

TIER 3 MOTOR VEHICLE EMISSION AND FUEL STANDARDS

EPA NOTICE OF PROPOSED RULEMAKING

ICCT POLICY UPDATES

SUMMARIZE
REGULATORY
AND OTHER
DEVELOPMENTS
RELATED TO CLEAN
TRANSPORTATION
WORLDWIDE.

EPA has released a Notice of Proposed Rulemaking (Docket No. EPA-HQ-OAR-2011-0135) intended to reduce air pollution from passenger cars and trucks through a new set of vehicle emissions and fuel quality standards.¹ These proposed standards will be phased in from MY 2017 and fully implemented by MY 2025. The proposed standards treat vehicle and fuel as an integral system, a view that ICCT shares as the best practice for policy development.

The proposed vehicle standards would reduce both tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles and some heavy-duty vehicles. Once fully implemented, smog-forming volatile organic compounds and nitrogen oxides will be reduced by 80% from current levels, particulate matter will be reduced by 70%, and fuel vapor emissions will be driven to near zero levels. The proposal includes reducing current commercial gasoline sulfur levels from 30 ppm average to a 10 ppm average across the nation by 2017. Changes to the fuel used for certification are also proposed, reflecting the widespread adoption of ethanol blends in commercial gasoline.

The proposal provides vehicle manufacturers and refiners sufficient lead time and compliance flexibilities to minimize the regulatory burden. Tailpipe emission standards are phased in between model year 2017 and 2025, in parallel with recently approved GHG standards. Early compliance and provision of ultra-low emitting vehicles would result in manufacturer credits which would allow sales of higher emitting models. Refiners would benefit from an Averaging Banking and Trading (ABT) system and other flexibilities.

The EPA estimates that the fuel quality changes proposed by the Tier 3 program would cost about 1.0 cents per gallon of gasoline, and vehicle technology changes would cost about \$130 per vehicle. As with previous vehicle and fuel emission standards, the EPA estimates that the annual benefits would far outweigh the cost; the benefits in 2030 would be three to eight times the cost of compliance, while helping the states to attain and maintain the existing health-based National Ambient Air Quality Standard (NAAQS).

¹ <http://www.epa.gov/otaq/tier3.htm>

The Tier 3 proposal is almost completely harmonized with the California Air Resources Board (CARB) Low Emission Vehicle (LEV III) program. This allows automakers to sell the same vehicles in all 50 states. The LEV III program starts in 2015 and has a phase-in period until 2025.²

1. TIER 3 VEHICLE EMISSION STANDARDS

EPA is proposing new tailpipe standards non-methane organic gases (NMOG) and nitrogen oxides (NO_x), measured as combined NMOG+NO_x, and for particulate matter (PM) that would apply to all light-duty vehicles and some heavy-duty vehicles.

Compared to current Tier 2 standards, the proposed standards for light-duty vehicles when fully phased in represent an approximately an 80% reduction from today's NMOG+NO_x fleet average and a 70% reduction in per-vehicle particulate matter (PM) standards. Proposed heavy-duty tailpipe standards represent about a 60% reduction in both fleet average NMOG+NO_x and per-vehicle PM standards. EPA is also proposing to extend the regulatory useful life period during which the standards apply from 120,000 miles to 150,000 miles.

The proposed Tier 3 program is identical to LEV III in most major aspects for both light duty and heavy-duty vehicle exhaust and evaporative emissions requirements. Differences arise in adoption of PM standards after MY2024, test fuels (E10 for LEV III and E15 for Tier 3), and an additional evaporative test leak for Tier 3. There are also some minor phase-in differences between adoption of some standards, such as transitional emission bins, use of new certification fuels, early compliance credit timing, longer useful-life application dates, and evaporative standards phase-in timing.

1.1 TIER 3 FTP STANDARDS

The proposed Federal Test Procedure (FTP) standards cover the primary pollutants of concern—NMOG, NO_x and PM—as well as carbon monoxide (CO) and formaldehyde (HCHO). The use of the combined NMOG+NO_x standard is a significant change with respect to the Tier 2 program, which uses a NO_x fleet-average standard.

The proposed FTP NMOG+NO_x standards are fleet average standards, meaning that a manufacturer would calculate the average emissions of the vehicles it sells for each model year and compare that average to the applicable standard for that model year. The manufacturer would certify each of its vehicles to a per-vehicle “bin” standard and sales-weight these values to calculate its fleet-average NMOG+NO_x emissions for each model year.

Each Tier 3 bin would have a NMOG+NO_x standard and a PM standard, as well as CO and HCHO standards. The proposed bins are presented in Table 1. Note that current Tier 2 bins less stringent than Bin 5 would be eliminated. These standards apply independent of fuel. As with the Tier 2 program, the proposed standards would apply to all LDVs and LDTs below 8,500 lbs GVWR, and MDPVs (8,500 to 10,000 lbs GVWR).

² <http://www.arb.ca.gov/msprog/levprog/leviii/leviii.htm>

Table 1 Proposed Tier 3 Bin Standards for LDVs, LDTs and MDPVs under the FTP and Full Useful life of 150,000 miles

Tier 3 Bins	NMOG+ NO _x (mg/mi)	PM ^a (mg/mi)	CO (mg/mi)	HCHO (mg/mi)
Current Tier 2 Bin 5	90+70=160	10	4200	18
Bin 160	160	3	4200	4
Bin 125	125	3	2100	4
Bin 70	70	3	1700	4
Bin 50	50	3	1700	4
Bin 30	30	3	1000	4
Bin 20	20	3	1000	4
Bin 0	0	0	0	0

a. PM Standard applies to a that segment of a manufacturer’s vehicles covered by the percent of sales phase-in for that model year

Following the phase-in design implemented for Tier 2 Standards, it is proposed that the Tier 3 fleet-average standards decline linearly from MY 2017 through MY 2025. After that model year the two fleet-average standards would remain at the same level, 30 mg/mi. Note that the phase-in is only for NMOG+NO_x; the PM standard does not decline over time.

Table 2 Proposed Phase in for LDV, LDT, and MDPV Fleet Average FTP NMOG+NO_x Standards (mg/mi)

Test cycle	Vehicle Class ³	Tier 2	Model Year								
		2016 ^a	2017 ^b	2018	2019	2020	2021	2022	2023	2024	2025+
FTP	LDV/LDT1 ^b	160	86	79	72	65	58	51	44	37	30
FTP	LDT2,3,4 and MDPV	160	101	92	83	74	65	56	47	38	30

a. 120,000 mile useful life for Tier 2

b. Starting with MY2018 for vehicles with GVWR >6,000 lbs

c. Tier 3 proposed standards apply for a 150,000 mile useful life. Manufacturers could choose to certify all of their LDVs and LDT1s to a useful life of 120,000 miles. If any of these families are certified to the shorter useful life, a proportionally lower numerical fleet-average standard would apply, calculated by multiplying the respective 150,000 mile standard by 0.85 and rounding to the nearest mg.

3 The LDV category includes all vehicles less than 8500 lb gross vehicle weight rating, GVWR (i.e., vehicle weight plus rated cargo capacity). Light Duty Truck (LDT) category divides trucks into four different weight categories. The MDPV category covers SUVs 10,000 max GVWR.

Tier 3 FTP PM Standards

The proposed PM standards apply to each vehicle separately, not as a fleet average. However, due to uncertainties derived from new technologies deployed for compliance with GHG regulations (e.g., Gasoline Direct Injection (GDI) technology, Start-Stop systems), and from new PM measurement methods at these low levels, EPA is proposing a phase-in period for PM Standards. The phase in program would apply based on sales percentages, as shown in Table 3.

The proposed program also includes a separate in-use FTP PM standard of 6 mg/mi for the testing of in-use vehicles that would apply during the percent-sale phase in period only. This in-use standard would address the uncertainties that accompany the introduction of new technologies, and then expire.

Table 3 Proposed LDV, LDT, and MDPV Vehicle PM Standards

Test cycle	Phase In	Tier 2	Model Year						
		2016 ^a	2017 ^b	2018	2019	2020	2021	2022	2023
	% of US sales		20%	20%	40%	70%	100%	100%	100%
FTP	Certification, mg/mile	10	3	3	3	3	3	3	3
FTP	In-Use Standard, mg/mile	10	6	6	6	6	6	3	3

a. 120,000 mile useful life for Tier 2
 b. Starting with MY2018 for vehicles with GVW >6,000 lbs
 c. Tier 3 proposed standards apply for a 150,000 mile useful life

1.2 TIER 3 SUPPLEMENTAL FTP STANDARDS

In addition to FTP standards, EPA is proposing NMOG+NO_x and PM standards measured on the supplemental FTP (SFTP). The SFTP is comprised of two additional tests: the US06 is designed to simulate higher speeds and higher acceleration rates (and thus higher loads); the SC03 simulates air conditioning operation at 95°F with full simulated sunload. These test-cycles were designed to ensure that emission controls are effective over a broad range of in-use driving conditions.

Tier 3 SFTP NMOG+NO_x Standards

The SFTP emissions value for certification of gaseous pollutants would continue to be calculated as a weighted composite value of emissions on three cycles, the FTP, US06 and the SC03 (0.35 x FTP + 0.28 x US06 + 0.37 x SC03), as is done for the Tier 2 SFTP standards.

Adding some flexibility to the rule, manufacturers would meet the SFTP fleet-average standard, by voluntarily determining the specific SFTP standard for an individual vehicle family and reporting that self-selected standard and the measured emission performance. A maximum of 180 mg/mile is available for this type of self-selected SFTP standards. The manufacturer SFTP fleet average should be lower than the corresponding year standard.

Table 4 Proposed Phase in for LDV and MDPV Composite Fleet Average SFTP NMOG+NO_x Standards (mg/mi)

Test cycle	Vehicle Class	Model Year								
		2017	2018	2019	2020	2021	2022	2023	2024	2025+
SFTP	NMOG + NO _x (mg/mi)	103 ^a	97	90	83	77	70	63	57	50
SFTP	CO (mg/mi)	4200 ^a								

a. Starting with MY2018 for vehicles with GVWR >6,000 lbs

The proposed Tier 3 SFTP standards are a major improvement over the SFTP standards for Tier 2, which were unchanged in stringency from the Tier 1 SFTP standards (and thus completely ineffective). However, the Tier 1 SFTP standards were set at the same numeric level as the Tier 1 FTP standards while the proposed Tier 3 SFTP standards are significantly higher than the proposed Tier 3 FTP standards, indicating that they are still not stringent enough.

Tier 3 US06 PM Standards

The proposed rule requires vehicle compliance for PM, as opposed to fleet average. The proposed Tier 3 program includes Certification and In-Use PM standards under the US06 test cycle. Certification PM standards are evaluated at a level of 10 mg/mi for lighter vehicles and 20 mg/mi for heavier vehicles. In-Use US06 PM standards are 15 and 25 mg/mi for vehicles up to and above 6,000 lbs GVWR, respectively. FTP and US06 PM standards would be phased in on the same schedule, reaching 100 percent of each company’s U.S. sales by MY 2022. **Note that the US06 PM standards are roughly 3 times higher for lighter vehicles and 7 times higher for heavier vehicles than the FTP PM standards.**

Table 5 Proposed SFTP Vehicle PM Standards

Test cycle	Vehicle category	Phase In	Model Year							Notes
			2017 ^a	2018	2019	2020	2021	2022	2023	
		% of US sales	20%	20%	40%	70%	100%	100%	100%	
US06	LDV, LDT1&2	Certification mg/mile	10	10	10	10	10	10	10	a
		In-Use Standard, mg/mile	15	15	15	15	15	15	15	b
	LDT3&4, MDPV	Certification mg/mile	20	20	20	20	20	20	20	a
		In-Use Standard, mg/mile	25	25	25	25	25	25	25	b

a. Manufacturers required to test 25% of each Model Year durability group
 b. Manufacturers required to test 50% of each Model Year durability group

1.3 TIER 3 STANDARDS FOR SOME HD VEHICLES

The proposal scope includes complete heavy-duty vehicles (HDVs) between 8,501 and 14,000 lb GVWR. Vehicles in this GVWR range are referred to as Class 2b (8,501-10,000 lb) and Class 3 (10,001-14,000 lb) vehicles; these vehicles are typically full size pickup trucks and work vans that are certified as complete vehicles on a chassis dyno and report emissions on a grams per mile basis. Current regulations allow for choosing between chassis or engine certification, with most manufacturers choosing the former. Incomplete HDVs below 10,000 lbs GVWR would continue the current chassis vs engine certification practice (EPA is asking for comments on this issue).

The proposed standards levels for both Class 2b and Class 3 HDVs are significantly higher than those being proposed for light-duty trucks due to marked differences in vehicle size, capability, and testing load condition. The proposed bin structure and standards levels are consistent with those in the LEV III program. The HDV bin structure is presented below.

The proposal calls for interim bins that are a carryover of current standards. Interim bins do not include SFTP requirements, longer useful life requirements, or requirements to conduct exhaust emissions testing with the proposed new gasoline test fuel.

Table 6 Proposed Bin Structure of FTP Standards for HDVs

	NMOG +NO _x (mg/mi)	NMOG (mg/mi)	NO _x (mg/mi)	PM (mg/mi)	CO (g/mi)	Formaldehyde (mg/mi)
Class 2b (8,501-10,000 lbs GVWR):						
Bin 395 (interim)	--	195	200	8	6.4	6
Bin 340 (interim)	--	140	200	8	6.4	6
Bin 250	250	--	--	8	6.4	6
Bin 200	200	--	--	8	4.2	6
Bin 170	170	--	--	8	4.2	6
Bin 150	150	--	--	8	3.2	6
Bin 0	0	--	--	0	0	0
Class 3 (10,001-14,000 lbs GVWR):						
Bin 630 (interim)	--	230	400	10	7.3	6
Bin 570 (interim)	--	170	400	10	7.3	6
Bin 400	400	--	--	10	7.3	6
Bin 270	270	--	--	10	4.2	6
Bin 230	230	--	--	10	4.2	6
Bin 200	200	--	--	10	3.7	6
Bin 0	0	--	--	0	0	0

Following the LDV bin structure, the HDV proposal calls for fleet average standards that change over time (Table 7). Because the fleet average standard is reduced over time, the bin mix would shift the fleet from higher to lower bins. The standards are consistent with those in the LEV III program in MY2018 and later. Manufacturer could average the two fleet classes using credits.

Table 7 Proposed HDV Fleet Average NMOG+NO_x Standards (mg/mi)

Model Year	Voluntary		Required Program				
	2016	2017	2018	2019	2020	2021	2022+
Class 2b	333	310	278	253	228	203	178
Class 3	548	508	451	400	349	298	247

PM standards of 8 mg/mi and 10 mg/mi are proposed for Class 2b and Class 3 HDVs, respectively, phasing in as an increasing percentage of a manufacturer’s sales per year. EPA is proposing the same phase-in schedule as proposed for the light-duty sector during model years 2018-2019-2020-2021: 20- 40-70-100 percent, respectively, and a more flexible but equivalent alternative PM phase-in is also being proposed.

EPA is proposing the first-ever SFTP standards for HDVs. As for light-duty vehicles, the proposal envisions SFTP compliance based on a weighted composite of measured emissions over the FTP cycle, the SC03 cycle, and an aggressive driving cycle. This aggressive driving cycle would be tailored to various HDV sub-categories: the US06 cycle for most HDVs, the highway portion of the US06 cycle for low power-to-weight Class 2b HDVs, and the LA-92 (or “Unified”) cycle for Class 3 HDVs. The proposed SFTP standards are the same as those adopted for California LEV III vehicles, and would apply to NMOG+NO_x, PM, and CO emissions.

Table 8 Proposed SFTP Standards for HDVs

	NMOG+NO _x (mg/mi)	PM (mg/mi)	CO (g/mi)
Class 2b with horsepower (hp)/GVWR ≤ 0.024 hp/lb:^a			
FTP Bins 200, 250, 340	550	7	22
FTP Bins 150, 170	350	7	12
Class 2b			
FTP Bins 200, 250, 340	800	10	22
FTP Bins 150, 170	450	10	12
Class 3			
FTP Bins 270, 400, 570	550	7	6
FTP Bins 200, 230	350	7	4

a. These standards apply for vehicles optionally tested using emissions from only the highway portion of the US06 cycle

1.4 TEST FUEL CHANGES

The proposal calls for an update on federal emission test fuel to be consistent with proposed Tier 3 fuel requirements and to accommodate higher levels of biofuels in commercial gasoline. Commercial gasoline is projected to continue to change with the implementation of the RFS2 program linked to E15 adoption, as well as the proposed Tier 3 gasoline sulfur program. The change in fuel specifications would apply to new vehicle certification, assembly line, and in-use testing, as well as fuel economy/GHG testing and evaporative emission testing. These changes cover testing of LDVs, cars and trucks, as well as HDVs subject to proposed emission standards changes.

EPA is proposing changes consistent with CARB's LEV III emissions test fuel specifications. Key changes include:

- » Adoption of E15 as test fuel, replacing Indolene (E0). One caveat is that EPA proposes to accept LEV III certification on E10 for vehicles being certified as 50-states through model year 2019. After that model year, E15 would be the only accepted test fuel.
- » Reduction of octane specs to match regular-grade gasoline AKI 87 (except for vehicles that require premium gasoline)
- » Change of distillation temperatures, aromatics, and olefins to better match today's in-use fuel and to be consistent with anticipated E15 composition; and
- » Reduction of the existing sulfur content specification and setting a benzene specification to be consistent with proposed Tier 3 gasoline sulfur requirements and recent gasoline benzene requirements

In addition to proposing a new E15 emissions test fuel, EPA has proposed detailed specifications for E85 emissions test fuel used for flexible fuel vehicle (FFV) certification. Historically, under the Tier 2 program, FFVs have only been required to meet all Tier 2 emission standards while operating on gasoline; when operating on the alternative fuel (generally this means a blend that is nominally 85 percent ethanol, or E85), they have only been required to meet the FTP emission standards, not the SFTP standards.

1.5 TIER 3 EVAPORATIVE STANDARDS

Evaporative standards are designed to eliminate hydrocarbon emissions from fuel evaporation. The proposed evaporative standards represent around 50% reduction from the existing standards. They apply to all gasoline light-duty and heavy-duty vehicles. The program encompasses new evaporative limits, new bleed testing requirements, leak test, and on-board-diagnostics requirements.

The proposed program for Tier 3 evaporative emission regulations are phased-in over a six model year period. The limits are presented in Table 9. Phase-in requirements for 2017 model year apply only to 40% of the combined fleet of LDVs, LDT1s and LDT2s; after that the sales percentage requirements, for all LDVs, LDTs, MDPS and HDGV, are 60 percent for MYs 2018 and 2019, 80 percent for model years 2020 and 2021, and 100 percent for model years 2022 and later. The phase in of both the bleed and leak tests are linked to the phase in of the "zero" evaporative standards. When a vehicle certifies to the primary evaporative standards based upon the % phase-in, that vehicle will then also need to meet the bleed and leak tests.

The proposed program would allow manufacturers to generate credits through early certifications (before the 2017 model year) and to demonstrate compliance using averaging concepts. There will be not credit trading between evaporative classes. EPA is not proposing any changes to the existing light-duty running loss or refueling emission standards, with the exception of the certification test fuel requirement.

Table 9 Proposed Evaporative Standards

Vehicle Class	Highest Diurnal + Hot Soak Level, g/test (over both 2-day and 3-day SHED diurnal tests)
LDV, LDT1	0.300
LDT2	0.400
LDT3, LDT4 MDPV	0.500
HDGVs	0.600

Proposed Canister Bleed Emission test

EPA is proposing a **new** testing requirement referred to as the **bleed emission test** procedure to help ensure fuel vapor emissions are virtually eliminated. Under this proposal, manufacturers would be required to measure diurnal emissions over the 2-day diurnal test procedure from just the fuel tank and the evaporative emission canister and comply with a 0.020 gram per test (g/test) standard for all LDVs, LDTs, and MDPVs, without averaging. The corresponding canister bleed test standard for HDGVs would be 0.030 g/test. The proposed Tier 3 evaporative emission standards would be phased in over a period of six model years between MY 2017 and MY 2022, with the leak test phasing in beginning in 2018.

New leak standard and test procedure to control fuel vapor leaks

The OBD system of current vehicles has the capability to check leaks in the vehicle’s evaporative emission control system. These systems employ either positive or negative pressure leak detection pumps or operate based on natural vacuum for negative pressure leak detection. EPA is proposing a test based on a similar concept of placing the system under a slight positive pressure (from an external source), measuring the flow needed to maintain that pressure in the fuel/evaporative control system, and converting that flow rate to an equivalent orifice diameter. The proposed standard would prohibit leaks with a cumulative equivalent diameter of 0.02 inches or greater. This would help ensure vehicles maintain near zero fuel vapor emissions over their full useful life. New LDV, LDT, MDPV, and HDGV equal to or less than 14,000 lbs GVWR meeting the proposed Tier 3 evaporative emission regulations would also be required to meet the leak emission standard beginning in the 2018 model year.

1.6 ONBOARD DIAGNOSTIC SYSTEMS (OBD)

Current EPA regulations allow manufacturers to certify OBD systems with CARB and to accept CARB OBD certifications. EPA is proposing to continue that practice but to upgrade EPA regulations to be consistent with the latest CARB regulations. EPA is also proposing specific additions to enhance the implementation of the leak emission standard. EPA is proposing to adopt the current CARB OBD regulations effective for the 2017 MY.

2. TIER 3 FUEL STANDARDS

EPA has proposed a reduction of sulfur content in federal gasoline. The objective is to help vehicle manufacturers comply with stringent new vehicle standards to reduce tailpipe emissions from older models. The proposal calls for maximum of 10 parts per million (ppm) of sulfur on an annual average basis by January 1, 2017.

In addition, EPA has proposed two options for setting maximum allowed sulfur levels for any batch of gasoline at refinery gate and downstream, as long as the annual average of 10 ppm sulfur level is met. Option 1 is to continue with the current 80-ppm refinery gate and 95-ppm downstream caps and option 2 is to lower them to 50 and 65 ppm, respectively.

The proposed Tier 3 gasoline sulfur standards puts the US on par with California, Europe, Japan, South Korea, and several other countries with Ultra low sulfur fuel standards (S <10 ppm). One important feature of the proposed standard is the flexibility in allowing refiners and fuel importers to comply with the 10-ppm sulfur standard. They can use fuel averaging on an annual basis and earn extra credits by lowering the level below 10 ppm and use those credits for banking for future compliance or trading. It is to be noted that small refiners that process 75,000 bbl/day or less crude oil will be given additional 3 years starting from January 2017 to comply with the standard. In their impact assessment, EPA referenced the ICCT sponsored study carried out by MathPro, which suggests that the cost of producing 10-ppm gasoline is in the range of 0.8-1.4 cents/gallon, fully supporting the EPA's estimate of about 1 cent/gallon.

Table 10 Proposed Tier 3 Gasoline Sulfur Standards

	Current Standard	Proposed Cap Option 1		Proposed Cap Option 2	
	Limit	Limit	Effective	Limit	Effective
Refinery annual average standard	30 ppm	10 pm	Jan 1 st 2017 ^a	10 ppm	Jan 1 st 2017 ^a
Refinery gate per gallon cap	80 ppm	80 ppm	Current	50 ppm	Jan 1 st 2020
Downstream per gallon cap	95 ppm	95 ppm	Current	65 ppm	March 1 st 2017

a. Effective January 1, 2020 for eligible small refiners and small volume refineries