CANADA: NONROAD: EMISSIONS

History

Prior to the Canadian Environmental Protection Act 1999 (CEPA 1999), there was no federal authority for regulating emissions from off-road engines such as those typically found in construction, mining, farming and forestry machines. Under the December 2000 Ozone Annex to the 1991 Canada-United States Air Quality Agreement, Canada committed to establishing emission regulations under CEPA 1999 for new off-road engines that aligned with the US EPA requirements. In the period before the regulations were promulgated, Environment Canada signed Memorandums of Understanding (MOUs) with 13 engine manufacturers in 2000. Under the terms of these MOUs, manufacturers agreed to supply off-road diesel engines designed to meet US EPA Tier 1 standards.

Off-Road Compression-Ignition Engine Emission Regulations

The Off-Road Compression-Ignition Engine Emission Regulations were promulgated on 23 February 2005. These regulations introduced emission standards for model year 2006 and later diesel engines used in off-road applications such as those typically found in construction, mining, farming and forestry machines. These regulations encompassed the US EPA Tier 2 and Tier 3 standards.

In November 2011, the regulations were amended to align with the US EPA Tier 4 standards.

Off-Road Small Spark-Ignition Engine Emission Regulations

The Off-Road Small Spark-Ignition Engine Emission Regulations were promulgated on 19 November 2003. The Regulations apply to off-road engines of model year 2005 and later that use sparkplugs and develop no more than 19 kW (25 hp) of power. Typical small spark-ignition engines are gasoline-fuel and are used in lawn and garden machines, in light-duty industrial machines, and in light-duty logging machines.

Off-Road Large Spark-Ignition Engine Emission Regulations

Environment Canada plans to propose regulations to address emissions from large spark-ignition engines used in industrial applications such as forklifts and ice re-surfacing machines in the future.

Technical Standards

Off-Road Compression-Ignition Engines

Tier 2/3 Standards

The Canadian Off-Road Compression-Ignition Engine Emission Regulations align the engine certification values with those of the US EPA Tier 2 and Tier 3 values. The implementations dates, however, were later.

In the US, compliance with Tier 2 requirements was mandatory as early as model year 2001 and with Tier 3 starting with model year 2006. Compliance in Canada with US EPA Tier 2 requirements was not mandatory until the 2006 model year.

Canadian Tier 2/3 Off-Road Compression-Ignition Engine Emission Standards, g/kWh					
Power (P), kW	**Tier**	**Year**	**NMHC + NOx**	**CO**	**PM**
P <8	Tier 2	2006	7.5	8.0	0.80
8≤ P <19	Tier 2	2006	7.5	6.6	0.80
19≤ P <37	Tier 2	2006	7.5	5.5	0.60
37≤ P <75	Tier 2	2006	7.5	5.0	0.40
	Tier 3	2008	4.7	5.0	0.40
75≤ P <130	Tier 2	2006	6.6	5.0	0.30
	Tier 3	2007	4.0	5.0	0.30
130≤ P <225	Tier 3	2006	4.0	3.5	0.20
225≤ P <450	Tier 3	2006	4.0	3.5	0.20
450≤ P <560	Tier 3	2006	4.0	3.5	0.20
P >560	Tier 2	2006	6.4	3.5	0.20

Tier 4 Standards

On 17 November 2011, Environment Canada adopted amendments to the Off-Road Compression-Ignition Engine Emission Regulations which align Canadian emission standards with the US Tier 4 standards for nonroad engines. The Tier 4 standards came into force on 16 January 2012 and apply to engines of the 2012 and later model years manufactured on and after 16 January 2012.

Applicability

The Off-Road Compression-Ignition Engine Emission Regulations apply to "reciprocating, internal combustion engines, other than those that operate under characteristics significantly similar to the theoretical Otto combustion cycle and that use a spark plug or other sparking device." This definition is not exactly the same as the definition of a diesel engine used in the On-Road Vehicle and Engine Emission Regulations where a diesel engine is defined as one "that has operating characteristics significantly similar to those of the theoretical Diesel combustion cycle. The non-use of a throttle during normal operation is indicative of a diesel engine." The off-road regulations focus on the ignition mechanism while the on-road regulations focus on the load control mechanism in distinguishing the engine type.

The regulations specifically exempt engines:

- designed exclusively for competition
- regulated by the On-Road Vehicle and Engine Emission Regulations;
- designed to be used exclusively in underground mines;
- with a per-cylinder displacement of less than 50 cm^3;
- for military machines used in combat or combat support;
- being exported and not sold or used in Canada;

- designed to be used in a vessel and for which the fuel, cooling and exhaust systems are integral parts of the vessel.

While not specifically exempted by the regulation, Environment Canada does not have legislative authority to regulate emissions from railway locomotive engines.

The Canadian Off-Road Compression-Ignition Engine Emission Regulations do not include an optional averaging, banking and trading program as in the US EPA regulations.

Mining Engines

Emissions from engines used exclusively in underground mining equipment fall under provincial jurisdiction. While emissions from these engines are not directly regulated, provincial regulations exist for ventilation rates in mines where these engines are used. Canadian Standards Association (CSA) standards have been established that describe the technical requirements and procedures necessary for the design, performance, and testing of new or unused non-rail-bound, diesel-powered, self-propelled machines in underground mines (MMSL02-043). Testing carried out according to these CSA standards establish the minimum ventilation rate required for any engine to keep air quality at an acceptable level. Some provinces base their ventilation requirements on the results of testing according to the CSA standards.

Off-Road Small Spark-Ignition Engines

The Off-Road Small Spark-Ignition Engine Emission Regulations apply to off-road engines of model year 2005 and later that use sparkplugs and develop no more than 19 kW (25 hp) of power. The emissions standards are divided into seven classes based on engine displacement and usage in either a handheld or non-handheld application as shown below.

Small Spark-Ignition Engine Emission Standards, g/kWh						
Class	**Engine Type**	**Displacement (D), (cm^3)**	**Date**	**HC + NOx[b]**	**NMHC + NOx**	**CO**
I-A	Non-handheld	D <66	2005	50	-	610
I-B		66≤ D <100	2005	40	37	610
I		100≤ D <225	2005[1]	16.1[a]	-	519[a]
			2005[2]	16.1	14.8	610
			2007	16.1	14.8	610
II		D ≥225	2005	12.1	11.3	610
III	Handheld	D <20	2005	50	-	805
IV		20≤ D <50	2005	50	-	805
V		D ≥50	2005	119	-	603
			2006	96	-	603
			2007	72	-	603

Notes:
a - Standards apply only when the engine is new
b - Some engine classes include a combined NMHC+NOx standard that applies only when the engine is fueled by natural gas
1 - For models already in production at coming into force of the Regulations
2 - For models initially produced after coming into force of the Regulations

Engines must meet the emission standards throughout their useful life (with the exception of pre-2005 Class I engines, as indicated in the table). At the time of engine certification, a manufacturer can select one of three specified useful life periods, which range from 50 to 1000 hours depending on the engine class. For example, for a class I engine, the useful life can be 125, 250 or 500 hours. The selection of useful life duration must be supported by technical information. Longer useful lives, which entail a higher manufacturing cost, are typically found in commercial equipment while home consumer products are often designed for shorter useful lives.

Alternative less stringent emission standards, consistent with those available under the CFR, are available:

- for HC+NOx levels for engines in machines used exclusively in wintertime, such as ice augers and snow-blowers; These engines are subject to the applicable CO standard.
- for replacement engines which are engines manufactured exclusively to replace an existing engine in a machine for which no current model year engine with physical or performance characteristics necessary for the operation of the machine exists;

- for class III, IV and V when less than 2000 engines of a particular model are sold in total in Canada to accommodate Canada-only niche products.

Marine Spark-Ignition Engine, Vessel and Off-Road Recreational Vehicle Emission Regulations

On 4 February 2011, Environment Canada adopted Marine Spark-Ignition Engine, Vessel and Off-Road Recreational Vehicle Emission Regulations. These emission regulations apply to outboard engines, personal watercraft, snowmobiles, off-highway motorcycles and all-terrain vehicles. Most of the regulatory provisions came into force from April 5, 2011. The standards align with corresponding US EPA rules for marine spark-ignition engines and off-road recreational engines and vehicles. An earlier MOU with the Canadian Marine Manufacturers Association covered only marine spark ignition engines and under its terms, engine manufacturers voluntarily committed to supply engines designed to meet United States federal emissions standards into Canada starting with the 2001 model year.