

Table 1. Off-Road Compression-Ignition (Diesel) Engine Standards (NMHC+NO<sub>x</sub>/CO/PM in g/kW-hr)

Maximum Power	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015+
< 8 kW	See Table 2 footnote (a)					10.5 / 8.0 / 1.0			7.5 / 8.0 / 0.80			7.5 / 8.0 / 0.40 <sup>a</sup>									
8 ≤ kW < 19						9.5 / 6.6 / 0.80			7.5 / 6.6 / 0.80			7.5 / 6.6 / 0.40									
19 ≤ kW < 37						9.5 / 5.5 / 0.80			7.5 / 5.5 / 0.60			7.5 / 5.5 / 0.30				4.7 / 5.5 / 0.03					
37 ≤ kW < 56									7.5 / 5.0 / 0.40			4.7 / 5.0 / 0.30 <sup>c</sup>				4.7 / 5.0 / 0.03 <sup>c</sup>					
56 ≤ kW < 75						- / 9.2 / - / - <sup>b</sup>						4.7 / 5.0 / 0.40				0.19 / 3.4 / 5.0 / 0.02 <sup>b,d</sup>					
75 ≤ kW < 130												6.6 / 5.0 / 0.30			4.0 / 5.0 / 0.30					0.19	
130 ≤ kW < 225	-					1.3 / 9.2 / 11.4 / 0.54 <sup>b</sup>			6.6 / 3.5 / 0.20			4.0 / 3.5 / 0.20 <sup>e</sup>				0.19 / 2.0 / 3.5 / 0.02 <sup>b,d</sup>					
225 ≤ kW < 450									6.4 / 3.5 / 0.20											0.19	
450 ≤ kW ≤ 560												6.4 / 3.5 / 0.20									
Mobile Machines > 560 kW	-					1.3 / 9.2 / 11.4 / 0.54 <sup>b</sup>			6.4 / 3.5 / 0.20			0.40 / 3.5 / 3.5 / 0.10 <sup>b</sup>				0.19		3.5		0.04 <sup>b</sup>	
560 kW < GEN ≤ 900 kW																0.19		0.67		3.5	
GEN > 900 kW												0.40 / 0.67 / 3.5 / 0.10 <sup>b</sup>				0.03 <sup>b</sup>					

a) The PM standard for hand-start, air cooled, direct injection engines below 8 kW may be delayed until 2010 and be set at 0.60 g/kW-hr.

b) Standards given are NMHC/NO<sub>x</sub>/CO/PM in g/kW-hr.

c) Engine families in this power category may alternately meet Tier 3 PM standards (0.40 g/kW-hr) from 2008-2011 in exchange for introducing final PM standards in 2012.

d) The implementation schedule shown is the three-year alternate NO<sub>x</sub> approach. Other schedules are available.

e) Certain manufacturers have agreed to comply with these standards by 2005.



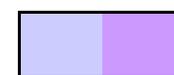
: Tier 1



: Tier 2



: Tier 3



: Tier 4 Interim / Final

Table 2. Small Off-Road Engine Exhaust Emission Standards ( ≤ 19 kW), HC+NOx / CO / PM in g/kW-hr

Displacement Category	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Displacement Category	2005	2006	2007	2008	2009	2010	2011	2012	2013+	
< 20 cc	HC: 295 / NOx: 5.36 / CO: 805					72 / 536 / 2.0 <sup>b</sup>					< 50 cc	50 / 536 / 2.0 <sup>b</sup>									
≥ 20cc - < 50cc	HC: 241 / NOx: 5.36 / CO: 805										< 50 cc	50 / 536 / 2.0 <sup>b</sup>									
≥ 50cc - ≤ 65cc	HC: 161 / NOx: 5.36 / CO: 402										≥ 50cc - ≤ 80cc	72 / 536 / 2.0 <sup>b</sup>									
> 65cc - < 225cc	16.1	16.1 / 467 / 1.2 <sup>a</sup>				16.1/467/ -	16.1 / 549 / - Horizontal-shaft	> 80cc - < 225cc Horizontal-shaft	16.1 / 549 / -		10 / 549 / -										
	402						16.1 / 467 / - Vertical-shaft	> 80cc - < 225cc Vertical-shaft													16.1 / 467 / -
≥ 225 cc	13.4	13.4 / 467 / 1.2 <sup>a</sup>				13.4/467/ -	12.1 / 549 / -		12.1 / 549 / -					8.0 / 549 / -							
	402																				
	1.2 <sup>a</sup>																				

a) HC+NOx, CO and PM standards applicable to all diesel-cycle engines. PM standard is not applicable to spark-ignition engines.

b) PM standard applicable to all two-stroke engines.

Table 3. Small Off-Road Engine Evaporative Emissions - Performance and Design Standards

Displacement Category	Requirements		2006	2007	2008	2009	2010	2011	2012	2013+
≤ 80cc	Fuel Tank Permeation g ROG/m <sup>2</sup> /day		-	2						
Walk-Behind Mowers > 80cc - < 225cc	Performance Requirements <sup>a</sup>	Diurnal Standard Grams HC/day	-	1.3	1.0					
	Design Requirements	Fuel Hose Permeation g ROG/m <sup>2</sup> /day	15	-					-	
Non Walk-Behind Mowers > 80cc - < 225cc	Performance Requirements <sup>a</sup>	Diurnal Standard Grams HC/day	-	1.20 + 0.056 × tank vol.(L)					0.95+0.056×tank vol.	
	Design Requirements	Fuel Hose Permeation g ROG/m <sup>2</sup> /day	15							
		Fuel Tank Permeation g ROG/m <sup>2</sup> /day	-	2.5					1.5	
		Carbon Canister or Equivalent Butane Working Capacity Grams HC	-	1.4 g/L (tanks ≥ 3.78L) or 1.0 g/L (tanks < 3.78L)						
≥ 225cc <sup>b</sup>	Performance Requirements <sup>a</sup>	Diurnal Standard Grams HC/day	-	1.20 + 0.056 × tank vol.(L)						
	Design Requirements	Fuel Hose Permeation g ROG/m <sup>2</sup> /day	15							
		Fuel Tank Permeation g ROG/m <sup>2</sup> /day	-	2.5					1.5	
		Carbon Canister or Equivalent Butane Working Capacity Grams HC	-	1.4 g/L (tanks ≥ 3.78L) or 1.0 g/L (tanks < 3.78L)						

a) For model year 2006 only, all engines and equipment with displacements > 80 cc - <225 cc must comply with the fuel hose permeation design requirement. Engines and equipment with displacements ≥ 225 cc must comply with the fuel hose permeation design requirement for model years 2006 and 2007 only.

b) Small production volume engines or equipment are exempted from the diurnal standards and the fuel tank permeation standard. In addition, these engines or equipment are not required to be configured with low permeation fuel hoses and carbon canisters until model year 2010.

Table 4. Large Spark-Ignition Engine Exhaust Emission Standards (> 19 kW), HC+NOx/CO in g/kW-hr (Durability Period)

Displacement Category	Test Cycle	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010 +	
≤ 1.0 liter	Steady-state testing		12.0 / 549 (1000 hours or 2 years)									
> 1.0 liter	Steady-state testing	4.0 / 49.6 <sup>a</sup>			4.0 / 49.6 (3500 hours or 5 years)			2.7 / 4.4 <sup>b</sup> (5000 hours or 7 years)			0.8 / 20.6 (5000 hours or 7 years)	
	Transient testing							2.7 / 4.4 <sup>b</sup> (5000 hours or 7 years)			0.8 / 20.6 (5000 hours or 7 years)	
	Field testing							3.8 / 6.5 <sup>c</sup> (5000 hours or 7 years)				

a) A manufacturer must show that at least 25% of its California engine sales comply with the standards in 2001, 50% in 2002, and 75% in 2003.

b) For the 2007 through 2009 model years, manufacturers may alternatively certify their engines according to the following formula:  $(\text{HC} + \text{NOx}) \times \text{CO}^{0.784} \leq 8.57$

c) Starting in 2007, manufacturers may apply the following formula to determine alternate emission standards:  $(\text{HC} + \text{NOx}) \times \text{CO}^{0.791} \leq 16.78$

Table 5. Large Spark-Ignition Engine Evaporative Emission Standards (Starting in the 2007 Model Year)

Evaporative Emission Standards	Requirements
Evaporative hydrocarbon emissions (g/gal of fuel tank capacity)	0.2 Use a tethered or self-closing gas cap on a fuel tank that stays sealed up to a positive pressure of 24.5kPa (3.5 psig) or a vacuum pressure of 0.7 kPa (0.1 psig).
Fuel lines	For nonmetallic fuel lines, manufacturers must specify and use products that meet the Category 1 specifications in SAE J2260 (November 1996).
Prevent fuel boiling at an ambient temperature of 30° C	Note that gasoline with a Reid vapor pressure of 62 kPa (9 psi) begins to boil at about 53° C.
Design-based certification	Design-based certification as described in subpart F, Title 40 CFR 1048.105 and 1048.245, as adopted July 13, 2005, may be used instead of generating new emission data.

Table 6. Large Spark-Ignition Engine Fleet Average Emission Level Standards, HC+NOx in g/kW-hr

Fleet Type	Initial Compliance Date		
	1/1/2009	1/1/2011	1/1/2013
Large Forklift Fleet (≥ 26 pieces of equipment)	3.2	2.3	1.5
Medium Forklift Fleet (4 - 25 pieces of equipment)	3.5	2.7	1.9
Non-forklift Fleet (≥ 4 sweeper/scrubbers, industrial tow tractors, or pieces of airport ground support equipment, alone or in combination)	4.0	3.6	3.4

Table 7. Spark-Ignition Marine Engine Standards, HC+NOx in g/kW-hr

Engine / MY		2001	2002	2003	2004	2005	2006	2007	2008	2009+
Personal Watercraft and Outboard Engines	$P_{tx} < 4.3 \text{ kW}^a$	81.00			64.80				30.00	
	$P_{tx} \geq 4.3 \text{ kW}^a$	$(0.25 \times (151 + 557/P_{tx}^{0.9})) + 6.0$			$(0.20 \times (151 + 557/P_{tx}^{0.9})) + 4.8$				$(0.09 \times (151 + 557/P_{tx}^{0.9})) + 2.1$	
Inboard and Sterndrive Engines	Option 1	-	16.0 <sup>b</sup>				5.0 / 16.0 <sup>b,c</sup>		5.0 <sup>d,e</sup>	
	Option 2						14.0	5.0		

a)  $P_{tx}$  is the average power in kW (sales-weighted) of the total number of spark-ignition marine engines produced for sale in California in model year x. Power outputs of outboard engines are determined separately from those of personal watercraft engines.

b) The 16.0 g/kW-hr standard may be met through sales averaging.

c) For model year 2007, engine manufacturers shall certify a minimum of 45% of their California production (projected California sales or projected California percentage of national sales) to the standard. For model year 2008, engine manufacturers shall certify a minimum of 75% of their California production (projected California sales or projected California percentage of national sales) to the standard.

d) Engines with rated power greater than 373 kW do not have to comply with the standards until 2009.

e) For engines with rated power greater than 373 kW, the 5.0 g/kW-hr standard may be met through sales averaging with engines less than 373 kw rated power.

Table 8. Off-Highway Recreational Vehicles and Engines <sup>a</sup>, HC<sup>b</sup> / CO (Durability Period)

Engine / MY	1998 <sup>c</sup>	1999	2000	2001	2002	2003	2004	2005	2006	2007 +
Off-Road Motorcycles and All-Terrain Vehicles with Engines > 90 cc (g/km)	1.2 / 15.0 (5 years or 10,000 km)									
Off-Road Motorcycles and All-Terrain Vehicles with Engines ≤ 90 cc or Less (g/km)	-	1.2 / 15.0 (5 years or 10,000 km)								
Off-Road Sport Vehicles and Off-Road Utility Vehicles	-									1.2 / 15.0 (5 years or 10,000 km)
Sand Cars	-									1.2 / 15.0 (5 years or 10,000 km)
Optional Engine-Based Testing: All-Terrain Vehicle with Engines < 225 cc (g/kW-hr) <sup>d</sup>	16.1 / 400 (5 years or 10,000 km)									
Optional Engine-Based Testing: All-Terrain Vehicle with Engines ≥ 225 cc (g/kW-hr)	13.4 / 400 (5 years or 10,000 km)									
Optional Engine-Based Testing: Off-Road Sport Vehicles and Off-Road Utility Vehicles (g/kW-hr)	-									12.0 / 400 (5 years or 10,000 km)
Optional Engine-Based Testing: Sand Cars	-									13.4 / 400 (5 years or 10,000 km)
Golf Carts in Federal Ozone Non-Attainment Areas <sup>e</sup>	Zero Emission									

a) Vehicles and engines that do not meet the applicable emission standards may be certified for sale subject to use restrictions.

b) Compliance with the HC emission standard to be applied as a corporate average.

c) These standards apply to all off-highway recreational vehicles and engines used in such vehicles produced on or after January 1, 1997, which is effectively applicable to 1998 model year and subsequent.

d) All-terrain vehicles with engines 90 cc or less would not have to comply with the standards until January 1, 1999, which is effectively applicable to 2000 model year and subsequent.

e) Golf carts in ozone attainment area may be equipped with spark-ignition engines meeting the small off-road engine standards.

Table 9. Off-Highway Recreational Vehicles and Engines Evaporative Emission Standards

Vehicle and Model Year	Emission Component	Permeation Standard	Test Temperature
All Off-Highway Recreational Vehicles 2008 and Later (grams per square meter per day)	Fuel Tank Permeation	1.5	28°C (82°F)
	Hose Permeation	15.0	23°C (73°F)