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DEDICATED TO GLOBAL GAS COMPRESSION PRODUCTS AND APPLICATIONS

2022

STATIONARY EMISSIONS AT-A-GLANCE

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2022 Stationary Emissions At-A-Glance

UNITED STATES

Environmental Protection Agency (EPA)

Existing stationary diesel engines

TABLE 1 NESHAP EMISSION REQUIREMENTS FOR EXISTING STATIONARY CI ENGINES		
ENGINE CATEGORY	EMISSION STANDARD	ALTERNATIVE CO REDUCTION
Area Sources		
Non-Emergency 300 < hp ≤ 500	49 ppm CO	70%
Non-Emergency > 500 hp	23 ppm CO	70%
Major Sources		
Non-Emergency 100 ≤ hp ≤ 300	230 ppm CO	-
Non-Emergency 300 < hp ≤ 500	49 ppm CO	70%
Non-Emergency > 500 hp	23 ppm CO	70%

Standards for spark ignition, gas-fired stationary engines are summarized in Table 2. The engine designations indicate two- or four-stroke (2S/4S) lean- or rich-burn (LB/RB) natural gas or landfill/digester gas (LFG/DG) engines.

TABLE 2 NESHAP EMISSION REQUIREMENTS FOR EXISTING STATIONARY SI ENGINES		
ENGINE CATEGORY	EMISSION STANDARD	ALTERNATIVE CO/HCHO REDUCTION
Area Sources[†]		
4SLB, Non-Emergency > 500 hp	Install OC ^a	
4SRB, Non-Emergency > 500 hp	Install NSCR ^b	
Major Sources		
2SLB, Non-Emergency 100 ≤ hp ≤ 500	225 ppm CO	-
4SLB, Non-Emergency 100 ≤ hp ≤ 500	47 ppm CO	-
4SRB, Non-Emergency 100 ≤ hp ≤ 500	10.3 ppm HCHO	-
LFG/DG, Non-Emergency 100 ≤ hp ≤ 500	177 ppm CO	-
4SRB, Non-Emergency > 500 hp	350 ppb HCHO	76% HCHO ^c

[†] Standards applicable only to engines operated > 24 hr/yr and installed in locations that are not "remote areas". Remote areas include (1) offshore locations along that portion of the coast that is in direct contact with the open seas, (2) pipeline segments with 10 or fewer buildings intended for human occupancy and no buildings with four or more stories within 660 ft. (220 yards) on either side of the centerline of any continuous 1 mile (1.6 km) length of pipeline, or (3) non gas-pipeline locations that have five or fewer buildings intended for human occupancy and no buildings with four or more stories within a 0.25 mile (0.4 km) radius around the engine.

^a The oxidation catalyst must provide a 93% CO emission reduction or a 47 ppm CO concentration.

^b The NSCR catalyst must provide a 75% CO reduction or a 30% THC reduction or a CO concentration of 270 ppm.

^c Alternative option: 30% THC reduction.

NEW ENGINES. NESHAP standards are also applicable to certain categories of new CI and SI engines located at major sources, Table 3. Note that "new" engine does not mean newly built engine – see the definitions above.

TABLE 3 NESHAP EMISSION REQUIREMENTS FOR NEW CI AND SI ENGINES AT MAJOR SOURCES		
ENGINE CATEGORY	EMISSION STANDARD	ALTERNATIVE CO/HCHO REDUCTION
CI Engines		
Non-Emergency > 500 hp	580 ppb CH ₂ O	70% CO
SI Engines		
2SLB, Non-Emergency > 500 hp	12 ppm CH ₂ O	58% CO
4SLB, Non-Emergency > 250 hp	14 ppm CH ₂ O	93% CO
4SRB, Non-Emergency > 500 hp	350 ppb CH ₂ O	76% CH ₂ O

Note: New limited use engines > 500 hp at major sources do not meet any emission standards under the NESHAP.

New and reconstructed engines of lower horsepower (< 500 hp; 4SLB < 250 hp) located at major sources, as well as new engines located at area sources must meet the applicable NSPS CI or NSPS SI emission standards.

EMISSION REQUIREMENTS FOR NON-EMERGENCY STATIONARY ENGINES			
DISPLACEMENT (D)	POWER	YEAR	EMISSION CERTIFICATION
D < 10 L per cylinder	≤ 3000 hp	2007+	Nonroad Tier 2/3/4
		2007-2010	Nonroad Tier 1
		2011+	Nonroad Tier 2/4
10 ≤ D < 30 L per cylinder	All	2007+	Marine Cat. 2 Tier 3/4/3/4
D ≥ 30 L per cylinder	All	2010-2011	Marine Cat. 3 Tier 1
		2012+	Marine Cat. 3 Tier 2/3

Nonroad diesel engines

TABLE 4 TIER 4 EMISSION STANDARDS—ENGINES ABOVE 560 KW, G/KWH (G/BHP-HR)					
YEAR	CATEGORY	CO	NMHC	NO _x	PM
2011	Generator sets > 900 kW	3.5 (2.6)	0.40 (0.30)	0.67 (0.50)	0.10 (0.075)
	All engines except gensets > 900 kW	3.5 (2.6)	0.40 (0.30)	3.5 (2.6)	0.10 (0.075)
2015	Generator sets	3.5 (2.6)	0.19 (0.14)	0.67 (0.50)	0.03 (0.022)
	All engines except gensets	3.5 (2.6)	0.19 (0.14)	3.5 (2.6)	0.04 (0.03)

Other provisions

CRANKCASE FILTRATION. Stationary engines – including CI ≥ 100 hp (74.6 kW) at major source, CI > 300 hp (223.7 kW) at area source, and SI 100 to 500 hp (74.6 to 372.8 kW) at major source – must be equipped with closed or open crankcase filtration system in order to reduce metallic HAP emissions.

WORLD BANK GUIDELINES Stationary engines

The maximum emission levels are expressed as concentrations, to facilitate monitoring. The emission limits are to be achieved through a variety of control and fuel technologies, as well as through good maintenance practice. Dilution of air emissions to achieve the limits is not acceptable.

The following are emission limits for engine driven power plants:

PARTICULATE MATTER PM emissions (all sizes) should not exceed 50 mg/Nm³.

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CANADA

The first Canadian federal emission standards for stationary compression-ignition (SCI) engines were adopted in December 2020. The SCI emission requirements are applicable to engines that have a displacement of less than 30 L per cylinder and are used to provide primary sources of electricity or power machines such as fire pumps and emergency backup generators. The new SCI emission standards took effect June 4, 2021 and are based on the date of manufacture.

APPLICABLE US EPA TIERS FOR CANADIAN STATIONARY COMPRESSION ENGINES		
POWER RANGE	NON-BACKUP AND NON-REMOTE	BACKUP/EMERGENCY OR REMOTE
≤37 kW	Tier 4	Tier 2
>37 kW to ≤560 kW	Tier 4	Tier 3
>560 kW	Tier 4	Tier 2

Note: Fire pumps have separate, less stringent standards.

In 2016, Environment Canada has published the final Multi-Sector Air Pollutant Regulations (MSAPR) [3528] that established requirements for the following emissions: (a) NO_x from boilers and heaters in various industrial sectors; (b) NO_x from stationary spark-ignition engines that combust gaseous fuels in various industrial sectors; and (c) NO_x and SO₂ from cement manufacturing facilities.

The regulation defines two sets of engine emission standards, applicable to modern engines and to pre-existing engines used in certain industrial sectors. The definitions and applicability of the standards are summarized in Table 1. The standards are further differentiated for regular-use and low-use engines (Table 2).

TABLE 1 ENGINE CATEGORIES AND APPLICABILITY OF MSAPR PERFORMANCE STANDARDS		
	MODERN ENGINES	PRE-EXISTING ENGINES
Definition	Manufactured on or after September 15, 2016	Manufactured before September 15, 2016
Regulated sectors	Aluminum and alumina, base metals, cement manufacturing, chemicals, iron ore pelletizing, iron, steel and ilmenite, nitrogen-based fertilizer, oil sands, petroleum refining, potash, power plants, pulp and paper, and oil and gas	Oil and gas – defined as upstream oil and gas, natural gas transmission pipelines and related underground storage facilities in those two sectors

The regulation affects some estimated 6,300 "pre-existing" engines in Canada, with more than 95% of these engines located in the

SULFUR DIOXIDE Total SO₂ emissions should be less than 0.20 metric tons per day (tpd) per MWe of capacity for the first 500 MWe, plus 0.10 tpd for each additional MWe of capacity over 500 MWe. In addition, the SO₂ concentration in flue gases should not exceed 2,000 mg/Nm³, with a maximum emissions level of 500 tpd.

NITROGEN OXIDES Provided that the resultant maximum ambient levels of nitrogen dioxide are less than 150 µg/m³ (24-hour average), the NO_x emissions levels should be less than 2,000 mg/Nm³ (or 13 g/kWh, dry at 15% O₂). In all other cases, the maximum NO_x emission level is 400 mg/Nm³ (dry at 15% O₂).

upstream oil and gas sector and the natural gas transmission pipeline sector.

The standards include exclusions for engines owned and operated by small businesses that meet certain criteria specified in the regulation.

Emission Standards

The emission requirements are summarized in Table 2. The emission standards for modern engines – which are comparable in stringency with the US EPA NSPS standards – become effective with the publication of the regulation. The emission requirements for pre-existing engines are phased-in from 2021 to 2026 and include two alternative compliance options: (1) per-engine standards (flat limit) or (2) engine group standards (yearly average limit).

TABLE 2 MSAPR PERFORMANCE STANDARDS FOR SI GAS FUELED ENGINES		
	MODERN ENGINES	PRE-EXISTING ENGINES
Regular-use Engines		
Engine size threshold	≥75 kW	≥250 kW
NO _x emission limits	2.7 g/kWh or 160 ppmvd at 15% O ₂	Per-engine approach: 4 g/kWh or 210 ppmvd at 15% O ₂ (engines comprising 50% of total power as of 2021; 100% by 2026) or Yearly-average approach: 8 g/kWh or 421 ppmvd at 15% O ₂ as of 2021; 4 g/kWh or 210 ppmvd at 15% O ₂ as of 2026
Emission testing	Baseline performance test; ongoing tests for engines ≥375 kW	Baseline performance test; ongoing tests for some engines ≥375 kW
Low-use Engines^a		
Engine size threshold	≥100 kW	≥250 kW ^b
NO _x emission limits	160 ppmvd at 15% O ₂	None
Emission testing	None	None

^a Low-use engines are defined as those used less than 5% of the time based on a three-year average

^b Engines must be registered and are subject to engine hours record and reporting requirements

REGISTRATION AND REPORTING REQUIREMENTS The regulation includes engine registration and reporting requirements for engine owners.

For modern engines, the engine must be registered and the results of emission testing submitted annually starting one year after the engine begins to operate. However, there are no emission testing requirements for modern, low-use engines.

For pre-existing engines, registration is required as of January 1, 2019, and annual reports must be submitted as of 2022.

CONTROL TECHNOLOGIES Environment Canada envisions a number of technologies that can be used to reduce NO_x emissions from stationary SI gas engines, including rich-to-lean engine management systems, non-selective catalytic reduction (NSCR = three-way catalyst) in conjunction with air-to-fuel ratio controllers, replacement with lean-burn engine with pre-combustion chamber, and improvements to the ignition system.

Source: <https://dieselnet.com/>

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