EPA/NHTSA Joint Final Rule

Phase 2 GHG / Fuel Consumption Standards for Medium- and Heavy-Duty Trucks

Overview for Motor Home Manufacturers

August 2016

INTRODUCTION

On Aug. 17, 2016, EPA and NHTSA announced the release of their joint Phase 2 final rule establishing greenhouse gas (GHG) and fuel consumption standards for medium- and heavy-duty trucks. The rule impacts 2021 2-207 model year motor home chassis sold in the U.S.

An advance copy of the final rule along with supporting documents are available online (see links below). In its pre-Federal Register format, the final rule is 1,690 pages in length. At the time of the writing, the Federal Register version had not yet been published.

AVAILABLE DOCUMENTS

- Final rule
- EPA Fact Sheet
- Regulatory Impact Analysis
- Response to Comments
- NHTSA News release
- Final Environmental Impact Statement (EIS)
  - EIS Summary
  - EIS Appendices
- CAFE compliance and effects modeling system (Volpe Model)

DOCKET REFERENCE

EPA–HQ–OAR–2014–0827; NHTSA- 2014-0132; FRL-9927-21-OAR

AFFECTED CODE SECTIONS

EPA: 40 CFR Parts 9, 22, 85, 86, 600, 1033, 1036, 1037, 1039, 1042, 1043, 1065, 1066, and 1068
NHTSA: 49 CFR Parts 523, 534, 535, and 538

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OVERVIEW OF STANDARDS AND CERTIFICATION PROCEDURES APPLICABLE TO MOTOR HOME CHASSIS

The Phase 2 rule (which covers 2021 model year to 2027 model year vehicles) is an extension of the Phase 1 rule which requires that 2014 model year to 2018 model year motor home chassis be equipped with Phase 1 certified engines and low rolling resistance tires. With the Phase 2 rule, motor home chassis will be required to meet more stringent GHG and fuel consumption standards. ***Motor home chassis manufacturers will have the option of certifying motor homes like any other vocational vehicle or they can be certified using the Custom Chassis provisions.*** If a manufacturer elects to certify a motorhome chassis using the vocational vehicle provisions, the standards will be up to 24% more stringent than was previously the case under Phase 1, however, the manufacturer will have the flexibility of utilizing averaging, banking and trading (ABT) provisions if it opts for this route. Alternatively, if a

manufacturer elects to use the Custom Chassis option, it will have less stringent standards[1] to comply with and less burdensome certification requirements but it will have fewer opportunities to use the ABT flexibility provisions.

In the sections to follow, both the regular vocational vehicle provisions as well as the Custom Chassis provisions are discussed.

Custom Chassis Standards and Certification Procedures

Per the final rule, the following types of vehicles can be optionally certified in accordance with the Custom Chassis provision:

- coach buses
- ***motor homes***
- school buses
- transit vehicles
- refuse trucks
- cement mixers
- emergency vehicles.

Note: These vehicle types listed above can also be certified per the rules applicable to all vocational vehicles (which allows use of ABT).

When certifying a motor home using the Custom Chassis provision, the manufacturer must certify the vehicle to one of two sets of standards (either the GEM-based standards or the Design Standards).

If the manufacturer opts to use the GEM-based standards, they will get to use a default EPA engine map as well as many other EPA default parameters that are required inputs for vehicles in the primary program. With this option, the manufacturer can choose which technologies to use in complying with the standards.

The Design Standard option is available only to manufacturers of motor homes, cement mixers and emergency vehicles. With the Design Standards option, the manufacturer installs technologies specified in the rule and does not need to use the GEM model in certifying the vehicle. It is a less complex alternative. Additional information on the two Custom Chassis certification options follows.

<u>The GEM-Based Custom Chassis Standards</u>

With the GEM-based standards, motor homes must emit 6% less CO2 than compared to 2017 model year baseline vehicles. By 2027, the required improvement for motor homes is 9%. In complying with the GEM-based standards, manufacturers will need to install Phase 2 certified engines which are expected to provide about a 2.3% improvement in 2021 and a 4.2% improvement in 2027. This means that in 2021, manufacturers will need to add technology (e.g., TPMS and low rolling resistance tires) that delivers another 3.7% reduction. For 2027, technology (e.g., TPMS and low rolling resistance tires) will need to provide an extra 4.8% reduction. Importantly, with the GEM-based standards, manufacturers can equip the vehicle with whatever technology they deem appropriate (so long as they comply).

The tables below show the EPA and NHTSA standards that must be complied with in using the GEM-based standards approach.

[1]With the custom chassis option, the standards will be 9% more stringent than the phase 1 standard.

Table V-12 EPA Emission Standards for Custom Chassis (gram CO_2/ton-mile)

	MY 2021	MY 2027
Coach Bus	210	205
Motor Home	228	226
School Bus	291	271
Transit	300	286
Refuse	313	298
Mixer	319	316
Emergency	324	319

Table V-13 NHTSA Fuel Consumption Standards for Custom Chassis (gallon per 1,000 ton-mile)

	MY 2021	MY 2027
Coach Bus	20.6287	20.1375
Motor Home	22.3969	22.2004
School Bus	28.5855	26.6208
Transit	29.4695	28.0943
Refuse	30.7466	29.2731
Mixer	31.3360	31.0413
Emergency	31.8271	31.3360

Design Standards for Select Custom Chassis Types

As noted above, ***the Design Standards are available only for motor homes, cement mixers, and emergency vehicles***. When using this option, a manufacturer can avoid using the GEM model in certifying the chassis. When using this option, the manufacturer must install specific technology on every vehicle. This option does not allow any averaging, banking, or trading. Note: These standards are equivalent in stringency to the GEM-based standards option.

Using the Design Standards option, motor home chassis must be equipped with certified Phase 2 engines plus the following technology:

> MY 2021: Low rolling resistance tires having a combined CRR of 6.7 kg/ton or less and one of the following: either a tire pressure monitoring system (TPMS) or an automatic tire inflation system (ATIS)
>
> MY 2027: Low rolling resistance tires having a combined CRR of 6.0 kg/ton or less and one of the following: either TPMS or ATIS

It should be noted that the optional Custom Chassis standards will phase in over the same period as the primary vocational vehicle standards, beginning in the 2021 model year. However, with the Custom Chassis provision, there are no separate intermediate standards in MY 2024 (i.e., the MY 2021 Custom Chassis standards will continue until the 2027 standards go into effect). ***This is another advantage of the Custom Chassis option.***

Because the optional Custom Chassis standards are numerically less stringent than the primary Phase 2 vocational vehicle standards, the agencies are adopting a more restrictive approach to ABT, allowing averaging only within each subcategory for vehicles certified to these optional standards. Trading and banking will not be permitted except that small businesses certifying vehicles to these optional standards may use traded credits to comply. ***No access to ABT is available with the Design Standard option***.

Vocational Vehicle Standards

For manufacturers who do not want to utilize the Custom Chassis provisions for motor homes, they can certify the motor home chassis using the regular vocational vehicle provisions. The standards established for vocational vehicles are anticipated to result in CO2 and fuel use reductions from the 2017 baseline as shown in the tables below. These standards are much more stringent than the Custom Chassis standards. There are separate EPA and NHTSA standards for 2021, 2024 and 2027.

Table V-3 Projected Vocational Vehicle CO_2 and Fuel Use Reductions (in Percent) from 2017 Baseline

Model Year	Engine Type	Light Heavy-Duty Class 2b-5[2]	Medium Heavy-Duty Class 6-7[3]	Heavy Heavy-Duty Class 8[4]
2021	Compression Ignition (CI) Diesel Engine	7-12	6-11	7-9
	Spark Ignition (SI) Gasoline Engine	6-8	5-7	-
2024	CI Engine	11-20	11-18	12-16
	SI Engine	9-14	9-12	-
2027	CI Engine	13-24	12-22	14-20
	SI Engine	11-18	10-16	-

The following tables show the certification standards that will apply when certifying a motor home chassis using the regular vocational vehicle provisions.

Table V-4 EPA CO_2 Standards for MY2021 Class 2b-8 Vocational Vehicles

EPA Standard for Vehicle with CI Engine Effective MY2021 (gram CO_2/ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7	Heavy Heavy-Duty Class 8
Urban	424	296	308
Multi-Purpose	373	265	261
Regional	311	234	205
EPA Standard for Vehicle with SI Engine Effective MY2021 (gram CO_2/ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7 (and C8 Gasoline)	
Urban	461	328	
Multi-Purpose	407	293	
Regional	335	261	

[2] <19,500 lbs. GVWR
[3] 19,500 to 33,000 lbs. GVWR
[4] >33,000 lbs. GVWR

Table V-5 NHTSA Fuel Consumption Standards for MY2021 Class 2b-8 Vocational Vehicles

NHTSA Standard for Vehicle with CI Engine Effective MY 2021 (Fuel Consumption gallon per 1,000 ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7	Heavy Heavy-Duty Class 8
Urban	41.6503	29.0766	30.2554
Multi-Purpose	36.6405	26.0314	25.6385
Regional	30.5501	22.9862	20.1375
NHTSA Standard for Vehicle with SI Engine Effective MY 2021 (Fuel Consumption gallon per 1,000 ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7 (and C8 Gasoline)	
Urban	51.8735	36.9078	
Multi-Purpose	45.7972	32.9695	
Regional	37.6955	29.3687	

Table V-6 EPA CO_2 Standards for MY2024 Class 2b-8 Vocational Vehicles

EPA Standard for Vehicle with CI Engine Effective MY2024 (gram CO_2/ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7	Heavy Heavy-Duty Class 8
Urban	385	271	283
Multi-Purpose	344	246	242
Regional	296	221	194
EPA Standard for Vehicle with SI Engine Effective MY2024 (gram CO_2/ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7 (and C8 Gasoline)	
Urban	432	310	
Multi-Purpose	385	279	
Regional	324	251	

Table V-7 NHTSA Fuel Consumption Standards for MY2024 Class 2b-8 Vocational Vehicles

NHTSA Standard for Vehicle with CI Engine Effective MY 2024 (Fuel Consumption gallon per 1,000 ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7	Heavy Heavy-Duty Class 8
Urban	37.8193	26.6208	27.7996
Multi-Purpose	33.7917	24.1650	23.7721
Regional	29.0766	21.7092	19.0570
NHTSA Standard for Vehicle with SI Engine Effective MY 2024 (Fuel Consumption gallon per 1,000 ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7 (and C8 Gasoline)	
Urban	48.6103	34.8824	
Multi-Purpose	43.3217	31.3942	
Regional	36.4577	28.2435	

Table V-8 EPA CO_2 Standards for MY2027 Class 2b-8 Vocational Vehicles

EPA Standard for Vehicle with CI Engine Effective MY2027 (gram CO_2/ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7	Heavy Heavy-Duty Class 8
Urban	367	258	269
Multi-Purpose	330	235	230
Regional	291	218	189
EPA Standard for Vehicle with SI Engine Effective MY2027 (gram CO_2/ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7 (and C8 Gasoline)	
Urban	413	297	
Multi-Purpose	372	268	
Regional	319	247	

Table V-9 NHTSA Fuel Consumption Standards for MY2027 Class 2b-8 Vocational Vehicles

NHTSA Standard for Vehicle with CI Engine Effective MY 2027 (Fuel Consumption gallon per 1,000 ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7	Heavy Heavy-Duty Class 8
Urban	36.0511	25.3438	26.4244
Multi-Purpose	32.4165	23.0845	22.5933
Regional	28.5855	21.4145	18.5658
NHTSA Standard for Vehicle with SI Engine Effective MY 2027 (Fuel Consumption gallon per 1,000 ton-mile)			
Duty Cycle	Light Heavy-Duty Class 2b-5	Medium Heavy-Duty Class 6-7 (and C8 Gasoline)	
Urban	46.4724	33.4196	
Multi-Purpose	41.8589	30.1564	
Regional	35.8951	27.7934	

Costs and Benefits of the Custom Chassis Standards

Estimated costs and benefits[5] associated with the Custom Chassis standards are shown below.

MY 2021-2026:

Estimated Cost of Compliance: $600

Estimated benefit: 6%

CO2 standard: 228 g/ton-mile

Fuel consumption standard: 22.3969 gallon per 1,000 ton-mile

MY 2027 and later:

Estimated Cost of Compliance: $900

Estimated benefit: 9%

CO2 standard: 226 g/ton-mile

Fuel consumption standard: 22.2004 gallon per 1,000 ton-mile

[5] Costs and benefits are relative to a 2017 baseline and are NOT cumulative.

Costs and Benefits of the Vocational Vehicle Standards

Costs and benefits associated with the standard vocational vehicle standards are shown in the tables below.

Table V-3 Projected Vocational Vehicle CO_2 and Fuel Use Reductions (in Percent) from 2017 Baseline

Model Year	Engine Type	Heavy Heavy-Duty Class 8	Medium Heavy-Duty Class 6-7	Light Heavy-Duty Class 2b-5
2021	CI Engine	7-9	6-11	7-12
	SI Engine	-	5-7	6-8
2024	CI Engine	12-16	11-18	11-20
	SI Engine	-	9-12	9-14
2027	CI Engine	14-20	12-22	13-24
	SI Engine	-	10-16	11-18

As can be seen, the percent reduction required for compliance can be as great as 24%. The contrasts with the maximum reduction required by the Custom Chassis option (which is 9%).

The estimated incremental costs to comply with the standard vocational vehicle standards are shown below. The per vehicle cost of compliance can be as much as $5,670. This is roughly five times the costs predicted for using the Custom Chassis option.

Table V-28 Final Vocational Vehicle Technology Incremental Costs in the 2021 Model Year [a,b] (2013$)

	Light HD			Medium HD			Heavy HD		
	Urban	Multi-purpose	Regional	Urban	Multi-purpose	Regional	Urban	Multi-purpose	Regional
Engine [c]	$298	$298	$298	$275	$275	$275	$275	$275	$275
Tires	$0	$27	$27	$9	$9	$9	$13	$13	$13
Tire Pressure Monitoring	$123	$154	$184	$123	$154	$184	$233	$292	$350
Transmission	$217	$217	$217	$217	$217	$217	$186	$413	$1,519
Axle related	$13	$13	$13	$13	$13	$13	$20	$26	$32
Weight Reduction	$69	$69	$69	$69	$69	$69	$250	$250	$250
Idle reduction	$155	$155	$12	$160	$160	$12	$68	$68	$12
Hybridization	$178	$178	$0	$178	$178	$0	$178	$178	$0
Air Conditioning [d]	$22	$22	$22	$22	$22	$22	$22	$22	$22
Other [e]	$30	$30	$30	$49	$49	$49	$89	$89	$89
Total	$1,106	$1,164	$873	$1,116	$1,146	$851	$1,334	$1,625	$2,562

Notes:

[a] Costs shown are for the 2021 model year and are incremental to the costs of a vehicle meeting the Phase 1 standards. These costs include indirect costs via markups along with learning impacts. For a description of the markups and learning impacts considered in this analysis and how it impacts technology costs for other years, refer to Chapter 2 of the RIA (see RIA 2.11).

[b] Note that values in this table include adoption rates. Therefore, the technology costs shown reflect the average cost expected for each of the indicated vehicle classes. To see the actual estimated technology costs exclusive of adoption rates, refer to Chapter 2 of the RIA (see RIA 2.11 in particular).

[c] Engine costs are for a light HD, medium HD or heavy HD diesel engine. We are projecting $138 of additional costs beyond Phase 1 for gasoline vocational engines.

[d] EPA's air conditioning standards are presented in Section V.C above.

[e] Other incremental technology costs include electrified accessories and advanced shift strategy.

Table V-29 Final Vocational Vehicle Technology Incremental Costs in the 2024 Model Year [a,b] (2013$)

	Light HD			Medium HD			Heavy HD		
	Urban	Multi-purpose	Regional	Urban	Multi-purpose	Regional	Urban	Multi-purpose	Regional
Engine [c]	$446	$446	$446	$413	$413	$413	$413	$413	$413
Tires	$0	$31	$33	$10	$10	$33	$13	$13	$53
Tire Pressure Monitoring	$155	$183	$211	$155	$183	$211	$294	$347	$401
Transmission	$276	$276	$276	$276	$276	$276	$222	$1,032	$2,193
Axle related	$24	$24	$24	$24	$24	$24	$37	$54	$60
Weight Reduction	$186	$186	$186	$186	$186	$186	$684	$684	$684
Idle reduction	$248	$248	$21	$256	$256	$21	$242	$242	$21
Hybridization	$550	$550	$0	$653	$653	$0	$844	$844	$0
Air Conditioning [d]	$20	$20	$20	$20	$20	$20	$20	$20	$20
Other [e]	$54	$54	$54	$89	$89	$89	$162	$162	$162
Total	$1,959	$2,018	$1,272	$2,082	$2,110	$1,274	$2,932	$3,813	$4,009

Notes:

[a] Costs shown are for the 2024 model year and are incremental to the costs of a vehicle meeting the Phase 1 standards. These costs include indirect costs via markups along with learning impacts. For a description of the markups and learning impacts considered in this analysis and how it impacts technology costs for other years, refer to Chapter 2 of the RIA (see RIA 2.11).

[b] Note that values in this table include adoption rates. Therefore, the technology costs shown reflect the average cost expected for each of the indicated vehicle classes. To see the actual estimated technology costs exclusive of adoption rates, refer to Chapter 2 of the RIA (see RIA 2.9 in particular).

[c] Engine costs are for a light HD, medium HD or heavy HD diesel engine. We are projecting $136 additional costs beyond Phase 1 for gasoline vocational engines.

[d] EPA's air conditioning standards are presented in Section V.C above.

[e] Other incremental technology costs include electrified accessories and advanced shift strategy.

Table V-30 Final Vocational Vehicle Technology Incremental Costs in the 2027 Model Year [a,b] (2013$)

	Light HD			Medium HD			Heavy HD		
	Urban	Multi-purpose	Regional	Urban	Multi-purpose	Regional	Urban	Multi-purpose	Regional
Engine [c]	$481	$481	$481	$446	$446	$446	$446	$446	$446
Tires	$12	$24	$24	$6	$24	$24	$12	$36	$36
Tire Pressure Monitoring	$187	$214	$240	$187	$214	$240	$355	$405	$456
Transmission	$271	$271	$293	$271	$271	$293	$220	$990	$3,269
Axle related	$35	$35	$35	$35	$35	$35	$52	$82	$87
Weight Reduction	$294	$294	$294	$294	$294	$294	$1,102	$1,102	$1,102
Idle reduction	$303	$303	$23	$314	$314	$23	$365	$365	$23
Hybridization	$857	$857	$0	$1,032	$1,032	$0	$1,353	$1,353	$0
Air Conditioning [d]	$20	$20	$20	$20	$20	$20	$20	$20	$20
Other [e]	$73	$73	$77	$122	$122	$127	$227	$227	$231
Total	$2,533	$2,571	$1,486	$2,727	$2,771	$1,500	$4,151	$5,025	$5,670

Notes:

[a] Costs shown are for the 2027 model year and are incremental to the costs of a vehicle meeting the Phase 1 standards. These costs include indirect costs via markups along with learning impacts. For a description of the markups and learning impacts considered in this analysis and how it impacts technology costs for other years, refer to Chapter 2 of the RIA (see RIA 2.11).

[b] Note that values in this table include adoption rates. Therefore, the technology costs shown reflect the average cost expected for each of the indicated vehicle classes. To see the actual estimated technology costs exclusive of adoption rates, refer to Chapter 2 of the RIA (see RIA 2.9 in particular).

[c] Engine costs are shown for a light HD, medium HD or heavy HD diesel engine. For gasoline-powered vocational vehicles we are projecting $125 of additional engine-based costs beyond Phase 1.

[d] EPA's air conditioning standards are presented in Section V.C above.

[e] Other incremental technology costs include electrified accessories and advanced shift strategy.

Hydrofluorocarbon (HFC) Leakage Standard

EPA's HFC direct emission leakage standard is independent of the CO2 vehicle standard. Manufacturers can reduce direct A/C leakage emissions by utilizing leak-tight components. Manufacturers may choose components from a menu of leak-reducing technologies sufficient to comply with the standard, as opposed to using a test to measure performance.

In Phase 1, EPA adopted a HFC leakage standard to assure that high-quality, low-leakage components are used in each air conditioning system installed in HD pickup trucks, vans, and combination tractors). In Phase 1, there was no HFC leakage standard for systems installed in vocational vehicles. In the final ***Phase 2 program, as proposed, EPA is extending the HFC leakage standard to all vocational vehicles (including motor homes).***

Beginning in the 2021 model year, vocational vehicle air conditioning systems with a refrigerant capacity of greater than 733 grams must meet a leakage rate of 1.50 percent leakage per year and systems with a refrigerant capacity of 733 grams or lower meet a leakage standard of 11.0 grams per year.

Note: For motorhome chassis, the HFC leakage requirement applies to the cabin AC. It does NOT apply to self-contained house half air conditioning on motorhomes even if they draw electrical power from engines used to propel the vehicles.

Small Business Provision

Per the final rule, motorhome chassis manufacturers that qualify as small businesses will receive one additional year to comply (i.e., compliance with Phase 2 begins 2022 MY instead of 2021 MY).

Emission Control Labels

In the Phase 2 final rule, EPA has removed the requirement to include the emission control system identifiers required in 40 CFR 1037.135(c)(6) and in Appendix III to 40 CFR part 1037 from the emission control labels. For ***vehicles certified to the optional custom chassis standards***, the label should meet the requirements of 40 CFR 1037.105(h). The 40 CFR 1037.105(h) label requirement reads as follows:

Vehicles certified to these standards must include the following statement on the emission control label: "THIS VEHICLE WAS CERTIFIED AS A [identify vehicle type as identified in Table 5 of this section] UNDER 40 CFR 1037.105(h)]."

The Loose Engine Provision

The final rule specifies that manufacturers certifying motor homes to the Custom Chassis standards may install engines certified through the interim "loose engine" provision.

With the "loose engine provision," spark ignition (SI) gasoline fueled engines produced by manufacturers of HD pickup trucks and vans and sold to chassis manufacturers and intended for use in vocational vehicles need not meet the separate SI engine standard, and instead may be averaged with the manufacturer's HD pickup and van fleet (see 40 CFR 86.1819-14(k)(8)). The loose engine provision was an "interim flexibility" included in the Phase 1 rule. It was adopted for the Phase 1 rule primarily to address small volume sales of engines used in complete vehicles that are also sold to other manufacturers.

Per the final rule, for MYs 2021-2023, each SI engine manufacturer may sell an annual maximum of 10,000 SI engines certified under the loose engine provision. They are generally not allowing custom chassis manufacturers to use SI engines that have been certified under this loose engine provision, if they are certifying using one of the custom chassis regulatory subcategories. However, there is an exception for motor homes and emergency vehicles. **Manufacturers certifying motorhome or emergency vehicles to the optional custom chassis standards may install engines certified through the interim loose engine rule. This exception could potentially reduce the cost of compliance for motorhome chassis manufacturers.**