (w/ MPT, Inc.)		OAR-2003-0190-0720
Railpower Hybrid Technologies Corp.		(hearing: OAR-2003-0190-0492)
Rail World, Inc.		OAR-2003-0190-0474
Respiratory Health Association of Metropolitan Chicago		OAR-2003-0190-0592.1 <sup>1</sup>
San Joaquin Valley Unified Air Pollution Control District		OAR-2003-0190-0556.1
Seaport Air Quality Program, Port of Seattle		OAR-2003-0190-0469
Southwest Clean Air Agency		OAR-2003-0190-0468, (hearing: OAR-2003-0190-0508, 0508.1)
South Coast Air Quality Management District	SCAQMD	OAR-2003-0558.1 (hearing: OAR-2003-0190-0483, 0483.1, 0493)
Survival Systems International		OAR-2003-0190-0657
Sustainable Energy and Economic Development Coalition	SEED	OAR-2003-0190-0592.1 <sup>1</sup>
Tacoma Public Utilities		(hearing: OAR-2003-0190-0517)
Teleflex EcoTrans Technologies		OAR-2003-0190-0553.1, 0554.1
Texas Commission on Environmental Quality	TCEQ	OAR-2003-0190-0612.1, 0660 ( <i>duplicate</i> )
Tidewater Marine		OAR-2003-0557, 0557.1 (hearing: OAR-2003-0190-0514)
U.S. Coast Guard		OAR-2003-0190-0721
U.S. Marine Safety Association	USMSA	OAR-2003-0190-0617, 0617.1
U.S. Public Interest Research Group	U.S. PIRG	OAR-2003-0190-0592.1 <sup>1</sup>
Washington State Department of Transportation	WSDOT	OAR-2003-0190-0555.1- 0555.2 <sup>3</sup>
Washington State Ferry System	WSF	OAR-2003-0190-0555.1- 0555.2 <sup>3</sup>
Wisconsin Department of Natural Resources	WDNR	OAR-2003-0190-0552
Wyoming Outdoor Council		OAR-2003-0190-0467
ZTR Control Systems		OAR-2003-0190-0564.1

<sup>3</sup> Comments OAR-2003-0190-0555.1 and OAR-2003-0190-0555.2 were jointly submitted by the Washington State Ferry System and the Washington State Department of Transportation.

## LIST OF ACRONYMS

AAPA	American Association of Port Authorities
ABS	American Bureau of Shipping
ABT	Averaging, Banking, and Trading
AECC	Association for Emissions Control by Catalyst
AECD	Auxiliary Emission Control Device
AESS	Automatic Engine Stop/Start
ANPRM	Advance Notice of Proposed Rulemaking
API	American Petroleum Institute
APU	Auxiliary Power Unit
ASTM	American Society for Testing and Materials
AQCD	Air Quality Criteria Document
AQMP	Air Quality Management Plan
bpcd	Barrels per Calendar Day
C1	Category 1 ( <i>marine diesel engines with capacity of 7 liters per cylinder or less; used to power vessels such as tugboats, fishing vessels, and other commercial vessels in and around U.S. ports, or as stand-alone generators for auxiliary electrical power on many types of vessels</i> )
C2	Category 2 ( <i>marine diesel engines with an engine capacity over 7 liters per cylinder but less than 30 liters per cylinder; used to power vessels such as tugboats, fishing vessels, and other commercial vessels in and around U.S. ports, or as stand-alone generators for auxiliary electrical power on many types of vessels</i> )
C3	Category 3 ( <i>marine diesel engines with per-cylinder displacement at or above 30 liters; very large marine diesel engines used on ocean-going vessels such as container ships, oil tankers, and cruise ships</i> ); also called “ocean-going vessels”
CAA	Clean Air Act
CARB	California Air Resources Board
CASAC	Clean Air Science Advisory Committee
CDPF	Catalyzed Diesel Particulate Filter
CFR	Code of Federal Regulations
CI	Compression Ignition
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
COPD	Chronic Obstructive Pulmonary Disease
CPP	Controllable Pitch Propeller
CVS	Constant Volume Sampler
DC	Direct Current
DDHS	Diesel Driven Heating System
DF	Deterioration Factor
DOC	Diesel Oxidation Catalyst
DoE, DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation



DPF	Diesel Particulate Filter
DPU	Distributed Power Unit
DRIA	Draft Regulatory Impact Analysis
ECM	Engine Control Module
EGR	Exhaust Gas Recirculation
EEZ	Exclusive Economic Zone
EIA	Economic Impact Analysis
EIA	(DOE's) Energy Information Administration
E.O.	Executive Order
EPA	U.S. Environmental Protection Agency
ERC	Emission Reduction Credits
ESC	European Stationary Cycle
ETC	European Transient Cycle
EU	European Union
F	Frequency Factor
FEL	Family Emissions Limit
FR	Federal Register
FRA	Federal Railroad Administration
FRM	Final Rulemaking
G	Gravitational Constant
g/bhp-hr	Grams per brake horsepower-hour
g/kW-hr	Grams per kilowatt-hour
GHG	Greenhouse Gas
GPS	Global Positioning System
GSM	Global System for Mobile Communications
H <sub>2</sub> S	Hydrogen Sulfide
HAD	Health Assessment Document
HC	Hydrocarbon
HD	Heavy Duty
HDOH	Heavy Duty On-Highway
HDV	Heavy-duty Vehicle
HEP	Head End Power
HEPA	High-Efficiency Particulate Air
HP, hp	Horsepower
HPD	High Power Density
HRA	Health Risk Assessment
Hz	Hertz
IEEE	Institute of Electrical Engineers
IM, I/M	Inspection and Maintenance
IMO	International Maritime Organization
INTERTANKO	International Association of Independent Tanker Operators
ISO	International Organization for Standardization
kW	Kilowatt
L/cyl	Liters per cylinder
LDV	Light-duty Vehicle

LEV	Low Emission Vehicle
LM	Locomotive and Marine Diesel Fuel
LMOA	Locomotive Maintenance Officers Association
LNG	Liquefied Natural Gas
LSD	Low Sulfur Diesel
LTR	Limited Testing Region
MARPOL	International Convention for the Prevention of Pollution from Ships
MIL	Malfunction Indicator Light
MOU	Memorandum of Understanding
MY	Model Year
NAAQS	National Ambient Air Quality Standard
NH <sub>3</sub>	Ammonia
NMHC	Non-methane Hydrocarbon
NO	Nitric Oxide
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Oxides of Nitrogen
N <sub>2</sub> O	Nitrous Oxide
NPRM	Notice of Proposed Rulemaking
NPV	Net Present Value
NRLM	Nonroad, Locomotive, and Marine diesel fuel
NTE	Not-to-Exceed
O <sub>3</sub>	Ozone
OBD	On-board Diagnostics
OEM	Original Equipment Manufacturer
OGV	Ocean-going Vessel
OMB	Office of Management and Budget
OSV	Off-shore Support Vessel
OTAQ	Office of Transportation and Air Quality
PFD	Partial-Flow Dilution
PGM	Platinum Group Metals
PLT	Production Line Testing
PM	Particulate Matter
PM <sub>10</sub>	Particulate Matter 10 microns in diameter or less
PM <sub>2.5</sub>	Particulate Matter 2.5 microns in diameter or less
ppm	Parts per Million
R&D	Research and Development
RCL	Remote-controlled Locomotive
RFA	Regulatory Flexibility Act
RIA	Regulatory Impact Analysis
ROG	Reactive Organic Gas
ROI	Return on Investment
SAB	Science Advisory Board
SAB-HES	Science Advisory Board Health Effects Subcommittee
SAE	Society of Automotive Engineers
SAPS	Sulfated Ash, Phosphorus, and Sulfur

SBA	Small Business Administration
SBAR Panel	Small Business Advocacy Review Panel (or, 'The Panel')
SBREFA	Small Business Regulatory Enforcement Fairness Act
SCR	Selective Catalytic Reduction
SCFM	"Standard" Cubic Feet Per Minute
SEA	Selective Enforcement Audit
SIP	State Implementation Plan
SO <sub>2</sub>	Sulfur Dioxide
SO <sub>x</sub>	Sulfur Oxides
SOLAS	(International Convention) for the Safety of life at Sea
SPD	Standard Power Density
STB	Surface Transportation Board
TBN	Total Base Number
THC	Total Hydrocarbon
TPD, tpd	Tons per day
ULSD	Ultra-low Sulfur Diesel
U.S.C.	United States Code
USCG	United States Coast Guard
USDA	United States Department of Agriculture
VOC	Volatile Organic Compound
VWT	Vanadium-Tungsten-Titanium Mixed Oxide
WHO	World Health Organization