

# California Air Resources Board (ARB)

## SMALL OFF-ROAD ENGINE EMISSIONS CERTIFICATION

(Exhaust & Evaporative)

February 20, 2008

Edited November 9, 2015



# What is a SORE?

“Small off-road engine” is defined in 13 CCR, §2401:

- Any spark-ignited engine that produces gross horsepower < 25HP (19kW)
- Is not used to propel an on-road vehicle, off-road motorcycle, all-terrain vehicle, sand car, or marine vessel
- Examples: lawn mowers, weed trimmers, chainsaws, generators, specialty vehicles



# Major Steps

1. (New Mfrs.) Register with U.S. EPA and ARB.
2. Group engines/equipment into exhaust & evaporative families.
3. Demonstrate service accumulation durability & emissions compliance for each family.
4. Submit Applications to ARB via the Document Management System (DMS).



# Major Steps

(cont'd)

5. Receive Certificate of Conformity from U.S. EPA and Exhaust/Evaporative Executive Order from ARB.
6. Produce and label each engine according to specifications described in applications.
7. Do not introduce engines/equipment into commerce in CA until certified.
8. Receive U.S. EPA and ARB approval for any emissions-related production running changes.



# Getting Registered (New Mfrs.)

- Register with U.S. EPA as a new Mfr.  
[<http://www.epa.gov/OMS/verify/documents/new-mfr-reg-code.pdf>]
- ARB issues its Executive Orders (EOs) to the engine Mfr. A business entity that has complete knowledge and control of the engine's specifications may certify on behalf of a Mfr.

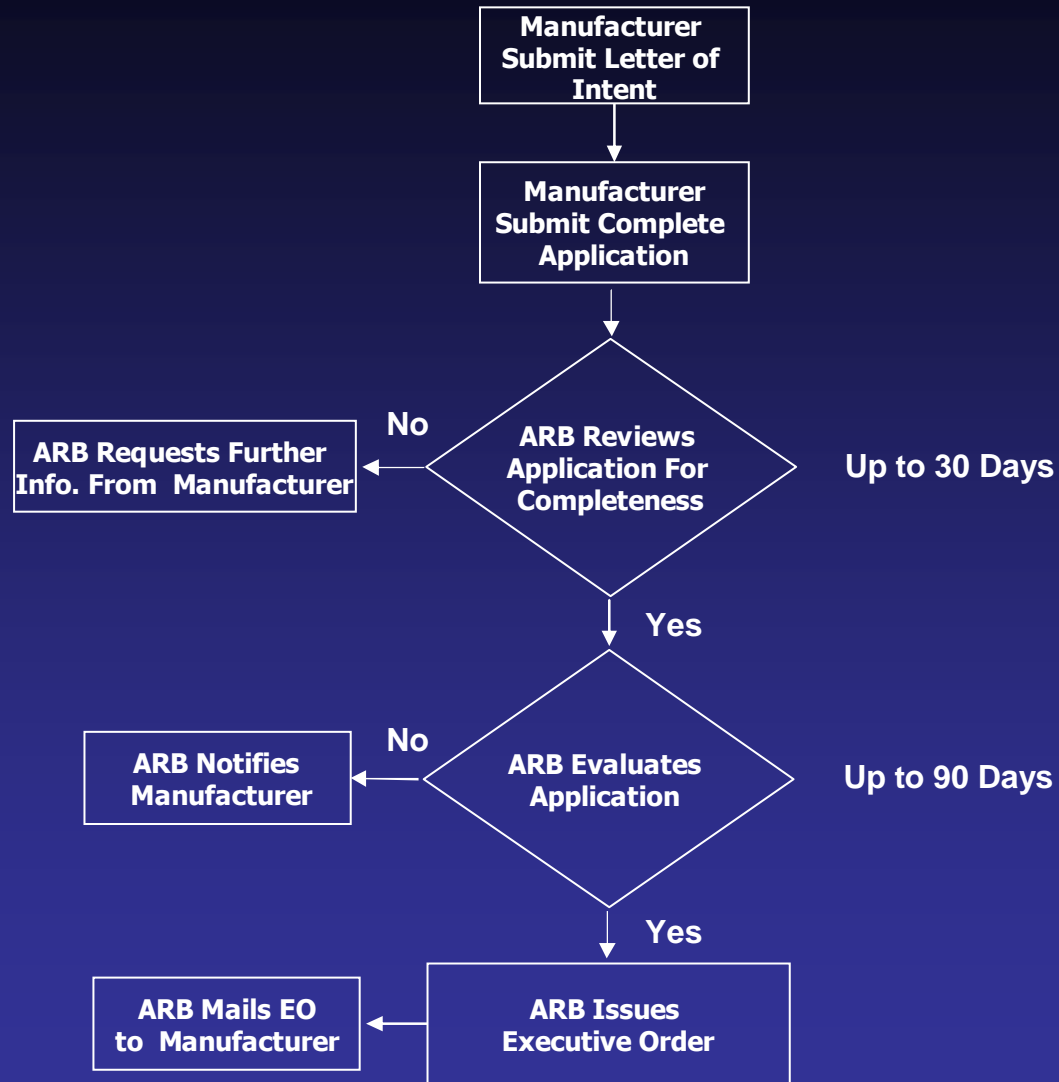


## Getting Registered (New Mfrs.)

- Submit to ARB via regular mail a hard copy “Letter of Intent” to certify engines in CA.
- ARB sends the applicant an Excel template to be completed by Mfr.
  - Contact information, i.e., name, address, phone number., etc.
  - U.S. EPA’s 3-character Mfr.’s code
  - Mfr.’s name or business entity’s name for EO
- ARB assigns unique ARB Mfr.’s code to enable access to DMS.



# Certification Process Flowchart



California Environmental Protection Agency



Air Resources Board



# Exhaust Emissions Certification





# Regulations and Guidance

- Title 13, CCR, Section 2400
- Small Off-Road Engine Resource Page

[[www.arb.ca.gov/msprog/OFFROAD/sore/sorectp/sorectp.htm](http://www.arb.ca.gov/msprog/OFFROAD/sore/sorectp/sorectp.htm)]

- SORE Exhaust Test Procedures

2005-2012: [<http://www.arb.ca.gov/regact/sore03/rtp2005.pdf>]

<http://www.arb.ca.gov/regact/2008/sore2008/soreresubtp.pdf>

<http://www.arb.ca.gov/regact/2011/soreci2011/soreci2011part2.pdf>

2013 and later (part 1054):

<http://www.arb.ca.gov/regact/2011/soreci2011/part3sore2011fro.pdf>

2013 and later (Part 1065):

<http://www.arb.ca.gov/regact/2011/soreci2011/part4sore2011fro.pdf>



# 2008 and Later Exhaust Emission Standards in g/kW-hr

<i>Displacement</i>	HC+NOx	CO	PM
<i>&lt; 50cc</i>	50	536	2.0 (2-stroke)
<i>≥ 50cc - ≤ 80cc</i>	72	536	2.0 (2-stroke)
<i>&gt; 80cc - &lt; 225cc</i>	10.0	549	-
<i>≥ 225 cc</i>	8.0	549	-



# Wintertime Products

- Engines used exclusively in wintertime, such as snow throwers and ice augers, do not need to certify to the HC+NO<sub>x</sub> emission standards



# Group engines into Exhaust Families

- Characteristics of Exhaust Families
  - Displacement, number of cylinders, cylinder configuration
  - Emission Controls, i.e., catalytic converter number & location
  - Fuel System, i.e., carburetor, TBI, MFI, SFI
  - Cooling Mechanism, i.e., liquid vs. air



# Carryover Applications

- May Carryover emission data from the previous model year
  - No changes to emission control system
- May Carryacross emission data from one engine family to another
  - Must be representative of new family
- Must submit application each model year
- Subject to ARB Approval



# Model Year Definition

- “Model Year” means the manufacturer’s annual production period that includes January 1 of a calendar year or, if the manufacturer has no annual production period, the calendar year.

- Example:

2008 Model Year

Production valid Jan 2, 2007 to Dec 31, 2008



# Certification Application Submittal

- Letter of Intent
- Cover letter/Statements of Compliance
- Application
  - Certification summary
  - Supplementary Information
- Engine Label/ Air Index Label
- Warranty Statement



# Certification Application Submittal (cont'd)

- Tamper Resistance Compliance
- Durability Plan
- Corporate Average Plan (ABT)
- Auxiliary Cooling Questionnaire
- Confirmatory Test data
- PLT sampling plan





# Engine Label/Air index Label

- Must be permanently fixed to engine
- Identify emission control system and maintenance adjustments
- Include engine family name, displacement and date of manufacture
- If a name other than manufacturer's is used, must get approval from ARB
- In regulations 13 CCR §2404



# Emissions Warranty

- Provide text in accordance with 13 CCR §2405
- If a name other than manufacturer's is used, submit an approval letter signed by both parties
- Warranty service phone number must be a U.S. number



# Adjustable Parameters Fuel & Ignition System

- Adjustable parameters (e.g., idle air fuel mixture):
  - Should employ measures approved by ARB to discourage adjustments by owners.
    - Plugs
    - Limiting Caps
  - Must be described in application.
- ARB can specify, for emission testing, any setting within the physical range of adjustments.



# Tamper Resistance Method Review

- TRMs prevents unauthorized changes to engine manufacturer-certified calibrations
- Previously approved TRMs will be periodically reevaluated to assure their continued effectiveness
- Equipment Manufacturers may not modify engine calibration



# Tamper Resistance Method Review (cont'd)

- Evaluation criteria includes but is not limited to:
  - need for special tools for access and/or adjustment
  - cannot be tampered using common tools
- All new engine manufacturers must submit carburetor samples for tamper resistance approval



# Deterioration Factor (D.F.) Calculation

- Each engine family must have a Deterioration Factor (D.F.)
- DF is found by running the test engine through a full durability period and using at least three test points to determine a least squares, linear regression line
- The DF is multiplied by the zero hour engine test results
- Assigned DFs can be determined according to Subpart C, Section 1054.245 of the 2013 and Later Test Procedures



# Averaging, Banking, Trading Program (ABT)

- Used to allow manufacturers to average emissions across entire production line
- Assign a Family Emission Limit (FEL) instead of normal standard for each applicable family
- Any surplus can be banked or traded with other participating manufacturers
- Submit Corporate Average Plan (CAP) with application
- Provide end of year reports



# Auxiliary Engine Cooling Systems (AECS)

- All applications must include the AECS questionnaire (available on SORE webpage)
- Evaluation of AECS is based on comparison to in-use operating conditions
- Manufacturers are encouraged to submit the AECS questionnaire prior to certification





# Auxiliary Engine Cooling Systems (cont'd)

- Special test procedures must be approved by ARB for any auxiliary cooling system
- Special test procedures must account for all factors that simulate in-use operating conditions
- Example: Handheld blowers with fan removed. The fan's effect may be reproduced externally, but must also be factored into the horsepower determination



# Confirmatory Testing

- Regulations provide authority to request Confirmatory Testing (CT)
- If a manufacturer submits only one certification test result, then CT is required if certification level is >85% of the standard
- Example, if the standard is 16.1, then:
  - $16.1 \times 0.85 = 13.7$
  - CT done for certification levels above 13.7
- CT may be performed voluntarily by manufacturer without prior ARB notification
- All tests must be reported in the certification application



# PLT Sampling Plan

- Production Line Testing (PLT) required for each SORE exhaust family
- New manufacturers must provide sampling plan to ARB designating method of choosing test engines from production line
- Submit quarterly PLT reports listing test results
- Immediately notify ARB if any PLT test engine fails compliance



# Post-Certification Responsibilities

(Exhaust)

- Submit quarterly PLT reports within 45 days of the end of each quarter
- Compliance Testing
  - ARB may request engines to test at manufacturer's facility or ARB's test facility
  - Compliance testing insures that production engines conform with emission standards
- Emission-related Defect Reporting
  - Defect that exists in 25 or more engines in a family
  - Must report within 15 days after defect found
- Voluntary Emission Recall
  - Must submit report detailing repair/adjustments, and engine families affected, to ARB



# Evaporative Emissions (Equipment) Certification



# SORE Evaporative Requirements (Applicability)

- Evaporative requirements are applicable to equipment that uses an engine from any SORE exhaust displacement category
- These standards do not apply to engines powered by the following fuels:

–CNG

–Propane

–LPG

–LNG



# Regulations and Guidance

- Title 13, CCR, Section 2750
- ≤ 80cc:
  - CP 901 (Certification Procedures)  
[[www.arb.ca.gov/regact/sore03/cp901.pdf](http://www.arb.ca.gov/regact/sore03/cp901.pdf)]
  - TP 901 (Test Procedure)  
[[www.arb.ca.gov/regact/sore03/tp901.pdf](http://www.arb.ca.gov/regact/sore03/tp901.pdf)]
- > 80cc:
  - CP 902 (Certification Procedures)  
[[www.arb.ca.gov/regact/sore03/cp902.pdf](http://www.arb.ca.gov/regact/sore03/cp902.pdf)]
  - TP 902 (Test Procedure)  
[[www.arb.ca.gov/regact/sore03/tp902.pdf](http://www.arb.ca.gov/regact/sore03/tp902.pdf)]
- SORE Homepage  
[[www.arb.ca.gov/msprog/OFFROAD/sore/sorectp/sorectp.htm](http://www.arb.ca.gov/msprog/OFFROAD/sore/sorectp/sorectp.htm)]



# Evaporative requirements for equipment using engines $\leq 80\text{cc}$





# 2008 and Later Evaporative Emission Standards

≤ 80 cc

- Apply to small engines ≤ 80 cc
- Typical equipment includes string trimmers, leaf blowers, and chainsaws

<i>Effective Date Model Year</i>	<i>Requirement Tank Permeation</i>
<b>2008</b>	<b>Fuel Tank Permeation Emissions Shall Not Exceed 2.0 Grams Per Square Meter Per Day As Determined By TP-901</b>



# Exemptions

≤ 80cc

- Equipment using structurally integrated nylon, metal, and co-extruded multi-layered tanks

*Equipment with exemptions must still certify with  
ARB*



# Fuel Tank Permeation Certification

≤ 80cc

- Application must include:
  - Cover Letter/Statement of Compliance
  - Worst Case Tank Determination using most surface area per volume
  - Fuel tank permeation data
  - Sample engine or equipment label
  - Emission warranty



# Evaporative requirements for equipment using engines > 80cc



# >80 cc - <225 cc Walk-Behind Mowers

- Apply to walk-behind mowers with engines > 80 cc to < 225 cc

	<i>Performance Requirements Section 2754(a)</i>
<i>Effective Date Model Year</i>	<i>Diurnal Standard Grams HC/day</i>
<b>2008</b>	<b>1.3</b>
<b>2009</b>	<b>1.0</b>



## >80 cc - <225 cc Non Walk-Behind Mowers

- Apply to equipment other than walk-behind mowers with engines > 80 cc to < 225 cc

	<i>Performance Requirements Section 2754(a)</i>	<i>Design Requirements Section 2754(b)</i>		
<i>Effective Date Model Year</i>	<i>Diurnal Standard Grams HC/day</i>	<i>Fuel Hose Permeation Grams ROG/m<sup>2</sup>/day</i>	<i>Fuel Tank Permeation Grams ROG/m<sup>2</sup>/day</i>	<i>Carbon Canister or Equivalent Butane Working Capacity Grams HC</i>
<b>2008</b>	1.20 + 0.056*tank vol. (liters)	<b>15</b>	<b>2.5</b>	Specified in TP-902
<b>2012</b>	0.95 + 0.056*tank vol. (liters)	<b>15</b>	<b>1.5</b>	Specified in TP-902



≥ 225 cc

- Apply to large equipment like lawn tractors and generators with engines ≥ 225 cc

	<i>Performance Requirements Section 2754(a)</i>	<i>Design Requirements Section 2754(b)</i>		
<i>Effective Date Model Year</i>	<i>Diurnal Standard Grams HC/day</i>	<i>Fuel Hose Permeation Grams ROG/m<sup>2</sup>/day</i>	<i>Fuel Tank Permeation Grams ROG/m<sup>2</sup>/day</i>	<i>Carbon Canister or Equivalent Butane Working Capacity Grams HC</i>
<b>2008</b>	1.20 + 0.056*tank vol. (liters)	<b>15</b>	<b>2.5</b>	Specified in TP-902
<b>2013</b>	1.20 + 0.056*tank vol. (liters)	<b>15</b>	<b>1.5</b>	Specified in TP-902



# Fuel Cap Performance Standards

> 80cc

- Fuel cap must be permanently tethered to the tank, equipment, or engine.
- Fuel cap must be designed to provide physical and/or audible feedback to the user that a fuel tank vapor seal is established.

<i>Effective Date Model Year</i>	<i>Applicability</i>
<b>2008</b>	<b><i>ALL SORE Equipment With Small Off-Road Engines &gt;80 cc</i></b>





# Exemptions

> 80cc

- Equipment  $\geq$  225cc using small production volume tanks (< 400 units)
- Generators fueled by an on-road vehicle tank

*Equipment with exemptions must still certify with  
ARB*



# Group Equipment into Evaporative Families

> 80cc

- Characteristics of Evaporative Families
  - Vapor Storage Device design, i.e., canister housing material & working capacity
  - Fuel Tank design, i.e., metal vs. plastic, vented vs. unvented
  - Purge strategy, i.e., uncontrolled vs. controlled



# Evaporative Code Determination

> 80cc

- A two digit code may be used as the evaporative family name
- The first digit represents the venting control, the second digit represents the tank barrier
- Example: “CM” = Carbon Canister and Metal Tank
- Full explanation found on pg. 13 in CP-902



# Design vs. Performance

> 80cc

- Engines or equipment must be certified under one of the following options:

- Performance-Based Option , 13 CCR 2754 (a)

- Compliance demonstrated through diurnal test
- Likely option for engine manufacturers that sell engines with complete evaporative systems

- Design-Based Option, 13 CCR 2754 (b)

- Compliance demonstrated by using components that meet specified design requirements
- Likely option for equipment manufacturers that purchase engines without fuel tanks



# Performance-Based Certification

> 80cc

- What is performance-based certification?
  - Performance-based certification is where compliance with the evaporative requirements are demonstrated by diurnal testing of engines or equipment with complete evaporative emission systems in a SHED.
- How is performance-based certification useful?
  - Standard for demonstrating compliance.
  - Manufacturers can take advantage of averaging and banking provisions within the regulations to optimize production.



# Performance-Based Certification

> 80cc  
(Durability)

- Durability test must actuate control valves, cables, linkages, where applicable for a minimum of 5000 cycles
- Pressure/Vacuum test must be performed
- Slosh Test must be performed
- Carbon Canister thermal and vibration exposure must be performed



# Performance-Based Certification

> 80cc

Averaging and Banking (EFELD & EMEL)

- For evaporative averaging and banking, manufacturers must certify to an Evaporative Family Emission Limit Differential (EFELD)
- EFELD is calculated by subtracting the Evaporative Model Emission Limit (EMEL) from the applicable diurnal evaporative standard
- Manufacturer determines worst case model in the family as the one with the lowest EFELD
- Manufacturer must submit an end of year report



# Performance-Based Certification

> 80cc

- Application must include:
  - Cover Letter/Statement of Compliance
  - Diurnal emissions data
  - Running loss determination
  - Engineering description of evaporative control system
  - Worst Case Evaporative Emission Control System Determination
  - Certification Averaging and Banking Worksheet, if applicable
  - Sample engine or equipment label
  - Emission warranty





# Design-Based Certification

> 80cc

- What is design-based certification?

–Design-based certification is where engine or equipment manufacturers use certified fuel hoses, fuel tanks, and carbon canisters, that meet specific design requirements and have received component EOs, in evaporative emission control systems.

–Alternatively, a manufacturer may test its own components using applicable test procedures and generate test data showing compliance with applicable design requirements. Worst case components must be tested.



# Design-Based Certification

> 80cc

- How is design-based certification useful?
  - Allows manufacturers to show compliance without testing the complete evaporative system in a Sealed Housing for Evaporative Determination Enclosure (SHED)
  - Manufacturer certifying by design-based will most likely use pre-certified components that have been issued component EO by ARB to avoid actual component testing and providing test data



# Design-Based Certification

> 80cc

- Application must include:
  - Component EO numbers in lieu of component test data, or
  - Provide hose and tank permeation and canister working capacity data
  - Running loss determination
  - Estimate diurnal emissions comparable to performance standards
  - Engineering description of evaporative control system
  - Worst Case Determination
  - Sample engine or equipment label
  - Emission Control Warranty Statements



# Component Certification

> 80cc

- What is component certification?
- Component certification is the certification of fuel hoses, fuel tanks, and carbon canisters by ARB.
- Certification means that the manufacturers have demonstrated that their product meets applicable design requirements.



# Component Certification

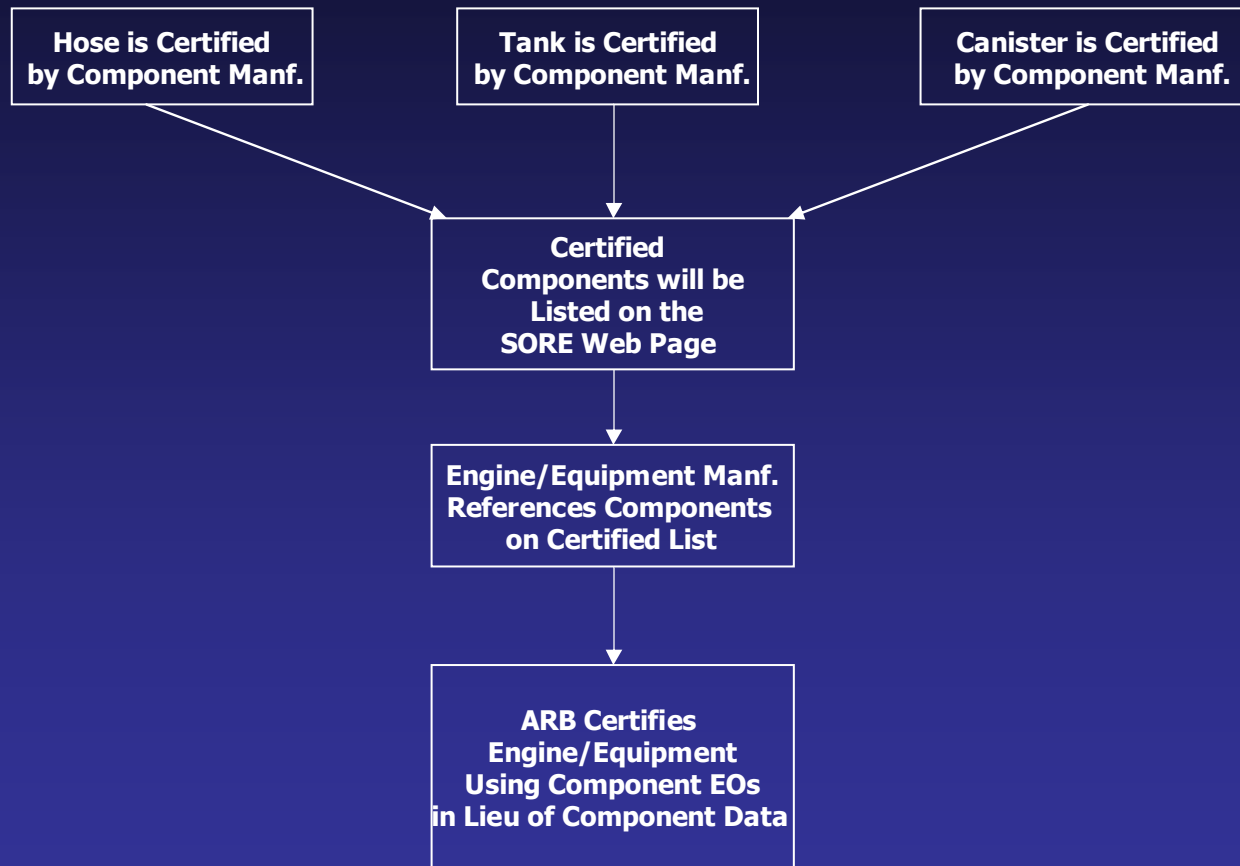
> 80cc

- How is component certification useful?
  - Allows manufacturers to reference a pre-certified component Executive Order (EO) in a certification application when certifying by design
  - Expedites certification process by eliminating the need to review component compliance data



# Component Certification

(How it works)



# Component Certification Contacts

Michele Dunlop 916-323-8971

[michele.dunlop@arb.ca.gov](mailto:michele.dunlop@arb.ca.gov)

Angus MacPherson 916-445-4686

[angus.macpherson@arb.ca.gov](mailto:angus.macpherson@arb.ca.gov)

Component EO Web Page

[<http://www.arb.ca.gov/msprog/offroad/sore/sorecomponent/sorecomponent.htm>]



# Post-Certification Responsibilities

## (Evaporative)

- Submit averaging and banking reports at end of year
- Compliance Testing
  - ARB may request equipment to test at manufacturer's facility or ARB's test facility
  - Compliance testing insures that production equipment conform with evaporative emission standards
- Emission-related Defect Reporting
  - Defect that exists in 25 or more equipment in a family
  - Must report within 15 days after defect found
- Voluntary Emission Recall
  - Must submit report detailing repair/adjustments, and evap families affected, to ARB
- Validation Study
  - To confirm that the performance and design based certification are reducing evaporative emissions
  - Will Take place in 2010 and 2015





# ARB Contacts

- Contact for SORE certification:  
Kumar Muthukumar, Manager  
Off-Road Certification/Audit Section  
(626) 575-7040  
[kumar.muthukumar@arb.ca.gov](mailto:kumar.muthukumar@arb.ca.gov)  
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# Question & Answer

