

# California Air Resources Board (ARB)

## HIGHWAY MOTORCYCLE (HMC) EMISSIONS CERTIFICATION

November 30, 2006




California Environmental Protection Agency  
 Air Resources Board



### Major Steps

1. (New Mfrs.) Register with U.S. EPA and ARB.
2. Group vehicles into exhaust & evaporative families.
3. Demonstrate useful life (UL) durability & emissions compliance for each family.
4. Submit Applications to U.S. EPA and ARB via the Internet.



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## Major Steps

(cont'd)

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



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## What Is A Motorcycle?

“Motorcycle” is defined in California HSC, §39041 which references California VC, §400.

- (a) Motor vehicle having a seat or saddle for the rider, having three wheels or less, and weighing less than 1,500 pounds.
- (b) Motor vehicle having four wheels, two of which are part of a sidecar, and otherwise conforming to (a).
- (c) Electric motor vehicle having a maximum speed of 45 mph, and weighing less than 2,500 pounds, and otherwise conforming to (a).
- (d) A farm tractor is not a motorcycle.



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## What Is A Motorcycle? (cont'd)

### “Motorcycle” defined (cont'd)

(e) A three-wheeled motor vehicle that otherwise meets the requirements of subdivision (a), has a partially or completely enclosed seating area for the driver and passenger, is used by local public agencies for the enforcement of parking control provisions, and is operated at slow speeds on public streets, is not a motorcycle. However, a motor vehicle described in this subdivision shall comply with the applicable sections of this code imposing equipment installation requirements on motorcycles.

(Note: definition mainly for purposes of exemption from use of a helmet.)



## What Is A Motorcycle? (cont'd)

- On-road motor scooters that meet the definition of a “motorcycle” are certified for emissions compliance as a highway motorcycle (HMC).
- Not HMC.
  - All-Terrain Vehicle (ATV)
  - Off-Road Motorcycle
  - Pocket Bike
  - Motorized Scooter (stand up riding position for kids)
  - Golf Cart
- U.S. EPA certifies HMC < 50 cc for all U.S. sales.



## Getting Registered (New Mfrs.)

- Register with U.S. EPA as a Mfr.
- ARB issues its Executive Orders (EOs) to the vehicle Mfr. A business entity that has complete knowledge and control of the vehicle's specifications may certify on behalf of a Mfr.
- ARB does not issue EOs to importers or dealers that do not meet the above criteria.



## Getting Registered (New Mfrs.)

- Submit to ARB via regular mail a hard copy "Letter of Intent" to certify vehicles in CA.
- ARB sends the applicant an Excel template to be completed by Mfr.
  - Contact information, i.e., name, address, phone number., etc.
  - Brief description of motorcycles you intend to certify, i.e., models, displacements, 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 E-Cert & EDMS.



## New HMC – Whole Vehicle Certification

A new highway motorcycle (HMC) must comply with exhaust and evaporative standards. The whole vehicle, not the engine by itself, is tested.

- Chassis dynamometer testing for exhaust emissions.
- **Sealed Housing for Evaporative Determination (SHED)** testing for evaporative emissions.



## Certifying Manufacturers

### Option 1:

Motorcycle OEM **A** produces the engine and chassis:

**A** is the certifying MFR carrying all compliance obligations and liabilities.



## Certifying Manufacturers (cont'd)

### Option 2:

Motorcycle OEM **B** buys complete engines and evaporative emission control components from Engine OEM **C** and builds own chassis:

**B** is the certifying MFR carrying all compliance obligations and liabilities.

(Mfr. **C** can support Mfr. **B** by providing durability data, AECD and adjustable parameter information, production running change information and test data, and by implementing any required corrective action for in-use noncompliance.)



## Certifying Manufacturers (cont'd)

### Option 3:

Engine OEM **D** has a close business relationship with, and supplies complete engines and evaporative emission control components to, motorcycle OEMs **E**, **F** and **G**:

**D** is the certifying Mfr. carrying all compliance obligations and liabilities.

**D** must include a comprehensive list of all vehicles produced by Mfrs. **E**, **F** and **G** using its engines.

**D** provides assembly instructions to **E**, **F**, and **G**.

**E**, **F**, and **G** do not need to recertify.



## Group Vehicles into Exhaust & Evaporative 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
- **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
  - Fuel System, i.e., carburetor, TBI, MFI, SFI
  - Purge strategy, i.e., uncontrolled vs. controlled



## Demonstrate UL Durability & Emissions Compliance

1. a. Durability Demonstration – Whole Vehicle
  - Accumulate mileage on a prototype test vehicle.
  - Mileage or service accumulation cycle is set forth in Appendix IV of 40 CFR, §86.426-78.
  - Test duration is 6,000 km. (class I), 9,000 km. (II), or 15,000 km. (III) (= ½ useful life (UL) distance).



## Demonstrate UL Durability & Emissions Compliance (cont'd)

### 1. a. Durability Demonstration – Whole Vehicle

- Conduct periodic exhaust & evaporative emission tests during mileage accumulation.
  - Recommended minimum of four test points, e.g., at minimum test distance (MTD), total test distance (TTD), and two intermediate test points
  - If there is scheduled maintenance during the durability mileage accumulation, an emission test before and after the maintenance must be performed.
- Maintenance must conform to restrictions in 40 CFR, §86.428-80.



## Demonstrate UL Durability & Emissions Compliance (cont'd)

### 1. b. Durability Demonstration – Evaporative System

- Perform evaporative emission control system component bench aging, or request assigned deterioration factor.
- Evaporative system component bench aging procedure is in MAC 81-002.
  - Vibration endurance
  - Thermal exposure
  - Loading & purging of vapor storage device (canister)
  - Mechanical actuation, i.e., carburetor & purge valve
  - Ozone exposure of rubber & plastic parts





## Demonstrate UL Durability & Emissions Compliance (cont'd)

1. c. Test vehicle = worst case configuration in engine family having greatest probability of exceeding the standards.
  - Highest fuel flow rate
  - Highest test vehicle weight
  - Highest engine speed vs. vehicle speed (N/V)
  - Transmission type, i.e., manual vs. automatic
  
- d. Unscheduled maintenance must be approved by ARB.
  
- e. All test data and projected emissions must be below applicable standard.



## Demonstrate UL Durability & Emissions Compliance (cont'd)

1. f. Useful Life (UL), Minimum Test Distance (MTD), Total Test Distance (TTD)

Class	Eng. Disp. (cc)	UL (km.)	MTD (km.)	TTD (km.)
I	[50-170)	12,000	2,500	6,000
II	[170-280)	18,000	2,500	9,000
III	[280+]	30,000	3,500	15,000



## Demonstrate UL Durability & Emissions Compliance (cont'd)

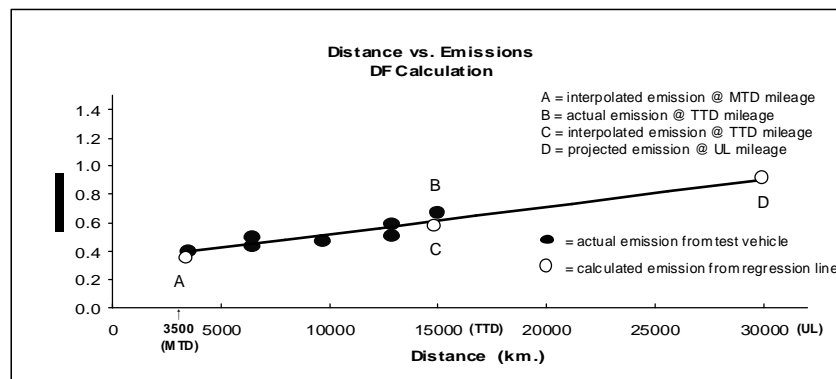
2. a. Determine UL deterioration factor (DF) for each pollutant.

- DF calculated from least squares linear regression of emission test data.
- Exhaust DFs (HC, NO<sub>x</sub>, CO) and evaporative vehicle DF (DF<sub>V</sub>) from mileage accumulation vehicle in 1.a.
- Evaporative bench DF (DF<sub>B</sub>) from component bench aging in 1.b.
- Overall evaporative DF =  $\frac{DF_V + DF_B}{2}$ .
- Exhaust DFs are multiplicative (≥1.000), evaporative DFs are additive (≥0.000).



## Demonstrate UL Durability & Emissions Compliance (cont'd)

2. b. Durability Data Plot



## Demonstrate UL Durability & Emissions Compliance (cont'd)

### 2. c. Determine UL Multiplicative DFs For Exhaust

$$DF = \frac{D}{C} = \frac{\text{projected emissions @ UL mileage}}{\text{interpolated emissions @ TTD mileage}}$$

Determine UL modified DF when the emission data vehicle (EDV) is different from the durability data vehicle (DDV).

(e.g., certification by Mfr. B under option 2, using Mfr. C's durability data, or testing for production running change on an MTD test vehicle.)

$$DF_{\text{modified}} = \frac{D}{A} = \frac{\text{projected emissions @ UL mileage}}{\text{interpolated emissions @ MTD mileage}}$$



## Demonstrate UL Durability & Emissions Compliance (cont'd)

### 2. d. Determine UL Additive DF For Evaporative Emissions.

$$\text{Evaporative DF} = D - C, \text{ or}$$

$$\text{Evaporative DF}_{\text{modified}} = D - A$$



## Demonstrate UL Durability & Emissions Compliance (cont'd)

3. Determine certification level for all pollutants. All certification levels must be  $\leq$  the applicable certification standard.

Certification level is the raw emission test data with DF applied.

Exhaust certification level =  $B \times$  exhaust DF

Evaporative certification level =  $B +$  evaporative DF

Or, when the EDV differs from the DDV

Exhaust certification level = EDV emission @ MTD  
mileage  $\times$  exhaust DF<sub>modified</sub>

Evaporative certification level = EDV emission @ MTD  
mileage + evaporative DF<sub>modified</sub>



## Demonstrate UL Durability & Emissions Compliance (cont'd)

4. Assigned evaporative DF allowance of 0.5 grams/test, See MAC 86-06.
  - Evap. emission control system previously CA-certified, or
  - Evap. system/components have proven UL durability
5. Retain test vehicle for possible confirmatory testing at ARB and for testing future production running changes.



## Highway Motorcycle Engine Certification Procedure Option 3

- Applicability
  - New HMC engine Mfrs.
  - New HMC chassis builders
  - Commercial HMC kit builders
- Emission Standards
  - All applicable CA exhaust & evaporative standards.
- Exhaust and evaporative system is part of engine package delivered to chassis Mfrs.
- Engine Mfr. is liable for vehicle compliance in use.



## Highway Motorcycle Engine Certification Procedure Option 3 (cont'd)

- Engine Mfr. conducts all required tests. ARB may conduct confirmatory tests
- Durability Demonstration Vehicle (DDV)
  - Install engine in worst case chassis configuration selected by ARB.
  - Highest loaded vehicle weight
  - Highest engine speed vs. vehicle speed (N/V)
- Run DDV to determine DFs.
- Show compliance with emissions standards.



## Highway Motorcycle Engine Certification Procedure Option 3 (cont'd)

- Specify all vehicles and vehicle parameters covered by application, including those implemented by running changes.
- Provide assembly instructions to all client chassis Mfrs.
- Provide emissions label, new vehicle emissions warranty, and owner's manual.



## Highway Motorcycle Engine Certification Procedure Option 3 (cont'd)

- No modification may be made by chassis Mfr. to engine, exhaust or evaporative ECS that could increase emissions over the stock configuration
  - Catalyst equipped vehicles must use supplied catalysts
  - CA evaporative system equipped vehicles must use supplied fuel & evaporative emission control system (e.g., fuel tank, gas cap, fuel lines, vapor hoses, canister, purge valve)
  - Non-catalyst equipped vehicle must not exceed Mfr.'s maximum back pressure limits.
- Assembler restrictions established by engine Mfr.
  - Maximum weight
  - Engine speed vs. vehicle speed (N/V)



## CA HMC Emission Standards Model Year 2007 and Later

EXHAUST (g/km.)			
	HC	HC+NO <sub>x</sub>	CO
Class I & II [50-279 cc]			
2007+	1.0	-	12
Class III [280+ cc]			
2007	-	1.4 <sup>(1)</sup>	12
2008+	-	0.8 <sup>(1)</sup>	12
EVAPORATIVE (grams per 1-hr. diurnal + hot soak SHED test)			
All	2.0		

<sup>(1)</sup> May be met on a corporate average basis.



## CA Small Volume HMC Mfr. (≤ 300 sales/yr.) Emission Standards Model Year 2007 and Later

EXHAUST (g/km.)			
	HC	HC+NO <sub>x</sub>	CO
2007			
Class III [280-699 cc]	1.0 <sup>(1)</sup>	-	12
Class III [700+ cc]	1.4 <sup>(1)</sup>	-	12
2008+			
Class III [280+ cc]	-	1.4 <sup>(1)</sup>	12
EVAPORATIVE (grams per 1-hr. diurnal + hot soak SHED test)			
All	2.0		

<sup>(1)</sup> May be met on a corporate average basis.



## Corporate Averaging

- Compliance based on sales-weighted emissions
- Applicable to exhaust HC or HC+NO<sub>x</sub> for class III only [280+ cc]
- Separate corporate average plan (CAP) for each standard
- List designated standard on emissions label
- May revise CAP during model year
- Cannot change designated standard for an engine family after start of production of that family



## Corporate Averaging (cont'd)

- Example Corporate Average Plan

MANUFACTURER: XYZ MOTORCYCLE CO.			
MODEL YEAR: 2008			
CORPORATE AVERAGE STANDARD: 0.8 g/km. HC+NO <sub>x</sub>			
Engine Family	Estimated Annual CA Production Volume (1)	Designated HC+NO <sub>x</sub> Standard (2)	Sales Weighted Emissions (3) = (1) × (2)
8XYZC0.58AAA	88	1.1	96.8
8XYZC0.64AAB	124	1.2	148.8
8XYZC0.78AAC	600	0.4	240
8XYZC0.99B23	122	0.9	109.8
8XYZC01.2C45	50	0.7	35
TOTALS	984		630.4
ESTIMATED CAP EMISSION VALUE = $\Sigma(3)/\Sigma(1) = 630.4/984 = 0.641$ g/km. HC+NO <sub>x</sub> Std. = 0.8			





## Adjustable Parameters Fuel & Ignition System

1. 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.
2. ARB can specify, for emission testing, any setting within the physical range of adjustments.



## Auxiliary Emission Control Devices (AECDs)

1. AECD: Any element of design which senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum, or any other parameters for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission control system.



## Auxiliary Emission Control Devices (AECDs) (cont'd)

2. All AECDs must be described in the application and approved by ARB.
3. Unapproved AECDs may be deemed a defeat device – a violation of certification.



## Submit Certification Documents Via The Internet

- Vehicle specifications and emission data are submitted to the U.S. EPA's VERIFY database.
- Mfr.'s data is automatically forwarded to ARB's Electronic Certification (E-Cert) database.
- Mfr. submits supporting certification-related documents to ARB's EDMS.



## Submit Certification Documents Via The Internet (cont'd)

- Documents to be submitted to ARB's EDMS:
  - manufacturer's identification
  - vehicle description
  - test procedures, e.g., durability, worst-case vehicle selection criteria
  - maintenance instructions
  - AECDs
  - adjustable parameters
  - anti-tampering devices for adjustable parameters
  - emissions label design
  - emissions warranty statement
  - compliance statements, corporate average plan



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## ARB Contacts

- Electronic Document Management System (**EDMS**)
  - Ms. Ivonne Guzman-Cicero, On-Road Certification/Audit Section at [iguzmanc@arb.ca.gov](mailto:iguzmanc@arb.ca.gov)
  - For Mfr.'s information Excel template, Ms. Kimberly Pryor, On-Road Certification/Audit Section at [kpryor@arb.ca.gov](mailto:kpryor@arb.ca.gov)
- Certification
  - Your Mfr. assigned cert. staff, or
  - Mr. Duc Nguyen, Manager, On-Road Certification/Audit Section at [dnguyen@arb.ca.gov](mailto:dnguyen@arb.ca.gov)



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## INTERNET ADDRESSES TO HMC EMISSIONS REGULATIONS

The California highway motorcycle regulations are in Title 13, California Code of Regulations (13 CCR), Section 1958.

<http://www.arb.ca.gov/regact/motorcyc/finreg.pdf>

The California evaporative emission standards are in 13 CCR, §1976, and California emissions label specifications are in 13 CCR, §1965.

<http://www.arb.ca.gov/msprog/levprog/cleandoc/cleancompletelev-ghgregs11-7.pdf>

13 CCR, §1976 references the "California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles."

<http://www.arb.ca.gov/msprog/evap/evaptp01.pdf>

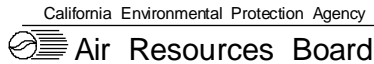
The California emissions warranty requirements are in 13 CCR, §2035 et seq.

13 CCR, §2035, §2037 & §2038

<http://www.arb.ca.gov/regact/obdii06/obdattachc.pdf>

13 CCR, §2036

<http://www.arb.ca.gov/msprog/onroadhd/regm5.pdf>



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## INTERNET ADDRESSES TO HMC EMISSIONS REGULATIONS (cont'd)

The ARB's definition of "motorcycle" is in California Health and Safety Code (HSC), Section 39041.

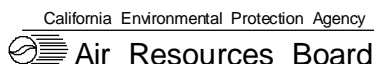
[http://www.arb.ca.gov/bluebook/bb06/hea39041/hea\\_39041.htm](http://www.arb.ca.gov/bluebook/bb06/hea39041/hea_39041.htm)

HSC §39041 directly references the California Vehicle Code (VC) Section 400. One important difference between California's and U.S. EPA's definition of a motorcycle is that for California, the maximum curb weight is 1,500 pounds; for U.S. EPA, the maximum curb weight is 1,749 pounds.

[http://www.arb.ca.gov/bluebook/bb06/veh400/veh\\_400.htm](http://www.arb.ca.gov/bluebook/bb06/veh400/veh_400.htm)

The California highway motorcycle regulations heavily reference the U.S. EPA's regulations in Title 40, Code of Federal Regulations, Part 86, Subparts E and F. These regulations are available from the U.S. EPA's Highway Motorcycle Information Page.

<http://www.epa.gov/otaq/roadbike.htm>



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