

U.S. EPA Proposes Emission Standards for Nonroad Engines

On September 14, 2001, the U.S. Environmental Protection Agency proposed NO_x, HC, and CO emission standards for several types of currently unregulated spark-ignition (SI) nonroad engines and vehicles. The vehicles and engines covered include:

- **Large Industrial Spark-Ignition Engines** – SI nonroad engines rated over 25 horsepower (19kW) used in commercial and industrial applications, including forklift, electric generators, airport ground vehicles, and a variety of other construction, farm, and industrial equipment.
- **Recreational Off-Road Vehicles** – SI nonroad engines used in off-road motorcycles, all-terrain-vehicles (ATVs), and snowmobiles.
- **Diesel Marine Engines** – Diesel engines rated at or above 50 horsepower (37kW) used in recreational boats.

EPA intends to issue proposals for highway motorcycles and marine spark-ignition engines (sterndrive and inboards) before the end of 2001.

The engines and vehicles covered by EPA's proposal account for about 13% of the mobile source inventory for HC emissions, 6% for CO emissions, and 3% for NO_x emissions. EPA expects the new standards will reduce CO by 56% and HC+NO_x by nearly 80% when fully implemented. EPA estimates the costs of compliance will range from \$50 to \$200 for snowmobiles, less than \$100 for ATVs, and about \$600 for marine diesel engines and large SI engines.

As discussed below, the proposed standards will create some opportunities for catalyst technology, but will be met primarily by modified 2-stroke engine technology (e.g., recalibration, clean carburetion, fuels system upgrades), changing from 2-stroke to 4-stroke engine technology, modified 4-stroke engine technology (e.g., recalibration, fuel system upgrades), or improved diesel combustion and aftercooling.

EPA will conduct public hearings on October 24, 2001 in Washington, DC and on October 30, 2001 in Denver. The deadline for written comments is December 19, 2001. MECA plans to participate at the public hearings, to submit written comments, and to work with its allies to support EPA's proposal for industrial SI engines >25 hp and to encourage the Agency to strengthen the proposed rules for the other categories of engines covered by the proposal.

Large Industrial SI Engines

As shown in Table 1, EPA is proposing a two-phase program for this category of engines. The 2004 standards are based on the California standards adopted in 1998. The 2007 standards are more stringent in that they more accurately reflect the in-use deterioration of emission controls, include a transient duty cycle and associated emission standards, as well as establish a

field test requirement, diagnostic requirements, and measures to reduce evaporative emissions from gasoline-powered SI engines >25 hp. When fully implemented, the rule will result in a 70% reduction in HC, an 85% reduction in NO_x, and a 90% reduction in CO.

**Table 1.
Proposed Emission Standards for Large SI Engines (g/kW-hr)**

Model Year	Testing Type	Emission Standards		Alternate Emission Standards	
		HC+NO _x	CO	HC+NO _x	CO
2004-2006	Duty-cycle testing	4.0	50.0	-	-
2007 and later	Duty-cycle testing	4.0	2.5	1.3	25.0
	Field testing	5.6	4.0	1.8	50.0

EPA states that the 2004 standards will be met by employing basic automotive emission control technologies – electronic fuel systems with three-way catalytic converters. To meet the 2007 standards, EPA notes that fuel system technologies and catalyst technology can be further optimized, citing a test program conducted at SwRI in which MECA participated. EPA also proposed more stringent voluntary “Blue Sky” standards based on the early introduction of engines that meet either the Phase 1 or Phase 2 mandatory standards. EPA hopes a market for the cleaner engines will emerge as a result of interest by end users in operating less polluting engines.

Recreational Vehicles and Engines

As shown in Table 2 below, EPA is proposing different standards for snowmobiles, ATVs, and off-road motorcycles. These categories of engines/vehicles account for approximately 10% of the HC and 3% of the CO from total mobile source emissions nationwide. Eight companies account for approximately 95% of all domestic sales of recreational vehicles.

**Table 2.
Recreational Vehicle Exhaust Emission Standards**

Vehicle	Model Year	Emission Standards		Phase-In
		HC (g/kW-hr)	CO (g/kW-hr)	
Snowmobiles	2006	100	275	100%
	2010	75	200	100%
		HC+NO _x (g/km)	CO (g/km)	
Off-highway motorcycles	2006	2.0*	25.0*	50%
	2007 and later	2.0*	25.0*	100%
ATVs	2006	2.0*	25.0*	50%
	2007 and 2008	2.0*	25.0*	100%
	2009	1.0*	25.0*	50%
	2010 and later	1.0*	25.0*	100%



*The motorcycle and ATV g/km standards relate to a vehicle test rather than an engine test. Thus, the g/km standards cannot be compared directly to the g/kW-hr standards for the other sectors. For example, an ATV emitting 2.0 g/km HC+NOx could emit as much as 16 g/kW-hr when tested on an engine basis.

EPA’s projected emission reductions for nonroad recreational engines and vehicles from the proposed standards are shown in Table 3.

**Table 3.
Recreational Vehicle Estimated Emission Reductions by Year 2020**

Vehicle	HC	CO
Snowmobiles	63%	63%
Off-highway motorcycles	90%	38%
ATVs	84%	34%

Off-Highway Motorcycles and ATVs – Approximately 55% of the non-competition off-road motorcycles (competition off-road motorcycles are exempt) and 80% of all ATVs sold in the U.S. are powered by 4-stroke engines. EPA’s proposed 2006 standards for off-highway motorcycles and ATVs are based on 4-stroke engine technology with some low-level modifications to the fuel system calibrations. For the ATV 2009 standards, EPA expects vehicle manufacturers to use 4-stroke engines with air injection on many models, but EPA notes they may also choose to use a combination of several possible emission control technologies, including base-engine modifications, improved fuel-system calibrations, electronic fuel injection, and catalyst technology.

EPA declined to propose applying the tighter 2009 ATV standards to off-highway motorcycles citing the complexity and cost of electronic fuel injection and manufacturers and end-users concern over possible leg burns from catalysts. EPA also maintained that catalysts and secondary air have the potential to adversely affect engine performance. MECA does not agree with EPA’s conclusion regarding the feasibility of catalyst technology and air injection for use on off-highway motorcycles and will communicate its view to EPA.

Snowmobiles – EPA is proposing HC and CO standards for snowmobiles. EPA declined to propose NOx standards because snowmobiles are operated in the winter when ozone (formed by NOx and HC emissions) is not a concern. EPA did not propose PM standards because of the cost of measuring PM emissions as part of the certification test and because HC controls will simultaneously limit PM. EPA expects manufacturers to meet the 2006 standards by applying 2-stroke engine modifications, clean carburetion, and/or direct or semi-direct injection. To meet the 2010 standards, EPA anticipates manufacturers will employ direct fuel injection systems or convert to 4-stroke engines.

Voluntary Low-Emission Standards – EPA is proposing voluntary low emission standards for snowmobiles (149 g/hp-hr for CO and 56 g/hp-hr for HC through 2009 and 89 g/hp-hr for CO and 34 g/hp-hr for HC thereafter). For ATVs and off-highway motorcycles, the voluntary standards would be 1.3 gpm for HC+NOx and 24.3 gpm for CO. EPA would promote product labeling and allow manufacturers to generate emission credits.

Recreational Marine Diesel Engines

EPA estimates that marine engines used in recreational craft account for approximately 0.5% of the NO_x and 0.2% of the PM from total mobile source emissions nationwide. The proposed standards are shown in Table 4. EPA expects manufacturers to employ the same emission control strategies that are expected for land-based nonroad diesel engines and commercial marine diesel engines. These strategies are primarily focused on engine modifications

Table 4.
Proposed Recreational Marine Diesel Emission Limits and Implementation Dates

Subcategory	Implementation Date	HC+NO _x (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)
power \geq 37 kW 0.5 \leq disp < 0.9	2007	7.5	0.40	5.0
0.9 \leq disp < 1.2	2006	7.2	0.30	5.0
1.2 \leq disp < 2.5	2006	7.2	0.20	5.0
2.5 \leq disp	2009	7.2	0.20	5.0

For Additional Information . . .

Contact EPA's Margaret Borushko at (tel.) 734/214-4334 or (e-mail) borushko.margaret@epa.gov. A copy of EPA's proposal will be posted soon on EPA's Internet site at: www.epa.gov/otaq.

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