# Understanding EPA NSPS emissions regulations for stationary spark ignited engines

**> White paper**

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On June 12, 2006, the Environmental Protection Agency (EPA) proposed the New Source Performance Standards (NSPS) to regulate emissions from stationary spark-ignited engines, and then finalized these standards on January 18th, 2008. Until the issuance of the SI NSPS, there were no Federal (US) emissions regulations for stationary natural gas or propane engines. Emissions regulations for stationary engines were usually governed by state and local permitting authorities and varied by the annual operating hours for the application.

This paper explains how the EPA NSPS apply to spark-ignited engines used in generator sets.

## Important EPA definitions

Stationary power sources such as diesel, natural gas or propane generator sets are regulated differently than non-road engine/generators such as rental or portable equipment. Additionally, emergency and non-emergency generator sets are regulated differently. Therefore, it is important to know how the EPA distinguishes emergency from non-emergency stationary engines and how the regulations for stationary applications differ from non-road engine regulations.

Below is a summary of the EPA definitions and some examples. Please refer to Appendix at the end of the paper for more details.

### Stationary engine

- Includes fixed engines and all portable or transportable engines that stay at a single site for at least 12 full months.
- If a stationary engine is moved anytime in its life after it has been in place for at least a full year, it becomes a nonroad engine unless it stays at the new location for a full year.

### Emergency stationary engine (standby generator set)

- Internal combustion engine (ICE) whose operation is limited to emergency situations and required regular testing. (EPA will allow up to 100 hours a year for testing and maintenance).
- Meets definition of stationary above.
- For example, an engine used to produce power when power from the electric utility or normal power source is interrupted.

### Non-Emergency stationary engine (prime generator set)

- Any engine that operates in a mode other than defined above as emergency. This covers applications like prime, peak shaving, and base load generators used for distributed generation.
- Meets definition of stationary above.

As you can see from the definitions above, it is important that owners/operators of stationary SI emergency ICE document how many hours were

spent for emergency operation; including what classified the operation as emergency and how many hours were spent for maintenance and test operation. The EPA requires a non-resettable hour meter on the engines to enforce this requirement.

## New Source Performance Standards

The purpose of the EPA New Source Performance Standards (NSPS) regulations is to limit the amount of NOx, CO, and VOC (Volatile Organic Compounds) emitted from new or modified stationary spark ignited engines.

The chart below shows NSPS standards effective dates, and references the limits and Parts from the Code of Federal Regulation, Title 40, that vary based on fuel type, duty, engine size (shown only for generator sets between 15 and 150 kWe) and the date of manufacture.

It is important to note that manufacturers must factory certify Gasoline and Rich Burn LPG engines, but they have the "option" of factory certifying all other regulated engines. This means that engines that are not certified by the manufacturer must be brought into compliance with the regulations by the owner/operator. This is where the EPA SI NSPS rule differs from the Diesel NSPS rule. Owners & Operators (O/O) are now responsible for compliance, not the manufacturer!

This may also be the case even if the engine is factory certified, if the local Authority Having Jurisdiction (AHJ) such as the state or county imposes more stringent standards for stationary spark ignited internal combustion engines than the federal NSPS regulations.

## Owner and operator responsibilities

The NSPS emission regulation for spark ignited engines is unique in the way that this is the first time EPA has put responsibilities on the owner and operator of the generator set. The provisions for owner and operator compliance are as follows:

### General provisions

- Must meet the applicable standards over the useful life of the engine.
- Keep records of conducted maintenance to demonstrate compliance.

### Engine specific provisions

- Emergency rich-burn propane fueled engines
  - > Purchase a manufacturer certified engine.
  - > EPA allows 100 hrs/yr for readiness and maintenance checks.
- Emergency rich-burn natural gas fueled engines
  - > Purchase a manufacturer certified engine when possible.
  - > The EPA requires a non-resettable hour meter on the engines.
  - > EPA allows 100 hrs/yr for readiness and maintenance checks.
- Non-emergency rich-burn propane fueled engines
  - > Purchase a manufacturer certified engine.
- Non-emergency rich-burn natural gas fueled engines
  - > Purchase a manufacturer certified engine when possible.
  - > If not a manufacturer certified engine, > = 100HP and < = 500HP conduct an initial performance test within 1 year of engine startup.
  - > If not a manufacturer certified engine, > 500HP conduct an initial performance test within 1 year of engine startup and every 3 years or 8,760 hours, whichever comes first.

**Stationary Spark-Ignited Generator Set Emission Regulations** — (NOx+HC) / CO (g/kWm-hr) — NOx / CO / VOC (g/kWm-hr)

| | kWe, 60Hz | Gross engine power kW (HP) | | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| Standby | 15–75 NG | 19–97 | (25–130) | — | (13.4) / 519 Part 90 V | | | |
| | 80–150 NG | 97–179 | (130–240) | — | (2.7) / 4.4 Part 1048 V[1] | or | 2.0 / 4.0 / 1.0 Part 60 V | |
| | 15–75 LP | 19–97 | (25–130) | — | (13.4) / 519 Part 90 M | | | |
| | 80–150 LP | 97–179 | (130–240) | — | (2.7) / 4.4 Part 1048 M[1] | | | |
| Prime | 15–50 NG | 19–75 | (25–100) | — | 2.0 / 4.0 / 1.0 Part 60 V | or | (2.7) / 4.4 Part 1048 V[1] | |
| | 60–150 NG | 75–179 | (100–240) | — | (2.7) / 4.4 Part 1048 V[1] | | 1.0 / 2.0 / 0.7 Part 60 V | |
| | 15–150 LP | 19–179 | (25–240) | — | (2.7) / 4.4 Part 1048 M[1] | | | |

M: Manufacture certification required
V: Manufacture voluntary certification or end user mandatory certification
1: Alternately can use emissions limit formula: (NOx+NMHC) x CO < 8.57 rounded to the nearest 0.1 g/kW-hr.
You may not select an HC+NOX emission standard hight than 2.7 g/kW-hr or a CO emission standard higher than 20.6 g/kW-hr.

Non-regulated
Interim
Final

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So, the customer gets the option of buying either a rich-burn natural gas fueled manufacturer certified EPA compliant product or a non-certified product and getting it certified it in the field.

For certified engines (60.4243(a)) the owner/operator may adjust, operate, and maintain engine per manufacturer's instructions and would have to keep records of it. If manufacturer's instructions are not followed, engine becomes non-certified and compliance must be demonstrated.

For non-certified rich-burn, natural gas fueled engines, the provisions (article 60.4243) are broken down based on power output as follows:

**A. For engines less than 25 hp (60.4243 (a))**

- Keep maintenance plan & records.
- Operate with good air pollution control practice.
- No performance testing required.

**B. For engines from 25 to 500 hp (60.4243 (b))**

- Same as 'A', plus initial performance test within 1 year.

**C. For engines above 500 hp (60.4243 (b))**

- Same as 'B', plus testing every 8,760 hours or 3 years, whichever comes first.

## Cummins position on emissions

Cummins is the leader in the engine manufacturing business when it comes to meeting emissions solutions and technologies. Our intent is to provide EPA certified spark ignited generator sets in 2009 for all commercial generator sets between 15kWe and 150kWe. The new emissionized gas generator sets will be factory equipped with electronic air/fuel ratio controls (eAFR) and oxygen sensors. A 3-way catalyst will also be included for all generator sets 85-150kW and non-emergency (prime) application for generator sets 20-75kW.

## Technology trends

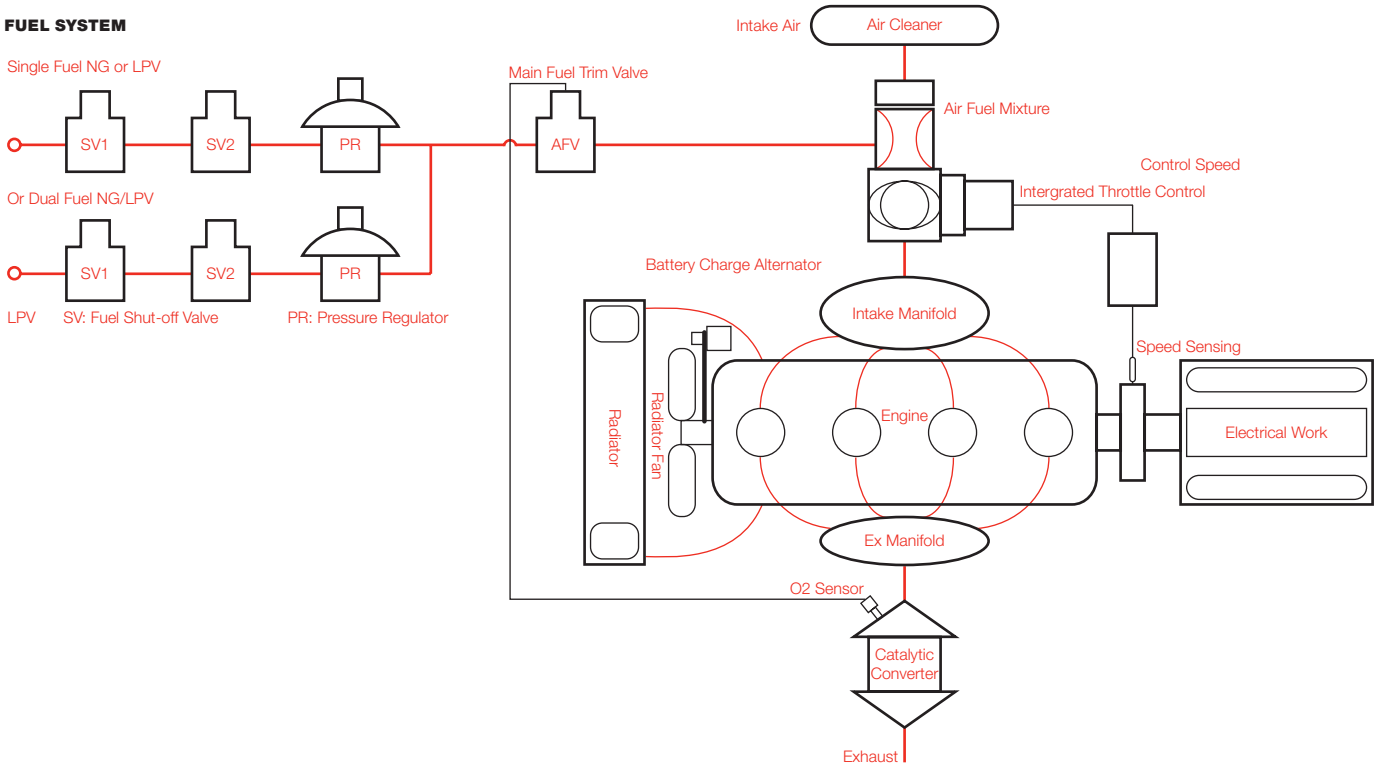
The tightening emissions regulations and the need for better performing engines call for technologies that better monitor and control the operation of the machine.

### Electronic air/fuel ratio controller

Using a closed loop feedback system allows for close monitoring of the tail pipe emissions. This system uses an oxygen sensor located downstream of the combustion chamber to detect deviation in oxygen level as compared to the desired value and then adjusts the air/fuel ratio accordingly.

A system without such a feedback loop is referred to as an open loop system and does not allow close control on the air/fuel ratio.

**EMISSION FUEL AND EXHAUST GAS AFTER TREATMENT**

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**About the authors**

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### Three-way catalytic converters

A three-way catalytic converter effectively helps curb pollution by accomplishing three simultaneous tasks:

- Reduction of nitrogen oxides and converting it to pure nitrogen and oxygen
- Oxidation of carbon monoxide to carbon dioxide
- Oxidation of unburnt hydrocarbons (HC) to carbon dioxide and water

The catalytic converter works best when the engine is running slightly rich.

### Closed-loop breather system

A reciprocating internal combustion engine experiences the gas in the combustion chamber seeping past the piston into the crankcase and it gets significant as the engine has had more hours on it. Even this slight seepage could build up pressure in the crankcase. To relieve this pressure, most engines vent out these gases into the atmosphere with a breather tube. A closed-loop breather system forms a circuit to remove these gasses from the crankcase and introduces them in the intake manifold, thereby optimizing combustion and reducing HC emissions.

## Summary

The new EPA NSPS regulations for stationary spark ignited engines will cause major changes to the way manufacturers build and certify their engines and the way owners operate their generators in an increasingly demanding power generation industry, yet keeping it environment friendly. These regulations are challenging, confusing (many different categories that determine the required emissions limits) and are continuously changing. What makes it different than earlier NSPS regulations for diesel generator sets is that for the first time, the EPA is placing responsibility on the Owner/Operator for compliance. It would be to the benefit of future Owners/Operators to make sure that the generator sets they purchase are EPA certified or they would have to spend valuable time and money on field certification.

For additional technical support, please contact your local Cummins Power Generation distributor. To locate your distributor, visit www.cumminspower.com.

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## Definitions from the Code of Federal Regulations

### Title 40 Part 60.4248

Emergency stationary internal combustion engine means any stationary internal combustion engine whose operation is limited to emergency situations and required testing and maintenance. Examples include stationary ICE used to produce power for critical networks or equipment (including power supplied to portions of a facility) when electric power from the local utility (or the normal power source, if the facility runs on its own power production) is interrupted, or stationary ICE used to pump water in the case of fire or flood, etc. Stationary SI ICE used for peak shaving are not considered emergency stationary ICE. Stationary ICE used to supply power to an electric grid or that supply power as part of a financial arrangement with another entity are not considered to be emergency engines.

Spark ignition means relating to a gasoline, natural gas, or liquefied petroleum gas fueled engine or any other type of engine with a spark plug (or other sparking device) and with operating characteristics significantly similar to the theoretical Otto combustion cycle. Spark ignition engines usually use a throttle to regulate intake air flow to control power during normal operation.

Useful life means the period during which the engine is designed to properly function in terms of reliability and fuel consumption, without being remanufactured, specified as a number of hours of operation or calendar years, whichever comes first.

### Title 40, Part 63.6675

Lean burn engine means any two-stroke or four-stroke spark ignited engine that does not meet the definition of a rich burn engine.

Rich burn engine means any four-stroke spark ignited engine where the manufacturer's recommended operating air/fuel ratio divided by the stoichiometric air/fuel ratio at full load conditions is less than or equal to 1.1. Engines originally manufactured as rich burn engines, but modified prior to December 19, 2002 with passive emission control technology for NOX (such as pre-combustion chambers) will be considered lean burn engines. Also, existing engines where there are no manufacturer's recommendations regarding air/fuel ratio will be considered a rich burn engine if the excess oxygen content of the exhaust at full load conditions is less than or equal to 2 percent.

Stoichiometric means the theoretical air-to-fuel ratio required for complete combustion.

## Referenced Code of Federal Regulations parts

### Title 40, Protection of Environment

http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=%2Findex.tpl

- Part 60, NSPS
- Part 63, NESHAPs
- Part 90, SI Engines < 19 kW (25 hp)
- Part 1048, Nonroad Large Spark-ignited (LSI) Engines
- Part 1065, Test Procedures
- Part 1068, Nonroad General Provisions




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