Greenhouse Gas (GHG) Emission Requirements
Heavy-Duty Pickup Trucks and Vans

Industry/EPA Workshop

Compliance Division

Washtenaw Community College

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How Does This Apply to HD Pickup Trucks and Vans?

- Regulations are located at 40 CFR Part 1037
  - §1037.104 – Exhaust Emissions Standards for CO2, CH4, N2O
  - § 1037.115 – Other Requirements
  - § 1037.150 (a, b, c, e, f, g, h, i, l, m) – Interim Provisions
  - § 1037.740 – Restrictions for Using Emission Credits
  - § 1037.801 - Definitions

- Applicable to 2014 and later model year new heavy-duty Vehicles
  - Specifically regulates emissions of carbon dioxide, nitrous oxide, methane, and hydrofluorocarbons

- Excluded Vehicles include:
  - Vehicles not meeting definition of “motor vehicle” or “heavy-duty vehicle”
  - Medium-duty passenger vehicles
  - Vehicles produced before 2014 model year, unless certified under §1037.150 (except early credits provision)
  - Vehicles subject to light-duty greenhouse gas standards of 40 CFR part 86
  - Small manufacturers qualifying under Small Business Administration regulations at 13 CFR 121

HD Pickup Truck and Van Program

- In general, the HD pickup truck and van program strongly resembles the existing non-GHG program for these vehicles and the existing LD GHG program
- Today's briefing focuses on the aspects of the program which are unique

GHG STANDARDS

HD Pickup Truck & Van CO2 Standards

1037.104

- The HD Pickup Truck and Van CO2 emissions standards:
  - Begin in 2014MY
  - Are CO2 standards, not CREE
  - Represent a production-weighted fleet-average standard where all vehicles in this category form a single averaging set

$$\text{Fleet-Average Standard} = \frac{\sum[\text{Target}_i \times \text{Volume}_i]}{\sum[\text{Volume}_i]}$$

  - The GHG emission standards for these vehicles apply for a weighted average of 55% FTP City and 45% Highway test cycle (new requirement for Federal HD) where the vehicle is tested at Adjusted Loaded Vehicle Weight (ALVW)

HD Pickup Truck & Van CO2 Standards

1037.104

Spark Ignition

CO2 Target (g/mile) = 0.0440 x WF + 339

Compression Ignition

CO2 Target (g/mile) = 0.0416 x WF + 320

WF = 0.75× (GVWR - Curb Weight + xwd) + 0.25 × (GCWR – GVWR)

Where:

xwd = 500 pounds if the vehicle has four-wheel drive or all-wheel drive; xwd = 0 pounds for all other vehicles.

HD Pickup Truck & Van GHG Phase-in

1037.150(b)

Table 1 to 1037.150

Model Year and Engine Cycle	Alternate CO_2 Target (g/mile)
2014 Spark-Ignition	[0.0482 × (WF)] + 371
2015 Spark-Ignition	[0.0479 × (WF)] + 369
2016 Spark-Ignition	[0.0469 × (WF)] + 362
2017 Spark-Ignition	[0.0460 × (WF)] + 354
2014 Compression-Ignition	[0.0478 × (WF)] + 368
2015 Compression-Ignition	[0.0474 × (WF)] + 366
2016 Compression-Ignition	[0.0460 × (WF)] + 354
2017 Compression-Ignition	[0.0445 × (WF)] + 343

Table 2 to 1037.150

Model Year and Engine Cycle	Alternate CO_2 Target (g/mile)
2014 Spark-Ignition	[0.0482 × (WF)] + 371
2015 Spark-Ignition	[0.0479 × (WF)] + 369
2016-2018 Spark-Ignition	[0.0456 × (WF)] + 352
2014 Compression-Ignition	[0.0478 × (WF)] + 368
2015 Compression-Ignition	[0.0474 × (WF)] + 366
2016-2018 Compression-Ignition	[0.0440 × (WF)] + 339

Optional Certification under §1037.104

1037.150(l)

- You may certify certain complete or cab-complete vehicles to the standards of §1037.104 (HD Pickup Truck and Van standards), such as:
  - Complete or cab-complete spark-ignition vehicles
  - Cab-complete vehicles based on a complete sister vehicle
  - Class 2b or 3 incomplete vehicles

<u>Restrictions:</u>

- Generally, does not affect criteria pollutant certification

HD Chassis-Certification Path #1

Complete HD Pickup Trucks and Vans

		Class 2b/3 complete
Spark-ignition	Criteria	C
	GHG	
Diesel	Criteria	C or E
	GHG	

E = engine-certified (g/hp-hr) for criteria pollutants and treated as a vocational vehicle for GHG with separate engine certification (g/hp-hr) and vehicle certification with GEM (g/ton-mile)
C = chassis-certified (g/mile)
C or **E** = manufacturer can choose between chassis-certification and engine-certification

- Spark Ignition vehicles must chassis certify for both criteria and GHG emissions

- Diesel vehicles may choose to either:
  - Chassis certify for both criteria and GHG emissions –or-
  - Engine certify for criteria emissions and certify as a vocational vehicle for GHG emissions with separate engine certification and vehicle certification using GEM

Optional HD Chassis-Certification Path #2

Incomplete HD Pickups and Vans
1037.104(f), 1037.150(l)

		Class 2b/3 Incomplete	
Spark-ignition	Criteria	C	E
	GHG	C (sister)	
Diesel	Criteria	C	E
	GHG	C (sister)	

E = engine-certified (g/hp-hr) for criteria pollutants and treated as a vocational vehicle for GHG with separate engine certification (g/hp-hr) and vehicle certification with GEM (g/ton-mile)
C = chassis-certified (g/mile)
C and **E** = manufacturer can choose between chassis-certification and engine-certification

- Spark Ignition and Diesel vehicles may choose to either:
  - Chassis certify for both criteria and GHG emissions: further may use a sister vehicle for purposes of GHG compliance
  –or–
  - Engine certify for criteria emissions and certify as a vocational vehicle for GHG emissions with separate engine certification and vehicle certification using GEM

Optional HD Chassis-Certification Path #3

Class 4 and Above Vehicles
1037.150(l)

		Classes greater than Class 3
Spark-ignition	Criteria	E
	GHG	C or E
Diesel	Criteria	E
	GHG	

E = engine-certified (g/hp-hr) for criteria pollutants and treated as a vocational vehicle for GHG with separate engine certification (g/hp-hr) and vehicle certification with GEM (g/ton-mile)
C = chassis-certified (g/mile)
C or E = manufacturer can choose between chassis-certification and engine-certification

- Spark Ignition and Diesel vehicles must engine certify for criteria emissions

- Diesel vehicles must:
  - Certify as a vocational vehicle for GHG emissions with separate engine certification and vehicle certification

- Spark ignition vehicles may choose to either:
  - Chassis certify for GHG emissions (2014MY and later) –or –
  - Certify as a vocational vehicle for GHG emissions with separate engine certification (2016MY and later) and vehicle certification using GEM (2014MY and later)

Optional HD Chassis-Certification Path #4

Loose Engine Provision
1037.150(m)

		Loose engines (for any HD vehicle class)
Spark-ignition	Criteria	E
	GHG	C (surrogate) or E
Diesel	Criteria	E
	GHG	

E = engine-certified (g/hp-hr) for criteria pollutants and treated as a vocational vehicle for GHG with separate engine certification (g/hp-hr) and vehicle certification with GEM (g/ton-mile)
C = chassis-certified (g/mile)
C or E = manufacturer can choose between chassis-certification and engine-certification

- Spark Ignition and Diesel vehicles must engine certify for criteria emissions

- Diesel vehicles must:
  - Certify as a vocational vehicle for GHG emissions with separate engine certification and vehicle certification using GEM

- Spark ignition vehicles may choose to either:
  - Chassis certify for GHG emissions using the highest ETW vehicle powered by the engine as a surrogate GHG result (with maximum of 15,000 engines or 10% of total HD engine production of the family; also not allowed to generate credits) –or –
  - Certify as a vocational vehicle for GHG emissions with separate engine certification and vehicle certification

HD Pickup Truck and Van N2O and CH4 Standards

1037.104(c)

- The GHG emission standards for these vehicles apply for a weighted average of 55% FTP City and 45% Highway test cycle

HD Pickup Truck and Van Standards (g/mile):

Model Years	CH4 Emissions	N2O Emissions
2014 and Later	0.05	0.05

- Use CO2 credits can be used to offset

HFC Standards
1037.115(c)

- HFC emissions are controlled through a leakage standard, not a credit program
- No averaging, banking, or trading of HFC credits is allowed
- The leakage of refrigerant from an A/C system may not exceed 1.50 percent per year
  - For systems with refrigerant capacities less than 734 grams, the leakage may not exceed 11.0 grams per year

Dual, Multi, or Flex Fuel Vehicles
1037.104(d)(10)

- Perform exhaust testing on each fuel type
- Use either the conventional fueled CO2 emission rate or a weighted average of the emission results as specified in 40 CFR 600.510-12(k)
- Must meet the N2O and CH4 standards on both fuels or:
  - Certify to an alternate standard for N2O or CH4 emissions (offset by the CO2 credit provision) and:
  - Not exceed the alternate standard when tested on either fuel.

CERTIFICATION

GHG Certification/Compliance Timeline

- Submit pre model year report with cert preview
- 90 days after end of model year:
  - Submit report including production volumes of vehicle subconfigurations
- 270 days after end of model year:
  - Submit final report

GHG Pre Model Year Report Templates will be available at www.epa.gov/otaq/certdat2.htm

PMY Reports for Class 2b-3 Pickup Trucks and Vans

- Required by EPA and NHTSA in accordance with 40 CFR 1037.104 (EPA) and 49 CFR 535.8 (NHTSA)
- Single submission through EPA database for both agencies
- Reports can be submitted:
  - As early as manufacturer's first pre-certification meeting with EPA and NHTSA
  - As late as manufacturer's first application submission for a certificate of conformity

PMY Report - Purpose and Contents

- Purposes
  - Built on continuing long-standing process for LD CAFE program
  - Provides early estimates of manufacturers' good faith efforts to comply with GHG and FC standards
  - Pre-requisite for EPA approving manufacturers' applications for certificates of conformity

- Overview of Contents
  - Subconfiguration target and fleet standards
  - Test group and fleet certification results
  - Production volumes
  - Joint approvals for innovative technology
  - Certification statements for EPA and NHTSA
  - Credit plans

HD Pickup Truck PMY Template

Subconfigurations
1037.104(a)(4), 1037.104(d)(9)

- May group subconfigurations that have the same equivalent test weight, GVWR, and GCWR. Assume the curb weight equals two times ETW minus GVWR.
- May group together other subconfigurations if use the lowest target value for any of the subconfigurations
- Must test at least the greater of 10 subconfigurations or ten percent of subconfigurations (unless we approve a lower number)
- At least 90 percent of production volume in the configuration level must be represented by test data (actual data, data substituted, or analytically derived)

Analytically Derived CO2 (ADC)

1037.104(g)

- Provision allows the use of analytically derived CO2 emission rates based on baseline test data instead of measured emissions rates
- ADCs are similar to ADFEs used for light-duty vehicles
- Calculated using the equation below, rounded to the nearest 0.1 g/mile

$$ADC = CO2_{base} + 2.18 \cdot \Delta F0 + 37.4 \cdot \Delta F1 + 2257 \cdot \Delta F2 + 189 \cdot \Delta AR + 0.0222 \cdot \Delta ETW$$

- ADC = Analytically derived combined city/highway CO2 emission rate (g/mile) for a new vehicle.
- CO2base= Combined city/highway CO2 emission rate (g/mile) of a baseline vehicle.
- Road load force coefficients
  - ΔF0 = F0 of the new vehicle – F0 of the baseline vehicle.
  - ΔF1 = F1 of the new vehicle – F1 of the baseline vehicle.
  - ΔF2 = F2 of the new vehicle – F2 of the baseline vehicle.
- ΔAR = Axle ratio of the new vehicle – axle ratio of the baseline vehicle.
- ΔETW = ETW of the new vehicle – ETW of the baseline vehicle.

ADC Constraints

1037.104(g)

- The baseline vehicle must (unless we approve otherwise)
  - Comply with all applicable emission standards in the model year associated with the ADC
  - Include in the pool of tests all official tests of the same or equivalent base engine, transmission class, engine code, transmission code, engine horsepower, dynamometer drive wheels, and compression ratio
  - May supplement the pool with tests associated with the worst-case engine or transmission codes and carryover or carry-across engine families
  - Must eliminate from the pool tests that were previously used during the model year as baseline tests in ten other ADC subconfigurations
  - Select the tested configuration with the smallest absolute difference between the ADC and the test CO2 emission rate as the baseline subconfiguration
- Downward adjustment of ADC from the baseline is limited to ADC values 20 percent below the baseline emission rate
- Upward adjustment is not limited
- No more than 40 percent of the subconfigurations tested in the final CO2 submission may be represented by ADCs

HFC Emissions

1037.115(c)

- An excel file is available to calculate percent leakage and leakage rate of HFC emissions

1. RIGID PIPE CONNECTIONS

Enter the number of each type of fitti

Type of connection	
Single O ring:	
Single captured O ring:	
Multiple O ring:	
Seal washer:	
Seal washer with O ring:	
Metal gasket:	
Rigid pipe connections emission	

2. SERVICE PORTS AND REFRIGERAI

Enter the number of each type of por

Type of connection	
High side service ports:	
Low side service ports:	
Switches, transducers, and press	
Refrigerant control devices:	
Service port/control device emiss	

3. FLEXIBLE HOSES

Enter the dimensions for each hose, by hose type, in the system.

All Rubber Hose	
	High pressure side, hose 1
	High pressure side, hose 2
	High pressure side, hose 3
	High pressure side, hose 4
	Low pressure side, hose 1
	Low pressure side, hose 2
	Low pressure side, hose 3
	Low pressure side, hose 4
Standard barrier or veneer hose	
	High pressure side, hose 1
	High pressure side, hose 2
	High pressure side, hose 3
	High pressure side, hose 4
	Low pressure side, hose 1
	Low pressure side, hose 2
	Low pressure side, hose 3
	Low pressure side, hose 4
Ultra-low permeation barrier or veneer	
	High pressure side, hose 1
	High pressure side, hose 2
	High pressure side, hose 3
	High pressure side, hose 4
	Low pressure side, hose 1
	Low pressure side, hose 2
	Low pressure side, hose 3
	Low pressure side, hose 4

4. HEAT EXCHANGERS, MUFFLERS, RECEIVER/DRIERS, AND ACCUMULATORS

Emission rate for all devices combined assumed to be 0.5 x 0.522.

Emission rate for all devices (g/year):	0.261

5. COMPRESSORS

Enter the number of each type of fitting in the appropriate cell below:

Type of Fitting	No.
O-ring housing seals:	1
Molded housing seals:	1
Fitting adapter plates:	1
Gasket housing seals:	
Lips on shaft seal (belt-driven compressors only):	1

Compressor emission rate (g/year):	11.223

6. REFRIGERANT CAPACITY FOR SYSTEMS WITH GREATER THAN 733 GRAMS

Enter the system's refrigerant capacity in grams in the appropriate cell below:

Refrigerant Capacity (g)	1300

FOR REFRIGERANT CAPACITY FOR SYSTEMS WITH LESS THAN OR EQUAL TO 733 GRAMS

TOTAL SYSTEM REFRIGERANT EMISSION RATE (G/YEAR):	**19.2**

FOR REFRIGERANT CAPACITY FOR SYSTEMS WITH GREATER THAN 733 GRAMS

TOTAL SYSTEM REFRIGERANT PERCENT LEAKAGE (%/YEAR):	**1.5%**

HFC Emissions

- Provide HFC Emission Summary Sheet for A/C systems with application
- Maintain records for each air conditioning system configuration

A/C System Information				Leakage Inputs						A/C Leakage Rate	
A/C system number	Refrigerant	Refrigerant GWP, if other than R134a	Production Volume	Rigid Pipe Connectins emission rate	Service port/control device emission rate (g/year):	Hose permeation rate (g/year):	Compressor emission rate (g/year):	Refrigerant Capacity (g)	Refrigerant GWP, if other than R134a	Total System HFC Emission Rate (g/year)	Total System HFC Percent Leakage (%/year)

Production and In-use Standards

1037.104(b)

- Each vehicle has an in-use CO2 standard that is calculated from the test results and applies for selective enforcement audits and in-use testing.
  - The in-use CO2 standards is equal to the deteriorated emission level * 1.10, rounded to the nearest 0.1 g/mile
  - For multi-fuel vehicles, must determine in-use CO2 standards for each fuel

- The in-use N_2O & CH_4 standards are the FEL (no multiplier)

- Unlike LD GHG IUVP program, manufacturers are not required to perform any GHG measurements or specific tests for HD pickup trucks and vans

- EPA In-use Surveillance Testing
  - EPA may measure CO2, N_2O, CH_4 on 2014 and later in-use vehicles
    - FTP and Highway cycles only
  - Any failures or unusual results would need to be addressed by the manufacturer

CREDITS

CO_2 Credits

Sum of five independent calculations (calculated separately for each averaging set) = total credits in a model year

1. Averaging, Banking, and Trading
   - 1037.150(m) – loose engines certified under this provision cannot generate credits
2. Early Credits – 1037.150(a)
3. Innovative Technology Credits – 1037.104(d)(13)
4. Advanced Technology Credits – 1037.150(i)
5. CO_2 credits to show compliance with CH_4 and/or N_2O standards – 1037.104(c)

Credits are always rounded to the nearest whole megagrams (Mg)

GHG Credit Programs

Early Credits – 1037.150 (a)(2):
- 2013 MY only (except electric vehicles)
- Entire fleet
- No multiplier

Restrictions:
- Credits stay in averaging set – 1037.740(a)
- 5 year credit life - 1037.740(c)

Advanced Technology Credits – 1037.150(i):
- Vehicles with Rankine cycle, electric vehicles, fuel cell vehicles, and hybrid powertrains
- Only a single certifier may establish credits for an advanced technology, no double counting credits
- 1.5x multiplier – 1037.150(i)

Restrictions:
- Credits can go into any averaging set, except only 60,000 Mg CO2 credits can come into a service class from another service class - 1037.740(b)
- 5 year credit life – 1037.740(c)

Innovative Technology Credits – 1037.104(d)(13):
- Vehicle or engine technology which is not captured on test and not in common use in 2010 MY for heavy-duty pickups and vans
- Do not need justification for not using the 5-cycle
- No multiplier

Restrictions:
- Credits stay in averaging set – 1037.740(a)
- 5 year credit life - 1037.740(c)

GHG Credit Programs (cont.)

CO2 Credits to Offset CH4 and/or N2O FEL – 1037.104(c):

- Calculate the CH4 and/or N2O emission credits needed using the equation:

Emission credits needed (Mg) = (FEL – Standard) · (Volume) · (UL) · GWP · (10-6)

- where GWP of CH4 is 25 and GWP of N2O is 298 Mg

Restrictions:

- None

REPORTING

Compliance Information

- EPA is committed to both protecting CBI and to achieving transparency in implementation of the GHG program
- EPA currently publishes:
  - Compliance Report
  - Certification data (certification testing summary)
- EPA does not consider emissions data to be CBI
- For GHG, EPA intends to publish as much non-CBI information for each manufacturer after the end of the model year as possible

Future Guidance

- EPA will issue guidance on future subjects when and if necessary.

- Please use the index cards to submit questions

For More Information:

- A copy of this presentation will be available at www.epa.gov/otaq/climate/regulations.htm
- See GHG rulemaking documents at www.epa.gov/otaq/climate/regulations.htm
- See Federal Register at 76 FR 57106, September 15, 2011
- See Code of Federal Regulations, 40 CFR Part 1037 and Part 86
- Contact your EPA team member