North American Certification and Compliance Program for Highway Motorcycles and Recreational Vehicles

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and
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October 14, 2016

Compliance Vision of EPA

- Ensure mobile source air quality goals are achieved or exceeded
- Provide compliance assistance to manufacturers to facilitate successful market participation and emission standards are met
- Facilitate a level playing field for all market participants to protect the investments of all market participants

Gasoline Engine Compliance Center

- Compliance Review
  - Ramping up our certification review activity with more rigorous analysis of data submitted
  - If industry appropriately completes this work, we can have high confidence their product / process should be compliant.
- We do not issue certificates (licenses to produce) if we do not believe manufacturers have met these requirements
- Improving our oversight of manufacturer-submitted PLT reports
- Leveraging information technology to identify potential problems from manufacturer-submitted compliance reports
- Identifying potential manufacturing problems in real-time
- Improving our cross-government communications (including with Customs) to turn away uncertified products at the port
- Providing transparency for our compliance activities by posting those families that have faced actions such as voiding
- http://www.epa.gov/otaq/motor-void.htm

Large Spark-Ignition	  
Small Spark-Ignition	  
On-highway Motorcycles	
Off-road Motorcycles	
Recreational Vehicles	 
Snowmobiles	
Evaporative Components	
Heavy-Duty Gasoline Engines	
Marine Spark-Ignition	

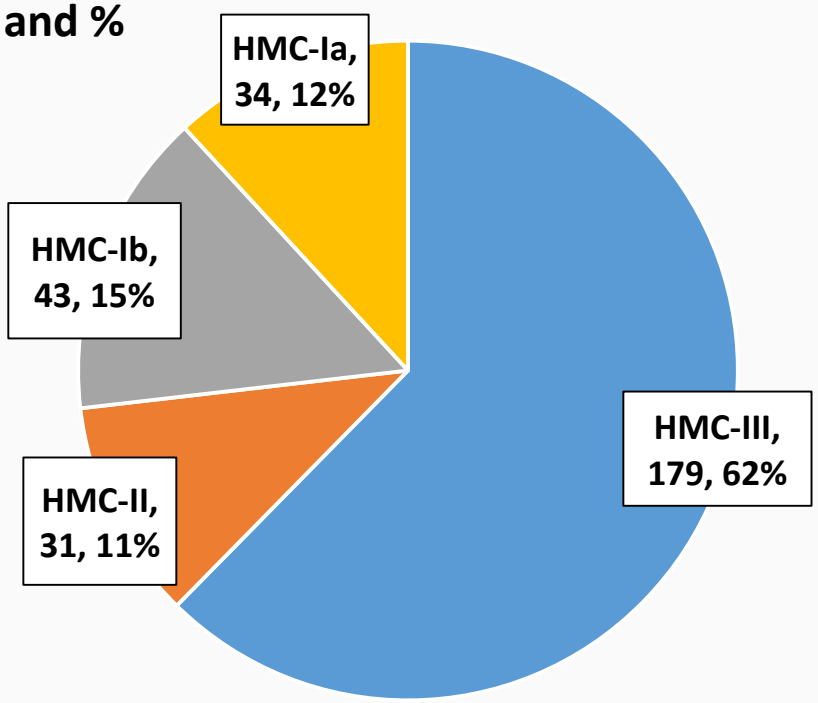
Topics

- Overview of 2015 MY HMC/RV Certification and Production
- Cert Requirements/ New Guidance /AECDs
- HMC Shift Predictor Model
- Testing Program (Cert, PV, SEA and PLT)
- In-Use Performance Assessment
- Round Robin Test Program
- Enforcement Action Updates

OVERVIEW OF 2015 MY HMC/RV CERTIFICATION AND PRODUCTION

2015 MY HMC Certified Engine Families & Production

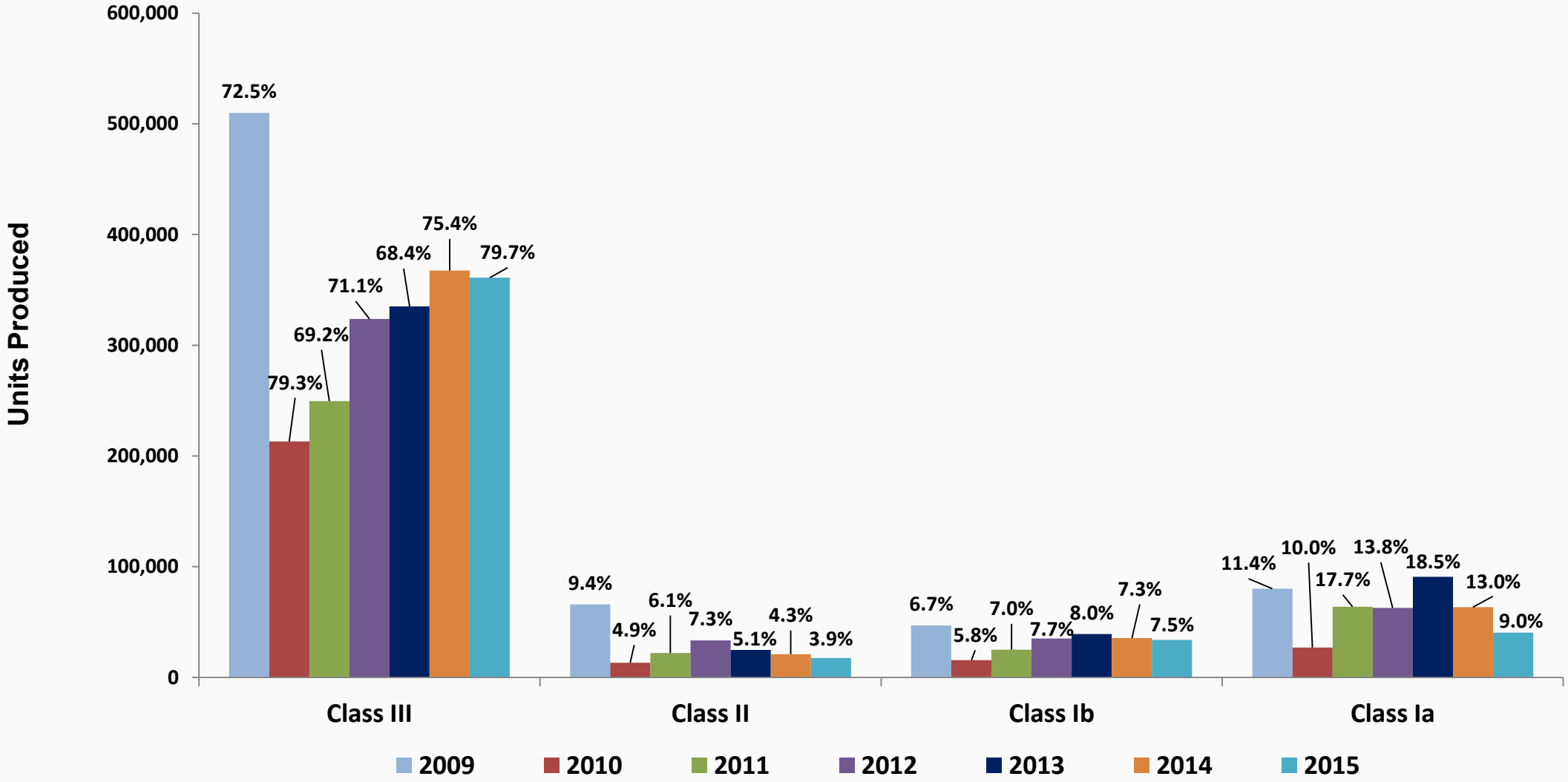
EF #s and %



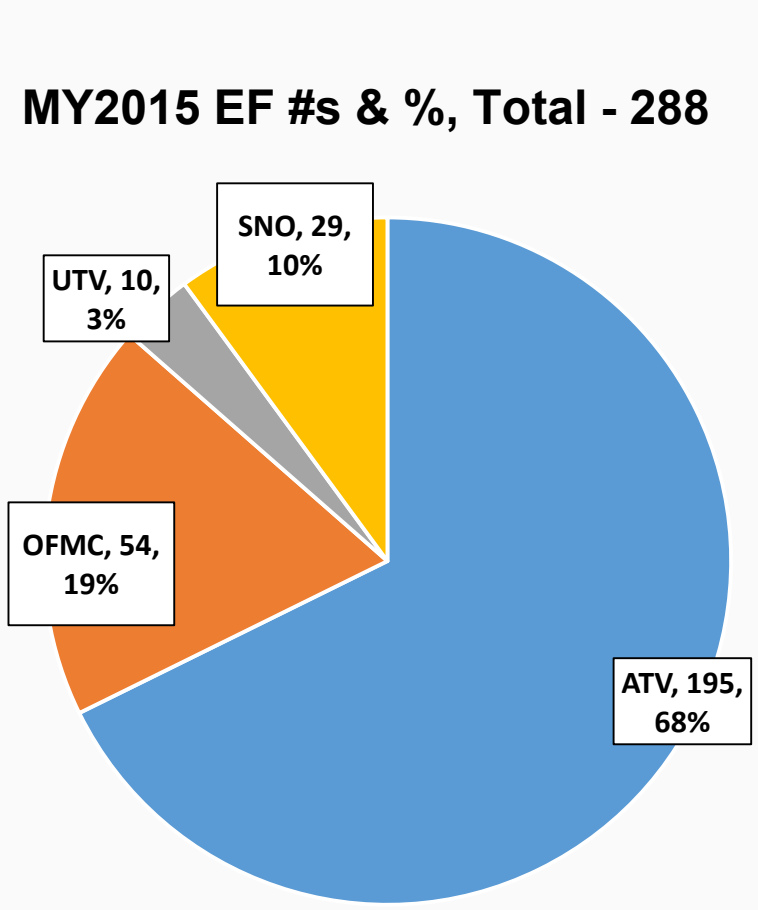
	EF with FI + O2 sensor	EF without FI + O2 sensor	Total Certified Engine Families
HMC	173	114	287
%	60.3%	39.7%	
HMC - Class III	149	30	179
%	83.2%	16.8%	62%

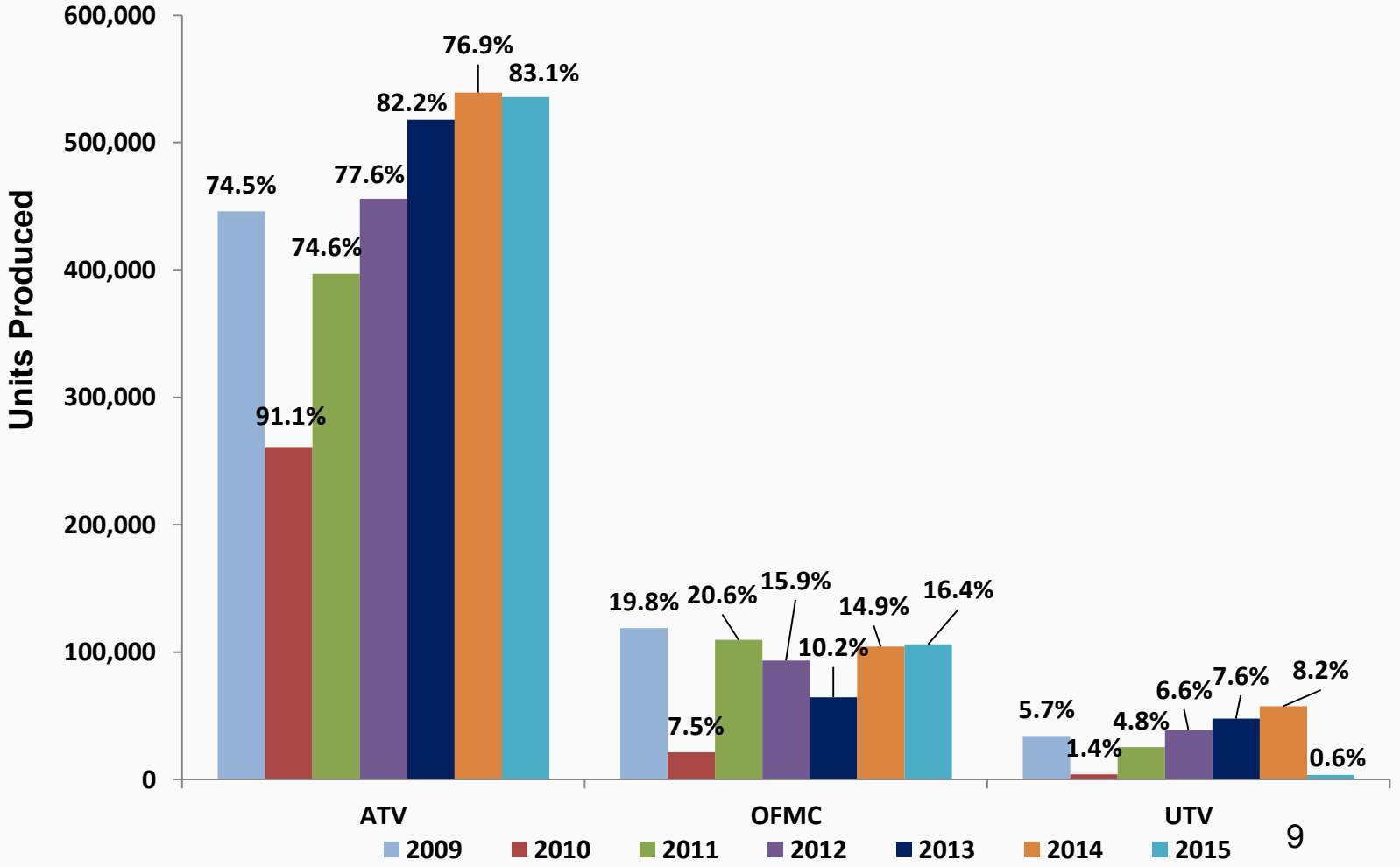
	Production Units with FI + O2 sensor	Production Units without FI + O2 sensor
HMC - %	78.9%	21.1%
HMC - Class III - %	89.5%	10.5%

HMC Overall Production by Class

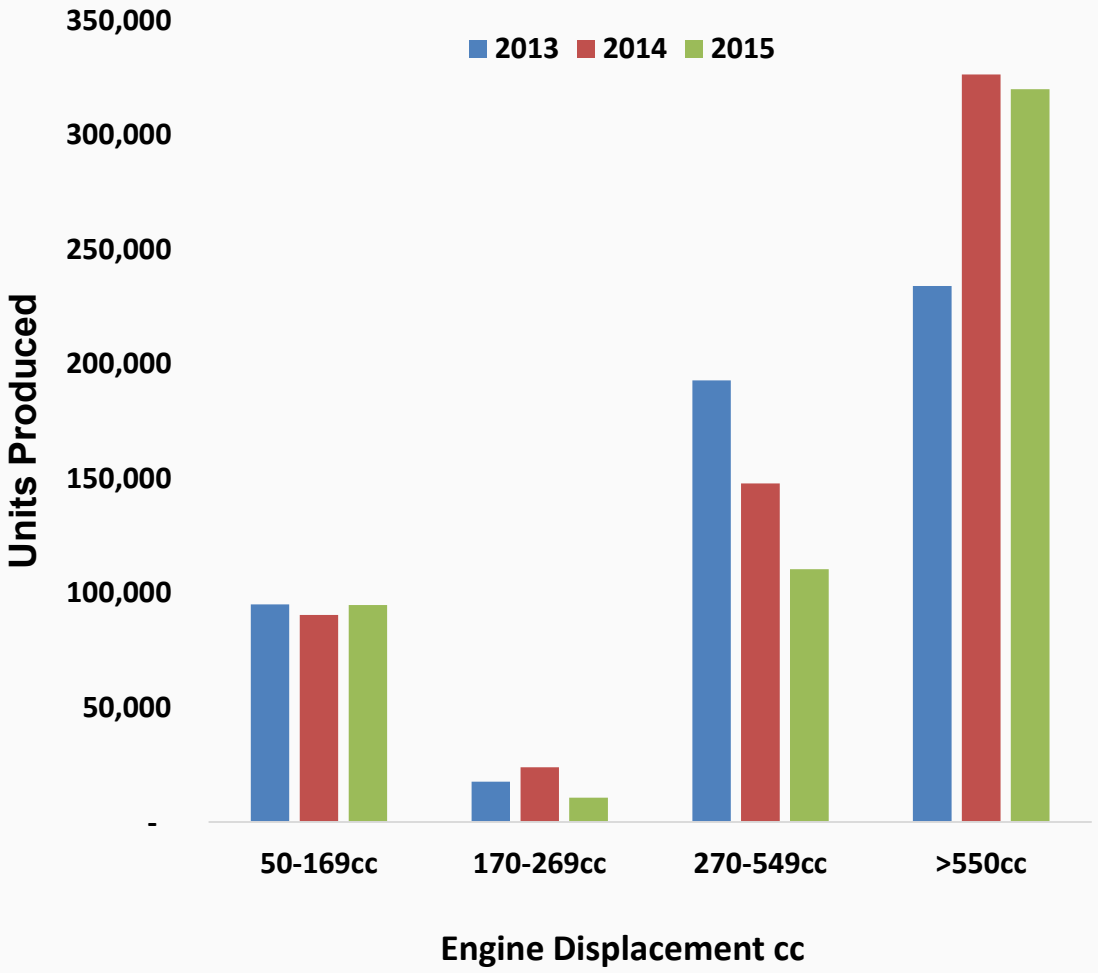


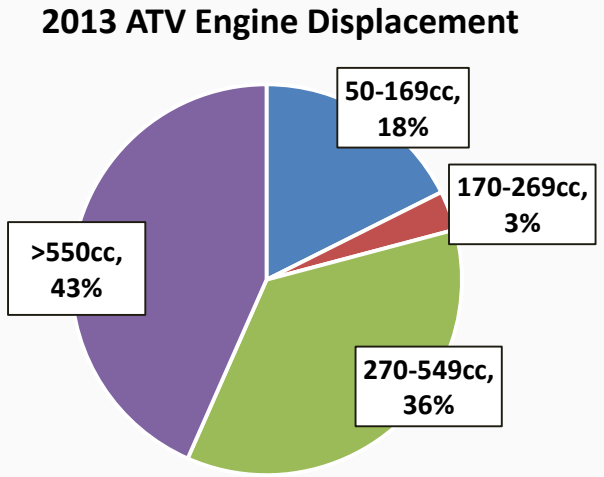
RV Certified Engine Families & Production Growth by Category

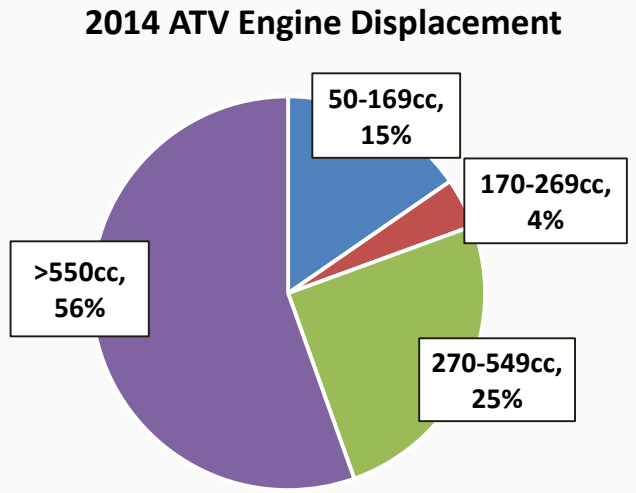


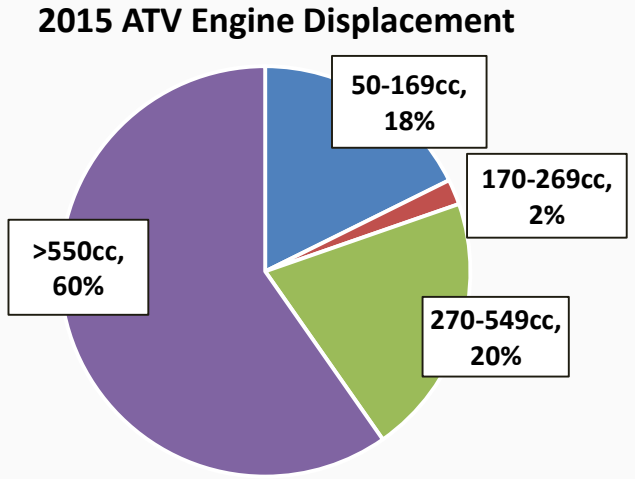


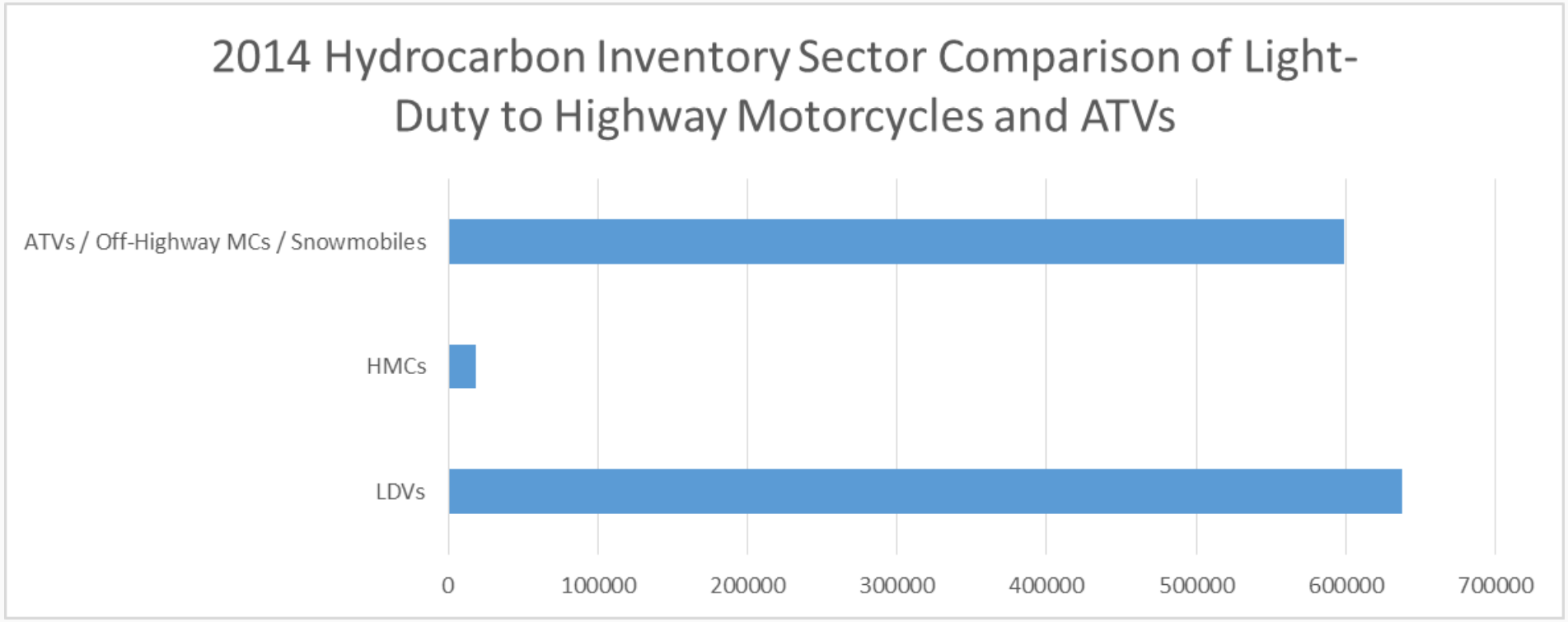
ATV Engine Displacement Trends











2014 MOVES Model estimates based solely on model default parameter estimates and may differ from inventories generated using detailed local data.

RV Engine Certified Engine Families & Production

% EFs with FI + Closed-loop Control (2015 MY)

	EF with FI + O2 sensor	EF without FI + O2 sensor	Total Certified Engine Families
RV (ATV+UTV+OFMC)	95	193	288
%	33.0%	67.0%	

% Reported Production with FI +Closed-loop Control (2015 MY)

	Production Units with FI + O2 sensor	Production Units without FI + O2 sensor
RV (ATV+UTV+OFMC) - %	29.4%	70.6%

CERTIFICATION REQUIREMENTS

CROMERR & Verify's New Request for Certificate (RFC) Module for Motorcycles and ATVs

Tentative Deployment Schedule

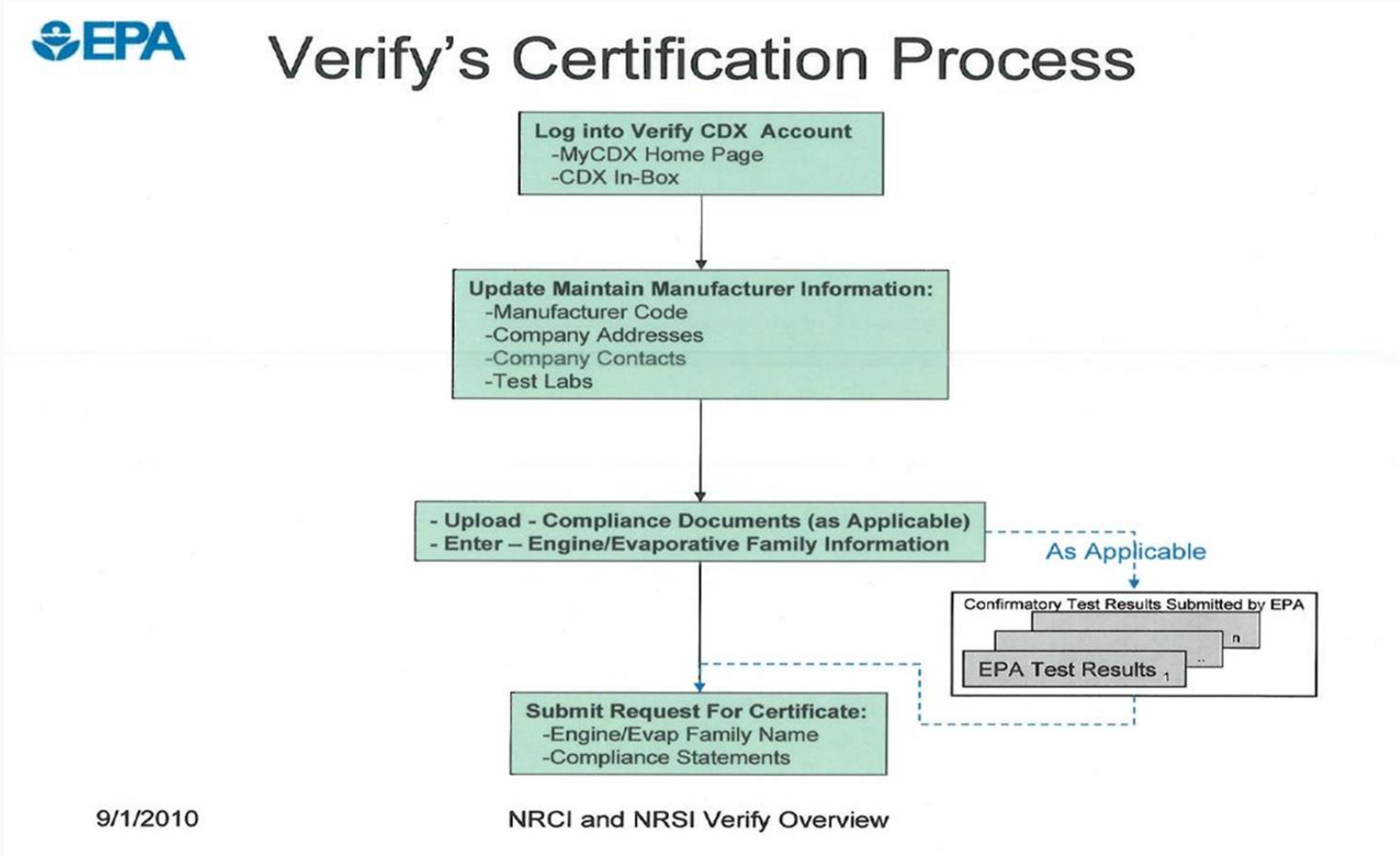
- Deployment of the CROMERR Process RFC (Request for Certificate) module for motorcycles and ATVs is tentatively scheduled for early 2017

- Manufacturers will need to establish new Verify roles in order to request certificates in the new module
  - Visit the Verify account setup page for more details: https://www3.epa.gov/otaq/verify/setup.htm

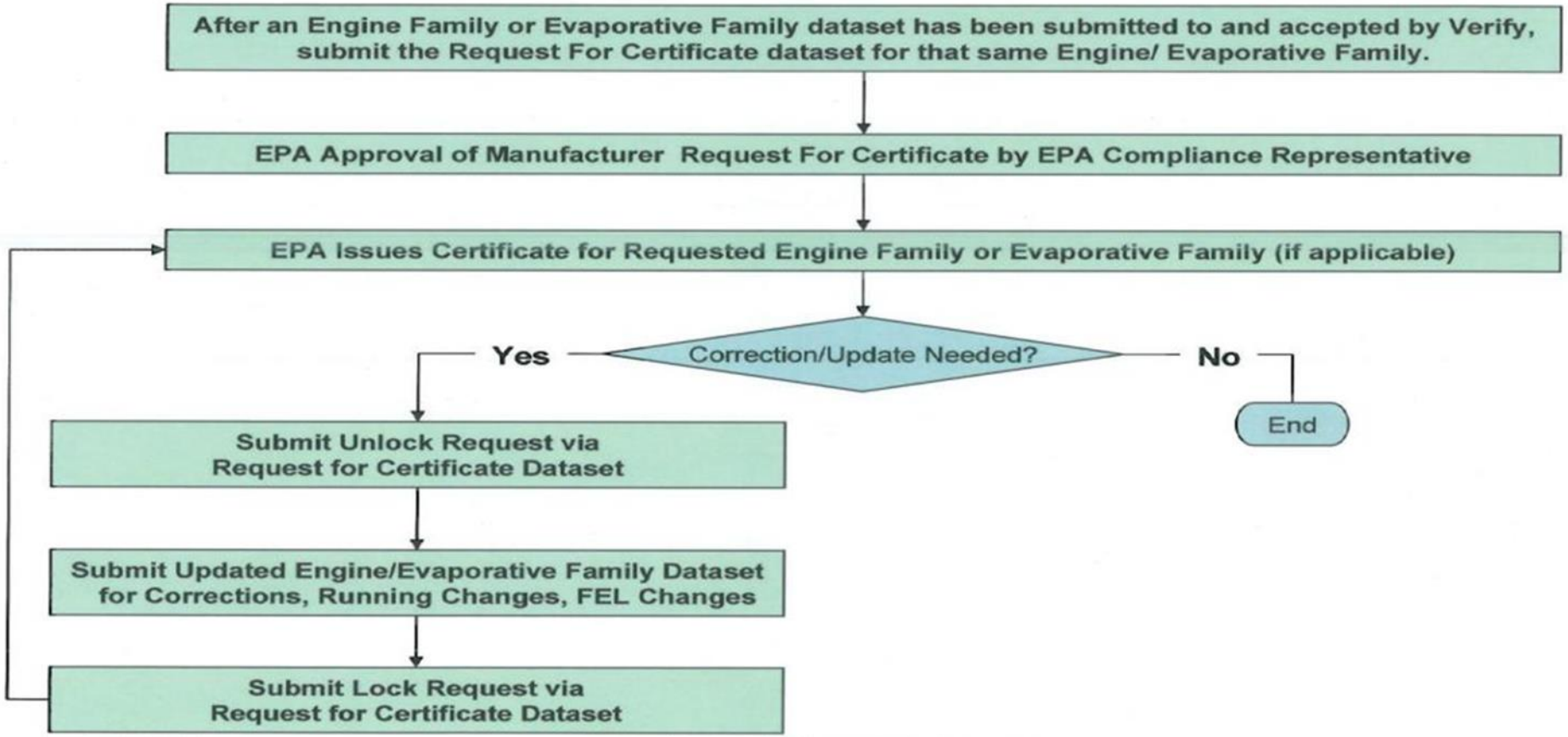
- EPA will conduct several webinars for industry well in advance of the deployment
  - Webinars will be announced via EPA Guidance Letters and Verify list server messages

- Send questions to pugliese.holly@epa.gov

Certification Process



Request For Certificate Process - NRSI



Certification

- Who may certify?
  - Manufacturer, or importer (since CAA defines importers as manufacturers). EPA expects importer to exercise a degree of control over production facility and to be aware of production line changes.
- Manufacturer tests worst case engine in the engine family (if the standard is g/kw-hr) or worst case vehicle in engine family (if standard is g/km).
- Manufacturer determines the emission deterioration factor for the engine family by testing the engine or vehicle when new, but also aged (approximately half useful life).
- If regulatory scheme requires On-Board Diagnostic (OBD) capability, Manufacturer designs and tests the OBD system to ensure it activates as required.

Application for Certification

- Manufacturer prepares and submits an Application for Certification (Cert Ap) that:
  - Follows EPA format and electronic submission protocols;
  - Follows EPA guidance;
  - Fully describes ALL of the models in the engine family that will be covered by the certificate; and
  - Contains a compliance statement that the test engines/vehicles were tested in accordance with regulations and all production engines/ vehicles will be built to conform to the description in the application for certification.
- Manufacturer updates Cert Ap when models are added or other changes made (Running Change).
- Submission of incomplete or inaccurate applications will result in delays in the completion of the review and may result in denial.

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Other Manufacturer Responsibilities

- Manufacturer must not introduce product into U.S. Commerce until the effective date of the Certificate of Conformity (COC).
- Certification for the engine family must be renewed annually (but data may be reused or “carried over” when there is no design change from year to year).
- Manufacturer must label each engine/ vehicle as it is produced with an EPA-compliant label.
- Manufacturer must warrant that its engine/ vehicle will meet standards for full useful life (both performance and defect warranties are required).
- Manufacturer must report emission-related defects to EPA.
- Manufacturer must maintain records.
  - Keep testing and production records for 5 years, or longer if being relied upon for carryover

Prohibition on Introduction Into U.S. Commerce of New Uncertified Engines or Vehicles

- CAA Section 203(a)(1), 42 U.S.C. § 7522(a)(1): The following acts and the causing thereof are prohibited
  - In the case of a manufacturer of new motor vehicle vehicles or new motor vehicle engines for distribution in commerce, the sale, or the offering for sale, or the introduction, or delivery for introduction, into commerce, or (in the case of any person, except as provided by regulation of the Administrator), the importation into the United States, of any new motor vehicle or new motor vehicle engine, manufactured after the effective date of regulations under this part which are applicable to such vehicle or engine unless such vehicle or engine is covered by a certificate of conformity issued (and in effect) under regulations prescribed under this part or part C in the case of clean-fuel vehicles (except as provided in subsection (b));

What it means to be Covered by a Certificate of Conformity:

- Certificate of Conformity language is the basis for determining what is covered.
- Generally, this means the vehicles or engines must be:
  - Built to same design specifications as the test engine and match the specifications in the application for certification;
  - Among the models named in the application for certification;
  - Built in the model year named on the certificate;
  - Built at the production facilities named in the application for certification;
  - Built by the manufacturer named in the application for certification; and
  - Not introduced into commerce prior to the effective date of the certificate.
  - See 40 C.F.R. § 85.2305 and § 1068.103(a).

What must be covered by an Emission Warranty CAA § 207(a)(1)

- Warranty covers:
  - Performance (vehicle must be repaired if it cannot meet standards in-use during the warranty period
    - Warranty period is typically and
  - Defects (emission control components and engine must be free from defects in materials and workmanship that would cause the vehicle to fail to conform to the applicable requirements for the useful life.)

Warranty

- You must warrant to the ultimate purchaser and each subsequent purchaser that the new engine, including all parts of its emission-control system, meets two conditions:
  - (1) It is designed, built, and equipped so it conforms at the time of sale to the ultimate purchaser with the requirements of this part.
  - (2) It is free from defects in materials and workmanship that may keep it from meeting these requirements.

- Your emission-related warranty must be valid for at least 50 percent of the vehicle's minimum useful life in kilometers or hours of engine operation (where applicable), or at least 30 months, whichever comes first. You may offer an emission-related warranty more generous than we require. The emission-related warranty for the engine may not be shorter than any published warranty you offer without charge for the engine.[1]

- The Agency is checking websites and calling warranty numbers to ensure accuracy of the information before and after the certificates are issued to help protect consumers and ensure the accuracy of the information provided so products can be properly maintained

[1] See 40 CFR 1051.120 and 40 CFR part 1068, Appendix I

ICR REVIEW

ICR Update

- To collect information consistent with the regulatory requirements, the Agency periodically reviews the cost associated with assembling the information by the regulated industry.
- The purpose is to evaluate whether the proposed collection of information is necessary for the proper performance of the functions of the Agency.
- Additionally, the Agency solicits comments to enhance the quality, utility, and clarity of the information to be collected
- Public review and comment is part of the process.
- EPA has established a public docket for this ICR for on-highway motorcycle emissions certification and compliance under Docket ID number OAR-2016-0027

Link to the Information Collection Request Notice in the Federal Register

- https://www.federalregister.gov/documents/2016/02/12/2016-02956/agency-information-collection-activities-information-collection-request-icr-for-on-highway

https://www3.epa.gov/otaq/certdat2.htm#annual-plt

RECOMMENDED TEMPLATES

Catalyst Information

40 CFR §86.416-80(a)(2)(i), 40 CFR §86.420-78(b)(7), and/or 1051.230(b)(5) where applicable

Note 1. For fields in which the catalyst information is not applicable or not available, please type "NA". We may consider your application to be incomplete if appropriate information is not provided.

Note 2. Production tolerances for the specifications below may be included at the applicant's discretion.

Engine Family Name: _____

Catalyst Information (Catalyst on this form refers to the loaded substrate without casing)

		Catalytic Converter Catalyst 1	Catalytic Converter Catalyst 2	Catalytic Converter Catalyst 3
Section 1	Catalyst Manufacturer			
	Part # shown on catalyst			
	Part # shown on catalyst casing			
	Vehicle Manufacturer Part #			
	Catalyst Manufacturer Part #			
	Catalytic/Active material (Pt, Pd, Rh, Ag, Ni, Ce, Zr, CoO, etc)			
	Ratio of Catalytic/Active material, in the order: Pt:Pd:Rh:Ag:Ni:Ce:Zr:CoO…			
	Loading of Catalytic/Active material (g/L)			
	Carrier/Washcoat Materials			
	Catalyst Type (honeycomb, mesh, etc.)			
	Catalyst Location (e.g., in muffler, etc.)			
	Substrate Material (ceramic, metallic, etc.)			
	Substrate Material (ceramic, metallic, etc.)			
Section 2		**Honeycomb Type**		
	Outside Container Diameter (mm)			
	Outside Container Length (mm)			
	Inside Substrate Diameter (mm)			
	Inside Substrate Length (mm)			
	Cell Density (specify units)			
		Mesh Type		
	Type of [illegible]			

Highway Motorcycle - Test Vehicle Information

EPA Test Order #	
Engine Family Name	
Certificate Holder Name	
Certificate Holder EPA ID	
Commercial Model Name	
Manufacturer Model Name	
st Vehicle Engine Manufacturer	
Test Vehicle Manufacturer	
Original Certification EDV (Y/N)?	
Production Vehcile (Y/N)?	

This form is filled by:

Name	
Company	
Phone #	
E-Mail	
Date	
Signature	
Odometer reading	

Certification Information: Exhaust

Constituent	CO	THC+NOX	THC	NOX	CO2
Units	(g/km)	(g/km)	(g/km)	(g/km)	(g/km)
Standard				n/a	n/a
Manufacturer Test Result					
Certification Value				n/a	n/a
Certification DF					n/a
Modified DF*					n/a
DF Type	Multiplicative				n/a

* *For use when test vehicle's mileage is different than the durability test distance.*

Test Parameters

Test Vehicle VIN or Other ID	
Engine Code	
Engine Displacement (cc)	
Make/Model Name	
Motorcycle Class	
Idle Speed (rpm)	
Drive Wheel Tire Pressure (psi)	
quivalent Inertial Mass [EIM] (kg)	
Force Coefficient A (nt)	
Force Coefficient C (nt/(km/h)^2)	
Fuel Tank Capacity	
50% Fuel Tank Capacity	

Manufacturer Start Procedures:

Coefficients are determined based on EIM, using CFR 86.529-78(b)figure F78-3

Conversion Factor 3.785 liters/gal

Transmission Type:

Shift Schedule, if applicable	Y/N
40 CFR 86.528-78 (h)(1) for Class I or Class II HMCs	
40 CFR 86.528-78 (h)(2) for Class III HMCs	
Use manufacturer shift schedule on page 2	

EPA Form # 5900-395

Shift Point (km/h)					
Upshift (gear)	1st-2nd	2nd-3rd	3rd-4th	4th-5th	5th-6th
Speed (KPH)					
Downshift (gear)	2nd-1st	3rd-2nd	4th-3rd	5th-4th	6th-5th
Speed (KPH)					

Manufacturer Specified Sec-by-Sec Shift Schedule					
Schedule Time (sec.)	Gear Shift (from - to)	Schedule Time (sec.)	Gear Shift (from - to)	Schedule Time (sec.)	Gear Shift (from - to)

OMB Control No. 2060-0048 Approval Expires on 8/31/2017
OMB Control No. 2060-0104 Approval Expires on 9/30/2016

United States
ENVIRONMENTAL PROTECTION AGENCY
2000 Traverwood Drive, Ann Arbor, MI, 48105

* = required field

Voluntary Emissions Recall Report (VERR)

Validate Form

Report / Manufacturer Information

( ) New VERR ( ) Correct / Update VERR *

Manufacturers are required to submit six Quarterly Reports following a new VERR submission.

EPA VERR Number *

Manufacturer VERR Number *

Form Version Number *

Additional email address

Voluntary Emission Recall Information

Owner notification start date *

Owner notification final date

Problem category *

Air Inlet/Intake System
Catalyst/Aftertreatment Component/System (non-diesel engine)
Computer Related (Other than OBD)
Electrical, Mechanical and Cooling Systems

101%

Manufacturer Request for Pre-approval of Using Certified Data In-lieu of New Tests

Form to assist manufacturer to comply with 40 CFR 86.421-78(d)

EPA Form No. 5900-392 (Rev: March 2015)

Requestor Name		**Agency Use Only**
Submission Date (MM/DD/YYYY)		**EPA Determination:**
Requester Signature		

Note : An official letter from the data owner to authorize data use must be attached for this request.

	Certified Engine Family	New Engine Family	Comparative Results/Notes
Engine Family			
Model Name(s)			
Engine Manufacturer			
Vehicle Assembly Manufacturer			
Combustion Cycle			
Cooling Mechanism			
Number of Cylinders			
Cylinder Configuration			
Engine Displacement (cc)			
Bore Size			
Stroke Size			
Transmission Type			
Prechamber Characteristics			
Combustion Chamber Configuration			
# of Intake and Exhaust Valve or Port Sizes			
Intake and Exhaust Timing of Actuation			
Fuel System			
Exhaust System			
Engine Oil			
Air Aspiration Method			
Spark Timing			

OMB Control No. 2060-0048 Approval Expires on 8/31/2017
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EPA United States Environmental Protection Agency

United States
ENVIRONMENTAL PROTECTION AGENCY
2000 Traverwood Drive, Ann Arbor, MI, 48105

Validate Form

Emissions Defect Information Report (EDIR)

* = required field

Report / Manufacturer Information

○ New EDIR ○ Correct / Update EDIR *

Manufacturers must submit EDIRs within 15 working days after an emission-related defect is found.

EPA EDIR Number *

Manufacturer EDIR Number *

Form Version Number *

Additional email address

Defect Information

Problem category *

Air Inlet/Intake System
Catalyst/Aftertreatment Component/System (non-diesel engine)
Computer Related (Other than OBD)
Crankcase Ventilation Component/System
Diesel Particulate Filter System

Defect description *

Defect Reporting

EPA issued the following guidance letter on August 1, 2016:

CD-16-12 (All Nonroad Indutries, HD On-highway)

Subject: Changes in Submission Process of Emissions-Related Defect and Recall Reports under 40 CFR Part 1068, Subpart F

This letter can be found at: https://iaspub.epa.gov/otaqpub/display_file.jsp?docid=36866&flag=1

40 CFR 1068, Subpart F- *Reporting Defects Engines/Equipment*

Header Information:

Corporate Name:
40 CFR §1068.501(d)(1)

Report Number:

Contact Name:
40 CFR §1068.501(d)(1)
The name of the contact person for this investigation or defect report.

Report Version:

Contact Email Address:

Contact Phone Number:

Report Data:

Report Type:
§1068.501(h)(1-3)
--Select--

Defect Category:
§1068.501(d)(2)
--Select--

Description of Defect:
§1068.501(d)(2)

Detailed Defect Information:

Description and details of engines/equipment affected 40 CFR §1068.501(d)(3)-(4):

Use Table 1 to add engine family information (Click Here)

An explanation of how you determined the number of affected engines/equipment.
Describe any statistical methods you used under paragraph (g)(6) of section 40 CFR §1068.501:

Helpful Websites

- Publications
  https://www3.epa.gov/otaq/verify/publications.htm#edir
- Guidance Documents
  https://www3.epa.gov/otaq/cert/dearmfr/dearmfr.htm
- Certification Assistance Videos (example)
  https://www3.epa.gov/otaq/verify/diurnal-video-1/diurnal-video-1.htm
- Emission Standards for Motorcycles
  https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZX.pdf
- Emission Standards for Recreational Vehicles
  https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100OA0L.pdf

AUXILIARY EMISSION CONTROL DEVICES (AECDS)

AECDs and Defeat Devices

- ***Auxiliary emission-control device*** means any element of design that senses temperature, motive speed, engine RPM, transmission gear, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission-control system.

- AECDs should be **fully disclosed** in the application for certification.

- ***Defeat devices.*** You may not equip your vehicles with a defeat device. A defeat device is an auxiliary emission-control device that reduces the effectiveness of emission controls under conditions that the vehicle may reasonably be expected to encounter during normal operation and use. This does not apply to auxiliary emission-control devices you identify in your certification application if any of the following is true:
- (1) The conditions of concern were substantially included in the applicable test procedures described in subpart F of this part.
- (2) You show your design is necessary to prevent vehicle damage or accidents.
- (3) The reduced effectiveness applies only to starting the engine.

Example: AECD Form Submitted within Application

Auxiliary Emission Control Devices for EPA

AECD	Sensed Parameter	Sensor	Controlled Parameters		Justification/Rationale	Defeat Devices ?
			High	Low		
AECD 1: Deactivation of the lambda control strategy						
AECD 2: Deactivation of the Secondary air injection						

Additional items we plan to request:

1. Submit a base engine map with torque(or throttle angle) and power vs. engine RPM. The map may be a 10 by 10 grid or finer resolution. Please add the following to this map:
   a. Target lambda contours, highlight region of closed-loop lambda control
   b. Exhaust temperature contours (measured after engine before TWC)
   c. FTP cycle operation region (or dots for each second)
   d. Vehicle top speed at the highest gear in which lambda equals 1
2. Identify each engine or emission control component that needs protection through your enrichment strategies
3. Indicate the temperature limitations of those components
4. Describe how each of enrichment strategy addresses those temperature limitations;
5. Explain why you believe the enrichments as seen in the lambda contour map for the purpose of increasing power do not go beyond the need for protecting those components.
6. Submit the temperature contour maps for each protected component, with X- rpm and y-Torque
7. Identify any other alternative A/F maps used for transient, excursions, or any other purposes
8. Identify other strategies that modify fuel injection quantities.
9. Identify any other user control that may modify fuel injection quantities.

COMPLIANCE TESTING

EPA TESTS

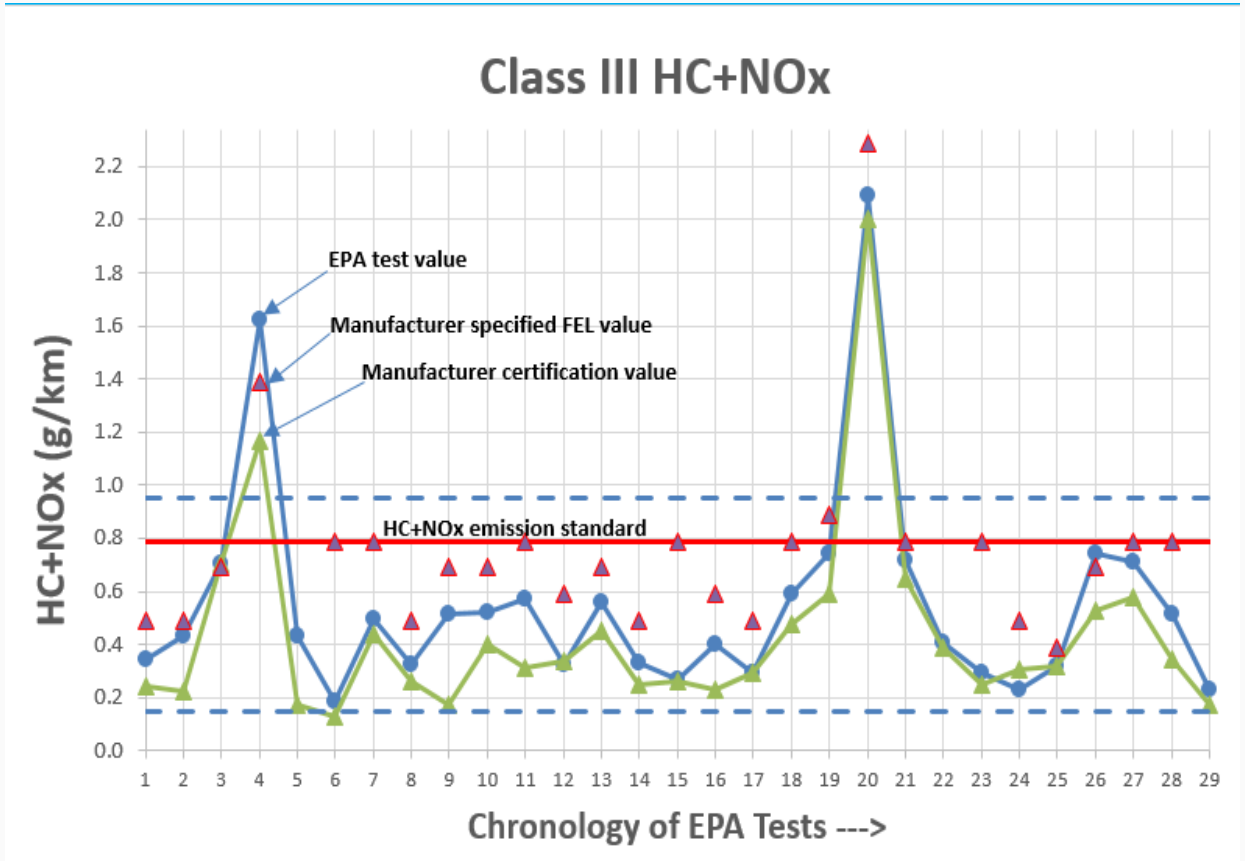
Highway Motorcycle Test
(2012 to present, Oct. 5, 2016)

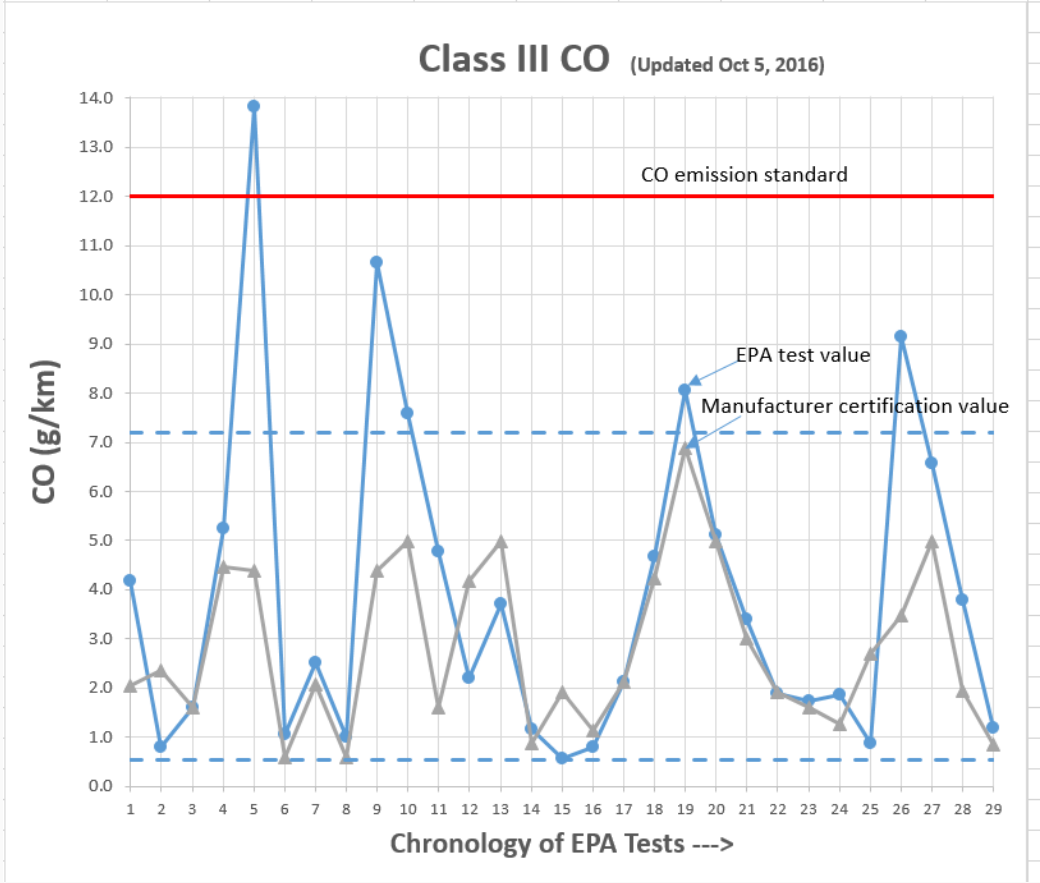
HMC Class		Failure Rate, %
<50 cc		16.67%
50 -169 cc		28.57%
170-279 cc		0.00%
>279 cc		6.90%

Recreational Vehicle Test
(2012 to present, Oct. 5, 2016)

Vehicle Category		Failure Rate, %
ATV/UTV		20%
Off-highway Motorcycles		0.00%

EPA TESTS (2012 +, HMC CLASS III SUMMARY)



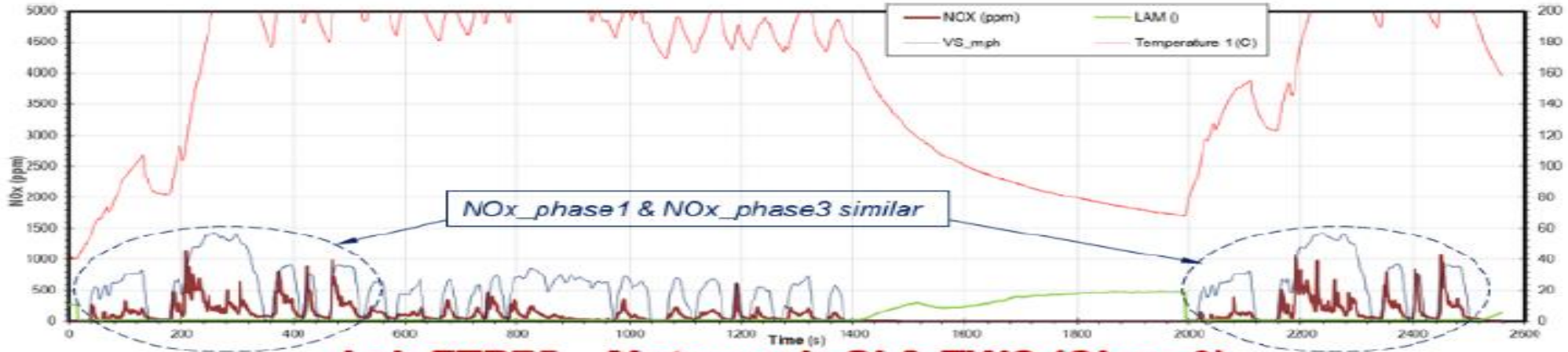


In-Use Evaluation

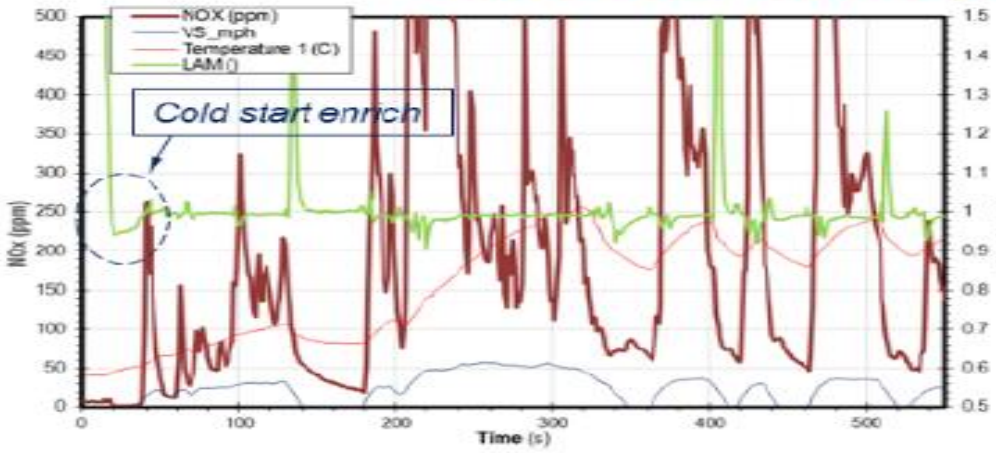
- Goal:
  - Collect “finger prints” during FTP
  - Identify difference during normal operation
  - Operational data loggers and portable emissions sampling are critical components to broadening our data sets
- Evaluation stage:
  - Assessing vehicles based on dynamometer and in-situ evaluation

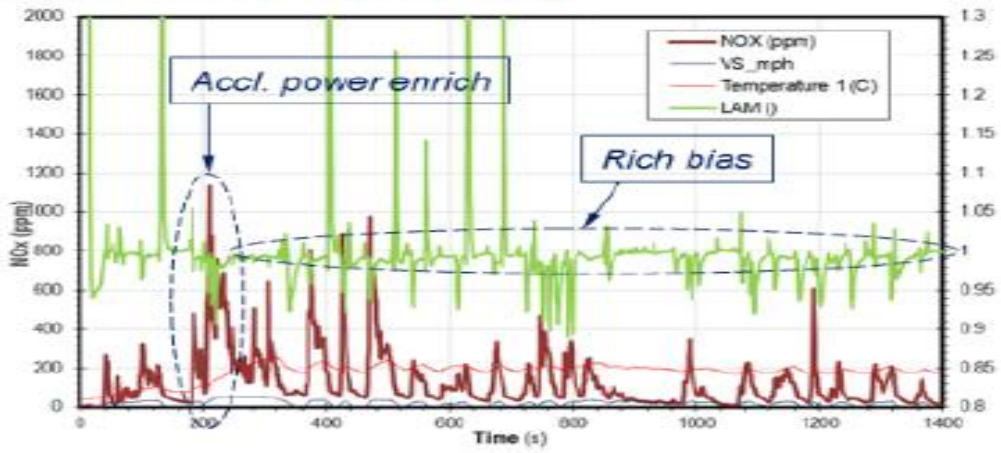
  - Tests considered:
    - FTP, US06, On-road, Dyno on-road-simulation
- Using an Emission Signature Device
  - Screening testing
  - Focused on identifying gross emission challenges in the real world

Data



Lab FTP75 – Motorcycle SI & TWC (Class 3)





EPA
Highway Motorcycle Shift Predictor Model

Modeling Background
Peter Caffrey

- Worked on Harvard Fire Code and FIRST models subroutines
- Wrote Fire code for flame and heat spread in submarines for General Dynamics Corporation
- Wrote EPA's Nonroad Emission Model
- Wrote complex heat exchanger design models for EPA's HYTEC system

Background

- Presently according to part 40 CFR 86 motorcycle manufacturers are allowed to supply their own shift schedules for emission testing, unless it is determined that their shift schedules are not representative

- Part 86 also indicates a shift pattern that can be used by the motorcycle manufacturer in lieu of supplying their own shift points

- Shift schedule revisions based on more recent operational data would support a more robust compliance testing regime

Present Motorcycle Shifting Patterns for the FTP

- Present shifting patterns presented by many manufacturers for testing exhibit an inordinate amount of shifts
  - Unrealistic for the FTP cycle
  - Difficult for a rider to perform shifts in tests
  - Would be more difficult to perform in actual road riding
- Preliminarily data from the model indicates a significant decrease in the number of shifts, both up and down

Present Motorcycle Shifting Patterns for the FTP

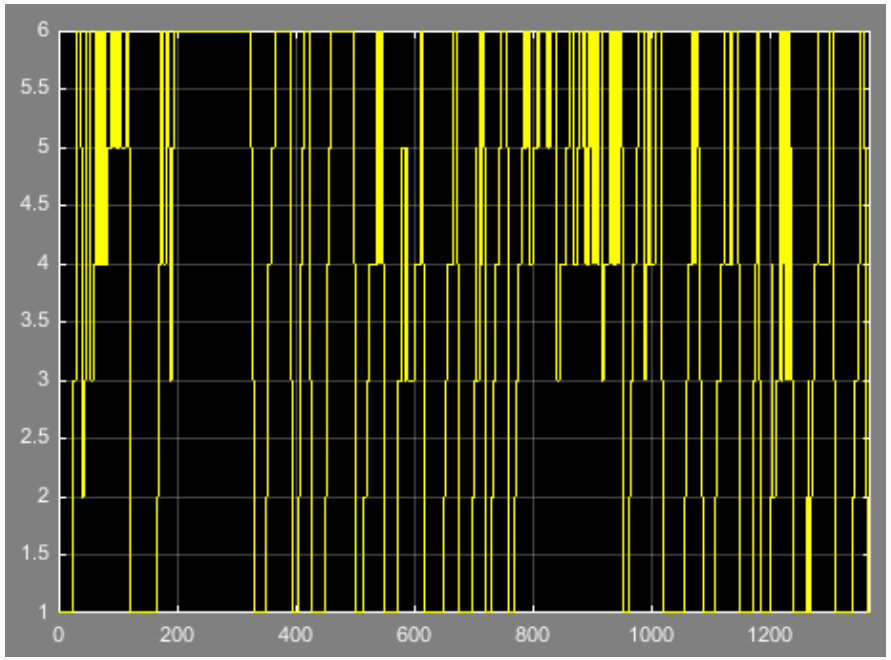
- 40 CFR 86.528-78 designates the shift speeds for motorcycle testing
- Manufacturers have two options
  - Follow the EPA shift schedule described in the tables of 40 CFR 86.528-78
  - Develop their own shift schedule

Shift (1) For Class I and II motorcycles:	Speed
1st to 2d gear	19 km/h (11.8 mi/h).
2d to 3d gear	33 km/h (20.5 mi/h).
3d to 4th gear	44 km/h (27.3 mi/h).
4th to 5th gear	53 km/h (32.9 mi/h).

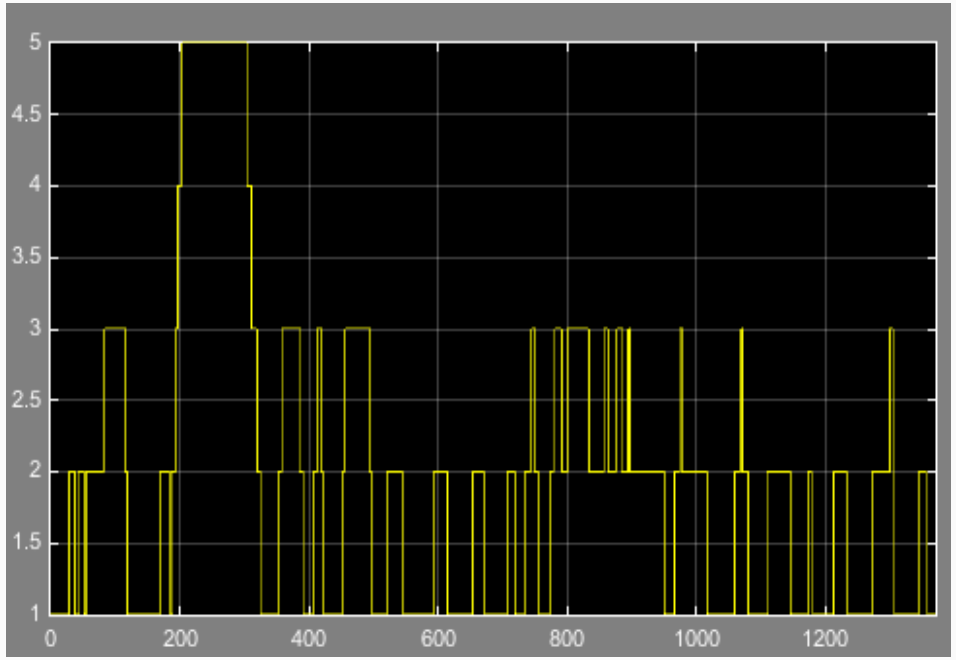
Shift (2) For Class III motorcycles:	Speed
1st to 2d gear	30 km/h (18.6 mi/h).
2d to 3d gear	45 km/h (28.0 mi/h).
3d to 4th gear	60 km/h (37.3 mi/h).
4th to 5th gear	75 km/h (46.6 mi/h).

Present Motorcycle Shifting Patterns for the FTP

- Both of these options can lead to many shifts during an individual test



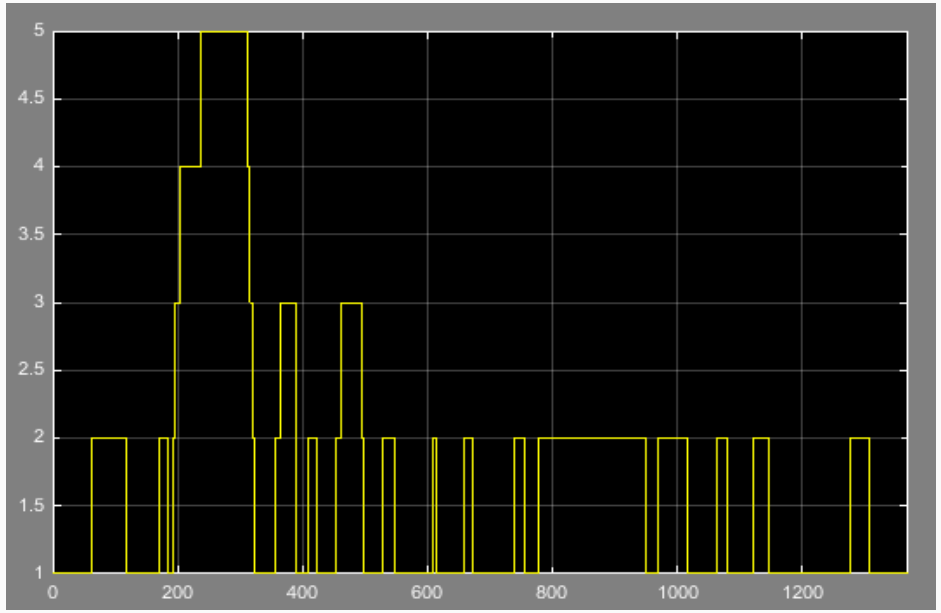
Example of Manufacturer Determined Shifts



EPA Part 86 Shifts

EPA Model

- EPA is developing a motorcycle shift model
  - This model will predict the operator shift behavior
  - It models this based on the motorcycle performance parameters



Preliminary EPA Model Shift Prediction

EPA Testing

- EPA has operated motorcycles for over 3000 miles on a city and highway course
  - Contains multiple starts and stops and subsequent accelerations and decelerations
  - Over 20 different drivers
  - Varied traffic conditions
  - Varied times of day
- EPA will use this data to determine the probability of shift changes occurring at a specific rpm and the behavioral nature of shifts during deceleration

EPA Model

- Production of a probability based model predicting the shift patterns for motorcycles
  - Retains flexibility to adapt to input of augmented input
- Will determine the shifting points based on specific motorcycle performance type and model
- Inputs may include but are not limited to: gear ratios, weights, wheel radius, engine map, etc

Model Specifics

- Written in MatLab/Simulink
- Utilizes modified normal curves to determine the probability of a rider shifting at a given RPM. This is based on:
  - The type of motorcycle
  - The gear being shifted into
    - Different curve (shape and position on the RPM range) for shifting from gear 1 to 2 than from shifting rom 2 to 3, 3 to 4, etc
- Downshift and deceleration is based on a forward looking algorithm that examines what the rider “sees” as well as typical rider tendencies

Timing

- Field studies are complete
  - Provide input to the probability model
- Coding will be complete this winter
- We expect a final model in the beginning of 2017

TESTING PROGRAM (CERTIFICATION, PRODUCTION VEHICLE, SELECTIVE ENFORCEMENT AUDIT, AND PRODUCTION-LINE-TESTING)

Production-Line Testing

Manufacturer testing of products has indicated a compliance rate of 100%

EPA testing has shown a compliance rate of 70% for some categories.

Additionally, given the differences in compliance rates for standard evaluation, the Agency has considered expanding the use of the regulatory mandated compliance assessment tools.

Compliance Testing

- Compliance testing of Emission Data Vehicles (pre-certification) has demonstrated compliance improvement over time.
- Compliance testing results of Production Vehicles have not matched the level of improvement that has been seen on pre-certification vehicles
- Challenges with test articles operating in ways that are inconsistent with practical vehicle operation for a typical user create concerns regarding the representativeness of test articles submitted by some manufacturers
- Challenges fulfilling the regulatory requirement to provide production vehicles for testing may impact the review of future applications

Compliance Oversight

- Working with independent contract labs through round robin test programs, we have seen improvements in the quality of reporting and test tracking
- Cooperation with other regulatory agencies such as Environment and Climate Change Canada and California's Air Resources Board, we have been able to broaden the North American compliance network through cooperative testing and information sharing
- Working with 3rd Party Laboratories inside and outside the United States we are better able to identify anomalies in reported test data
- EPA has expanded its audit rates of engine and vehicle manufacturers domestically and internationally

Round Robin Test Program

ATV Round Robin Test Program Plan

- Laboratories are currently being contacted for Round Robin Phase IV to test a recreational vehicle
- Testing will begin in 2017
- Test articles are will be provided by industry, Environment and Climate Change Canada, and EPA

Enforcement Action Updates

The Clean Air Act

- The Clean Air Act (CAA) was enacted by Congress in 1970, and amended in 1977 and 1990.
- Title II of the CAA – Mobile Source Provisions
  - On-highway (motor vehicles and motor vehicle engines) and nonroad (nonroad vehicles and nonroad engines) are regulated.
  - "Motor Vehicle" includes all cars, trucks, motorcycles
  - "Nonroad" includes construction equipment, lawn and garden, generators, marine, locomotive, recreational vehicles
- CAA § 203 contains the following prohibitions (among others) for which EPA may seek injunctive relief and a penalty.

CAA Title II Prohibitions: Defeat Devices

- **The following acts and the causing thereof are prohibited** –
  - For any person to manufacture or sell, or offer to sell, or install, a part or component for a motor vehicle, where
    - A principle effect of the part or component is to bypass, defeat, or render inoperative any emission control device, and
    - The person knows or should know that such part or component is being offered for sale or installed for such use or put to such use.

CAA § 203(a)(3)(B), 42 U.S.C. § 7522(a)(3)(B).

CAA Title II Prohibitions: Tampering

- **The following acts and the causing thereof are prohibited** –
  - For anyone to remove or render inoperative an emission control component on a certified motor vehicle or engine prior to sale or delivery to ultimate purchaser, or
  - For anyone to knowingly remove or render inoperative any emission control component on a certified motor vehicle or engine after sale and delivery to the ultimate purchaser.

CAA § 203(a)(3)(A), 42 U.S.C. § 7522(a)(3)(A).

Defeat Device and Tampering Examples

- Alterations to Fueling, Timing Strategy
- DPF Delete
- EGR Delete
- SCR Delete
- Alterations to OBD
- Software and Hardware

Conclusions

- We are partnering with other agencies to ensure we augment a robust compliance regime for North America
- We are working with the industry and other domestic and nondomestic stakeholders to address the veracity of submissions to the Agency
- We continue to expand our real world presence to be sure the American public receives the expected air quality benefits and to provide for confidence that there is a level playing field for all market participants
- Robust compliance actions result in significant health and welfare improvements

In-Use Performance Assessment

Mini-PEMS Signature Device Overview

Today's discussions

- Challenges we face
- Vehicles we can test on a chassis dyno
- Setup and features
- Additional benefits and considerations.

Challenges we face

We would like to broaden our in-situ compliance test rate in a broader set of sectors

US Annual Tons of emissions from HMC+RV compared to LD **

Criterion Pollutant	HMC + RV	LD	Total HMC+RV+LD Inventory	HMC+RV % of Total Inventory
HCs	617,361	640,530	1,257,891	49%
CO	1,641,571	6,806,017	8,447,588	19%
HC + NOx	645,245	1,487,127	2,132,373	30%

** This is not counting emissions from Small SI, Large SI, or Marine

Why Signature Device

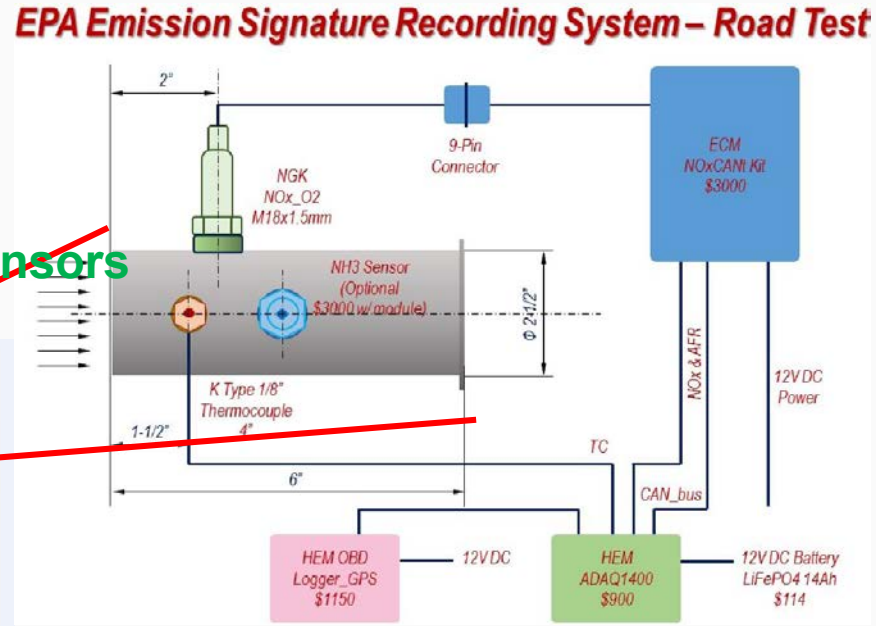
Reasons why we want Signature Device measurements as a pre-screening tool

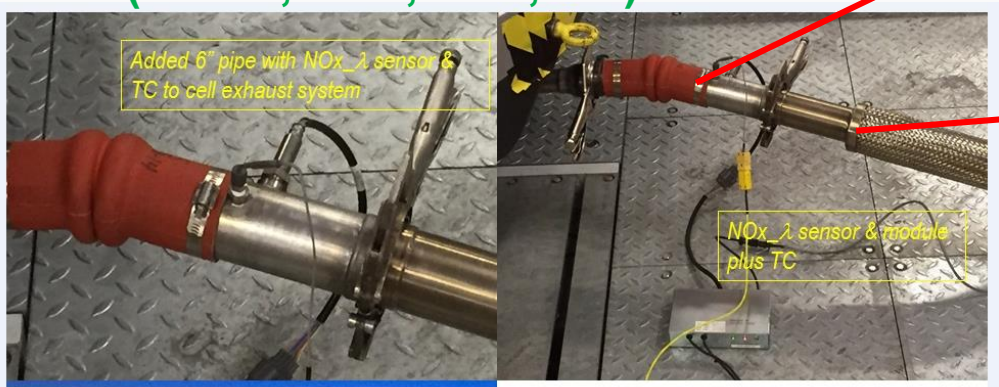
- Lighweight and compact – Under 15 lbs
- Real time Measurements – up to 10 hz data
- Good for screening – good emission measurements w/o using costly emissions bench -- Saving $$$ per test
  1) Pre-screen production vehicles for potential confirmatory
  2) Off-cycle evaluation
  3) Real-world driving evaluation possibilities
  4) Suitable for both chasses and engine tests
  5) Increasing testing rate with limited budget
- Be able to evaluate engine control and AECD strategies – More thorough Cert review
- Prepared for the future - Trends show increasing usage of ECU vs. Carbureted engines

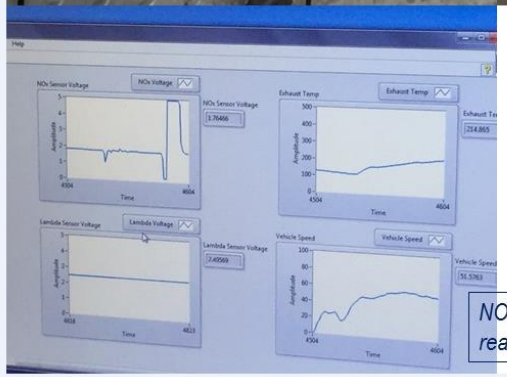
Vehicles We can Chassis or Engine test

Setup and Features

- Simple inline connection with tailpipe
- No sample removed from exhaust
- No disturbance of exhaust flow stream
- Durable solid state sensors
- Other bosses will be added for other sensors (ie. CO, CO2, NH3, etc)

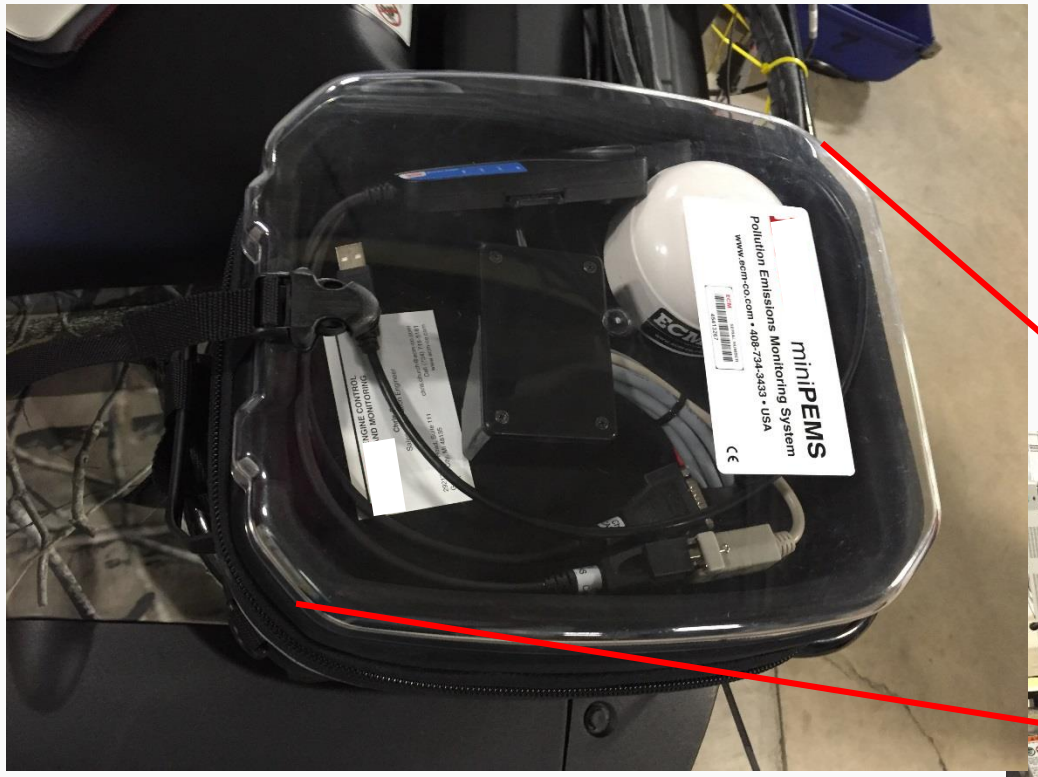






Emission Dynamic Signature Recording System 1st Run on GM Volt
(20151103 DM Cell_6)

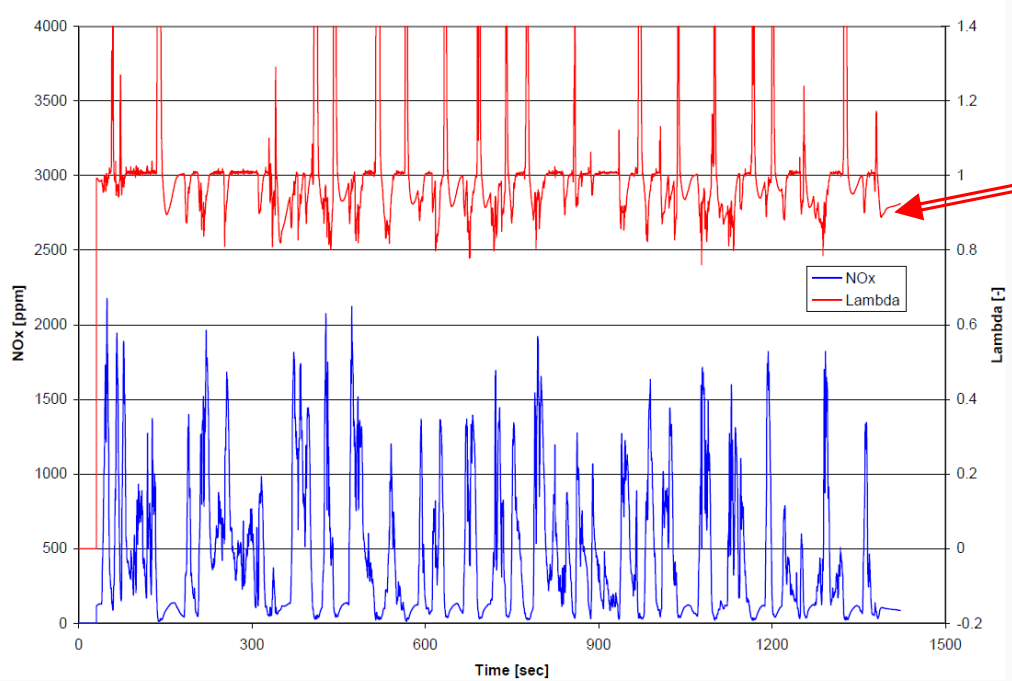
NOx, λ, Texh, and VS displayed real time in lab


miniPEMS
Pollution Emissions Monitoring System
www.ecm-co.com • 408-734-3433 • USA

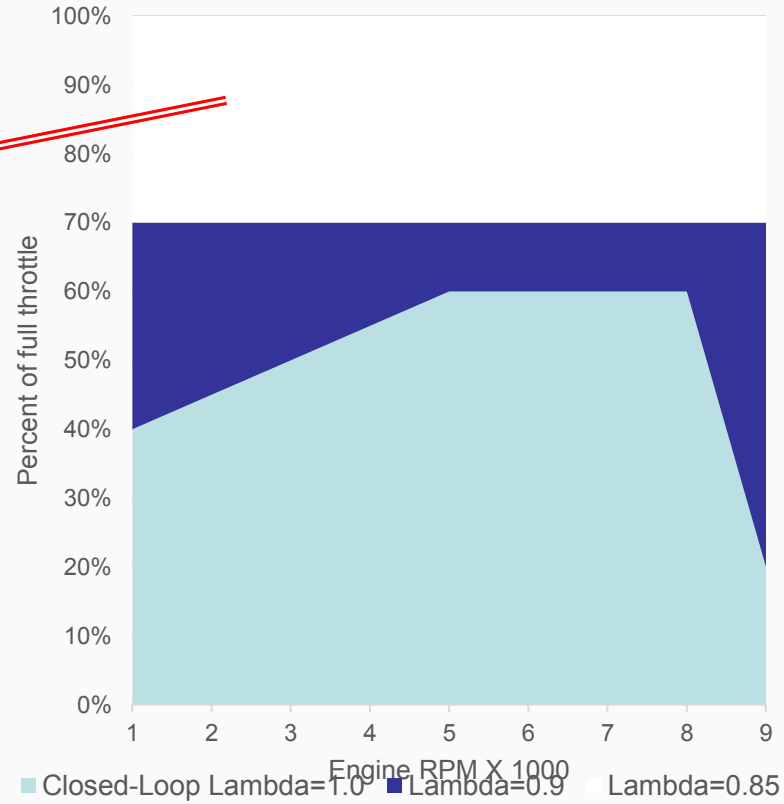
Confirm AECD information

Confirm open-loop lambda values

Plot of NOx and Lambda vs. Time showing some measured lambda values of 0.79



Mock-up of ECU mapping Plot of Torque vs speed showing regions of various lambda control regions



Additional Benefits and Considerations

Trends show increasing usage of ECU vs. Carbureted engines, and this means there is a greater opportunity to tailor ECU behavior around any regulation specified driving pattern for emissions testing.

The mini-PEMS will enable us to:

- ❑ **Alert manufacturers their AECDs will be audited in detail**
- ❑ **Quickly evaluate anonymous tips on violations**
- ❑ **Quickly evaluate emissions status of production vehicles**
- ❑ **Obtain comprehensive data on manufacturer emission control strategies**
- ❑ **Increase compliance rates with more effective budget use.**

- The Mini-PEMS will help broaden our in-situ compliance testing rate in a broader set of sectors

- The Mini-PEMS has potential to measure other emissions and signals realtime, such as N_20, NH_3, RPM, and throttle position

- The Mini-PEMS can perform in the field without adding excessive weight

*Please see the SAE Paper from Don Tang and Dan McBryde available starting October 17th for more information.

QUESTIONS?