



Publication of Heavy-Duty Vehicle and Engine GHG Emissions Compliance Report

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HD Engine/Vehicle GHG Emissions Compliance

- Greenhouse gas (GHG) emissions have been regulated since January 1, 2014 for both the heavy-duty (HD) vehicle and engine sectors. GHG emissions include CO₂ for both sectors as well as N₂O and CH₄ for HD engines.
- As part of the regulatory program, an averaging, banking, and trading (ABT) program is offered to provide HD manufacturers additional flexibility in meeting these regulations
- This GHG program is similar to the optional HD Engine NO_x ABT program and not like the mandatory light-duty program which is done on a fleet-averaged basis. In the HD program, every certificate is either neutral, a credit generator or a credit user
- This optional ABT program allows manufacturers to meet specific customer demands for a vehicle with higher GHG emissions than the current standard as long as that higher emitting vehicle/engine is offset with similar products performing below the standard



HD Engine/Vehicle GHG Emissions Compliance

- Similar vehicles/engines are grouped within an averaging set to determine if end of model year emissions for each averaging set is in compliance with the applicable GHG emissions standards
- This averaging set compliance determination is performed using a CO₂ emissions credit basis program as described on the next slides. There is no trading between averaging sets
- If a manufacturer chooses not to participate in this optional ABT program, then every vehicle/engine produced must emit at or below the applicable GHG standard(s)
- There exists a wide array of manufacturers and vastly different vehicle types
 - Light Heavy, Medium Heavy, Heavy Heavy
 - Line Haul, Vocational, Light Heavy Pickup, Refuse



Were the Goals of the Phase 1 Program Achieved?

- The success of the heavy-duty GHG program is documented in the pages of report:
- The entire industry was able to implement and begin complying with this program
- All vehicle manufacturers are compliant In each of the three averaging sets for vehicles
- Many manufacturers generated significant credit banks reflecting better overall fleet performance than the agencies originally projected in setting up the program.
- All heavy-duty engine manufacturers are compliant
- Many manufacturers generated significant credits



Credit Calculation for HD Vehicles Participating in the ABT Program

- The ABT programs for HD engines and vehicles are separate programs
- For every HD vehicle produced, the manufacturer uses an EPA-developed model (GHG Emissions Model or “GEM”) to determine the vehicle’s CO₂ emissions level.
- A CO₂ credit value is then calculated for each group of similar vehicles using the following equation:

CO₂ Credit (Mg) = (STD-FEL) x PL x UL x PV x 10⁻⁶ where:

STD = the applicable CO₂ standard for that grouping of similar vehicles (g/ton-mile)

FEL = the common CO₂ value generated by GEM for that grouping of similar vehicles (g/ton-mile)

PL = the prescribed payload for that specific grouping of vehicles (tons)

UL = the prescribed useful life for that specific grouping of vehicles (miles)

PV = US directed production volume of similar vehicles having the common FEL

- In addition to the above conventional vehicle credits, there exist opportunities to generate off-cycle and advanced technology credits. Advanced technology credits generated in MY 2013 – 2020 may be used to offset deficits in other engine and vehicle sectors.



Determining Compliance for HD Vehicles Participating in the ABT Program

- The credit values determined using the calculation on the previous slide are then summarized for all vehicles falling into three averaging sets:
 1. Light HD – vehicles with a gross vehicle weight rating (GVWR) between 8501-14,000 pounds
 2. Medium HD – vehicles with a GVWR between 14,001-33,000 pounds
 3. Heavy HD – vehicles with a GVWR above 33,000 pounds
- Compliance determination for a given model year is determined at each of the three vehicle averaging sets listed above by simply adding up all the credits from all the vehicles produced that fall within that averaging set.
- A “zero” or positive balance of credits within an averaging set indicates that a manufacturer was compliant for the model year for all vehicles produced that fell within that averaging set. Similarly a negative credit balance indicates that the manufacturer was not compliant for that given model year for that averaging set of vehicles.
- A credit deficit for an overall averaging set needs to be reconciled within 3 model years after the model year in which the deficit occurred.
- Credit surpluses may be banked for use in future model years but expire after 5 model years



Credit Calculation for HD Engines Participating in the ABT Program

- The ABT program for HD engines is a bit different and requires the manufacturer to physically test the engine over known test cycles while directly measuring not only CO₂ emissions but also N₂O and CH₄
- For every HD engine family (grouping of similar engines) produced, a manufacturer utilizes a representative engine within that family to measure GHG emissions over both a transient (which simulates a vocational vehicle duty cycle) and a steady-state test cycle (which more closely simulates a long-haul tractor application) on the engine dynamometer.
- Based on the GHG test results measured above, the manufacturer declares a family emissions value for each GHG constituent to be used in the credit calculation below.
- N₂O and CH₄ deficits (no credits can be generated for these GHG pollutants) are converted into equivalent CO₂ deficits and thus can be offset only by CO₂ credits generated within the family
- A CO₂ credit value is then calculated for each engine family using the following equation:

GHG Credit (Mg) = (STD-FCL) x CF x UL x PV x 10⁻⁶ where:

STD = the applicable CO₂ standard for that engine (g/hp-hr)

FCL = the CO₂ family emissions value declared for that engine (g/hp-hr)

CF = conversion factor to convert engine work into miles (hp-hr/miles)

UL = the prescribed useful life for that engine family (miles)

PV = US directed production volume of that engine family



Determining Compliance for HD Engines Participating in the ABT Program

- Calculated credit values are summarized for all engine families, each engine family being grouped within one of four averaging sets:
 1. Light HD CI – compression ignition (CI) engines for use in LHD vehicles
 2. Medium HD CI – CI engines for use in MHD vehicles
 3. Heavy HD CI – CI engines for use in HHD vehicles
 4. SI – HD engines subject to the spark-ignition standards
- Compliance determination for a given model year, within each of the above engine averaging sets, is determined by summing all credits from the engine families that fell within the appropriate averaging set. Note that engines produced for long-haul tractors and urban vocational vehicles are combined within the MHD and HHD averaging sets.
- A positive balance of credits indicates that a manufacturer is compliant for the model year for all engines produced that fell within that averaging set. Similarly a negative credit balance indicates that the manufacturer is not compliant for that given model year for that averaging set of engines.
- A credit deficit for an averaging set needs to be reconciled within 3 model years after the model year in which the deficit occurred.
- Credit surpluses may be banked for use in future model years but expire after 5 model years



Questions?

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