



# Alternative Diesel Fuels Symposium August 19 & 20 2003

*Biodiesel*

*Gas to Liquids*

*Water Emulsified*

*Ethanol Diesel*

## **Verification of Emission Reductions for Alternative Diesel Fuels**

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# Definition

- ✦ Title 13, CCR, Section 2701
- ✦ “Alternative Diesel Fuel” means any fuel used in diesel engines that is not commonly or commercially known, sold or represented as diesel fuel No. 1-D or No. 2-D, pursuant to the specifications in ASTM D975-81.
- ✦ No engine or fuel system modifications

# Verification Procedures

- ✦ Stationary Source Division
  - Interim Verification Procedure
  
- ✦ Mobile Source Control Division
  - Diesel Emission Control Strategy Verification Procedure

# Interim Verification Procedure

- ✦ Informal voluntary process
- ✦ Allows verification of emission benefits of fuel technologies
- ✦ Qualify for incentive programs
- ✦ Applies to on/off road mobile sources
- ✦ Fleet average basis

# Diesel Emission Control Strategy Verification Procedure

- ✦ Formal process
  - Title 13, CCR, Sections 2700-2710
- ✦ Supports diesel “In-use Strategies” programs
- ✦ Allows verification of emission benefits of hardware and fuel technologies
- ✦ Qualify for incentive programs
- ✦ Applies to on/off road mobile sources and stationary sources
- ✦ Engine technology/application basis

# Verification Criteria

- ✦ No increase in PM and NO<sub>x</sub>
- ✦ No net increase in toxic/SOF emissions
- ✦ HC are 25 percent less than any applicable engine exhaust standard
- ✦ Registered with U.S. EPA
- ✦ No significant adverse impacts
  - engine durability
  - public health and the environment

# Verification Process

- ✦ Application
- ✦ Submission of fuel/additive formulation
- ✦ Approved Test Protocol
  - Reference fuel
  - Candidate Fuel
  - Emissions Tests
  - Engine Dynamometer Tests

# Reference Fuel

- ✦ 10 percent aromatic diesel
  - California produced or “like”
  - Produced from straight run diesel-hydrodearomatization process
  - other specifications
- ✦ Any California commercially available diesel when used as a base blend in the candidate fuel

# Reference Fuel Specifications

Property	General Reference Fuel Specifications	ASTM Test Method
Sulfur Content	500 ppm max	D5453-93
Aromatic Hydrocarbon content, Vol. %	10% max	D5186-96
Polycyclic Aromatic Hydrocarbon content %	1.4% max	D5186-96
Nitrogen Content	10 ppm max	D4629-96
Natural Cetane Number	48 min	D613-84
Gravity, API	33-39	D287-82
Viscosity at 40°, cSt	2.0-4.1	D445-83
Flash point, °F	130	D93-80
Distillation, °F		D86-96
IBP	340-420	
10%REC	400-490	
50%REC	470-560	
90%REC	550-610	
EP	580-660	

# Candidate Fuel

- ✦ Chemical composition and concentration of fuel additives
- ✦ Sulfur content
- ✦ Total aromatic content
- ✦ Total PAH
- ✦ Nitrogen content
- ✦ API gravity
- ✦ Distillation temperature distribution
- ✦ Copper, Iron, Cerium, Lead, Cadmium, Chromium, Phosphorus content

# Comparative Emissions Tests

- ✦ Criteria Pollutants: PM, NO<sub>x</sub>, SO<sub>x</sub>, CO, and HC
- ✦ Toxics
  - SOF
  - Formaldehyde, Acetaldehyde, BTEX, 1,3-Butadiene, PAHs
- ✦ Other Toxics-based on fuel formulation

# Engine Dynamometer Tests

- ✦ 1991 Detroit Series 60 Engine
- ✦ Test cycles
  - Heavy-Duty Engine Transient Federal Test Procedure
  - Steady State (Diesel Emission Control Strategy Verification Procedure only)
- ✦ Number of tests
  - Dependent on test pattern selected
  - Hot Starts-20-21 tests per fuel
  - Cold+Hot Starts-5 tests per fuel

# Additional Criteria under Diesel Emission Control Strategy Verification Procedure

- ✦ A minimum 25% reduction in PM required
- ✦ CO emissions must be no greater than the current CO exhaust emissions standard
- ✦ No more than 10% increase in NMHC or NO<sub>x</sub> with specified exceptions designed to ensure no increased exposure to ozone
- ✦ No more than 10% increase in other pollutants

# Additional Criteria under Diesel Emission Control Strategy Verification Procedure

## ✦ PM Reductions

- Level 1                      25% minimum
- Level 2                      50% minimum
- Level 3                      85% or greater

## ✦ NOx Reductions - Can verify reduction of 15% or greater

# Additional Criteria under Diesel Emission Control Strategy Verification Procedure

- ✦ Demonstrate applicability to other engine technology groups/applications
- ✦ Durability Testing
- ✦ In-use compliance testing
- ✦ Fuel additives must be used with a particulate filter unless proven safe to use alone

# Additional Criteria under Diesel Emission Control Strategy Verification Procedure

- ✦ Multimedia Assessment as required by Health and Safety Code 43830.8
  - Reviewed by the Governor's California Environmental Policy Council
  - No significant adverse impact to public health and the environment

# Summary

- ✦ Interim Verification Procedure
  - Informal voluntary process to document emission benefits
  - Qualify for incentive programs
- ✦ Diesel Emission Control Strategy Verification Procedure
  - Formal verification process to participate in diesel “In-use Strategies” program
  - Qualify for incentive programs

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Webpage for SSD verification:

<http://www.arb.ca.gov/fuels/diesel/altdiesel/altdiesel.htm>

Webpage for MSCD verification:

<http://www.arb.ca.gov/diesel/verdev/verdev.htm>