

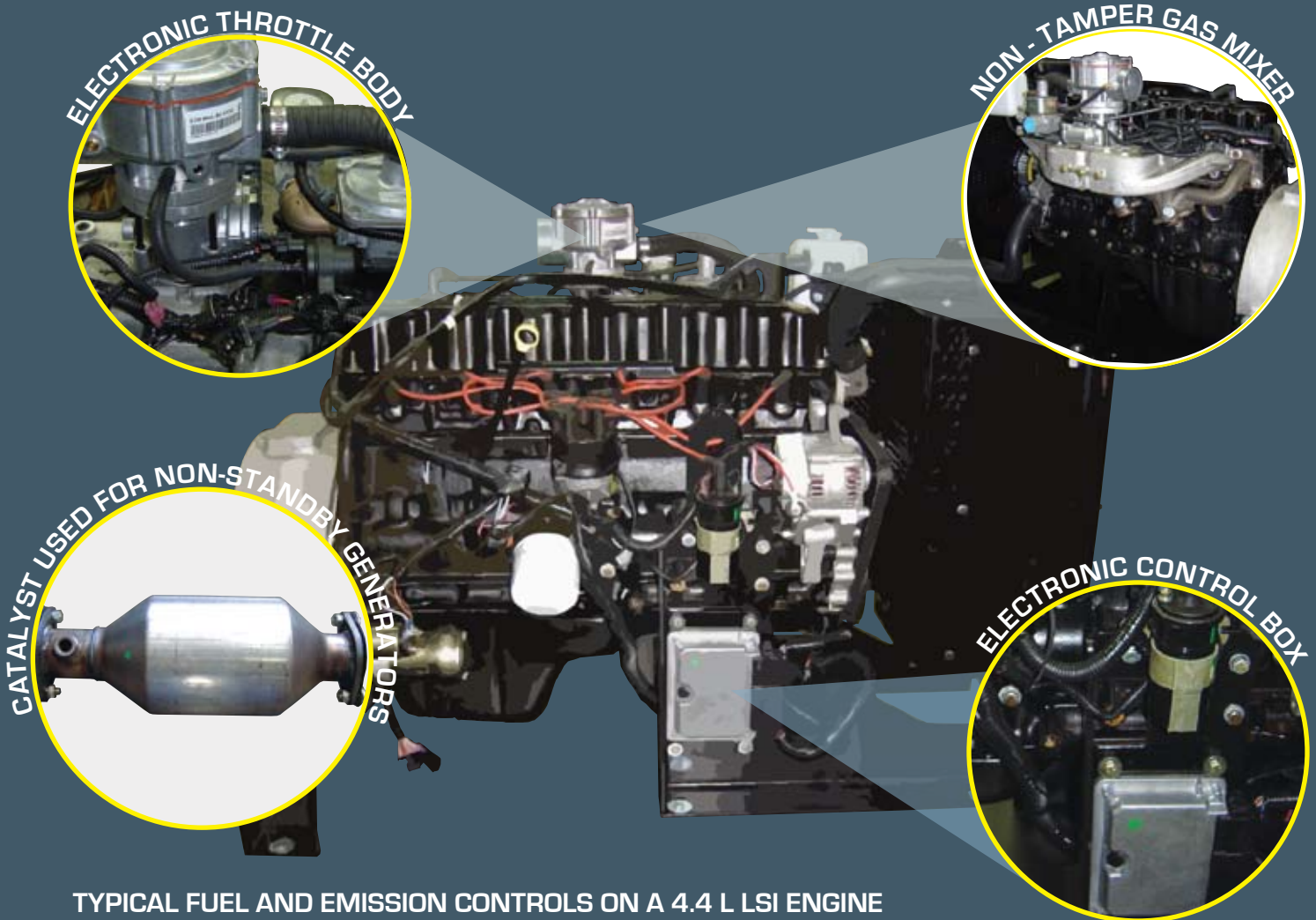
Exhaust Emission Standards for Larger Spark-Ignition Engines

Information Sheet # 33

1.0 Introduction

US manufacturers supply industrial and commercial standby generator sets powered by diesel engines or by larger bore spark-ignition engines. Most gas engines are fueled by natural gas or propane. The Environmental Protection Agency (EPA) and California Air Research Board (CARB) both have adopted similar exhaust emission standards for off-road spark-ignition engines of more than 1.0-liter displacement and above 25hp (19kWm) up to 500hp (373kWm).

This information sheet discusses the past, current and future regulations, as well as general information, on natural gas and liquid petroleum gas (LPG), the most common dry fuels used in this power range. Canada currently has no regulations except at local level, but is expected to introduce them in the near future.



To fulfill our commitment to be the leading supplier and preferred service provider in the Power Generation Industry, the Clifford Power Systems, Inc. team maintains up-to-date technology and information standards on Power Industry changes, regulations and trends. As a service, our **Information Sheets** are circulated on a regular basis, to existing and potential Power Customers to maintain awareness of changes and developments in engineering standards, electrical codes, and technology impacting the Power Generation Industry.

2.0 New EPA regulation terminology for spark ignition combustion engines 500 HP or less

To regulate emissions on stationary spark-ignition engines, introduced on Jan. 18, 2008 a new document referenced 40 CFR Parts 60, 63, 85 et al. The standards in this document refer to introduction dates, not tier levels, which apply to diesel. Also, this action formally declares the new source performance standards (NSPS) that will apply to new, modified and reconstructed stationary spark-ignition (SI) internal combustion engines (ICE). This action also promulgates emissions standards for new and reconstructed stationary, reciprocating internal combustion engines (RICE) with a site rating of less than or equal to 500 HP.

3.0 EPA LSI regulations introduced 2004

The first emission regulations for large mobile spark-ignition engines were introduced in 2004. Certification testing was for steady-state duty cycles with standards applicable over the full useful life of the engine. Emissions were to be measured using variable speed or constant speed steady-state cycles.

The Manufacturer of Record (MOR), is responsible for emissions certification. MORs providing such units for the US market had to provide an emission-related warranty for at least the first half of the engine's useful life (in operating hours) or for three years, whichever came first. Any adjustable components must be tamper-proof.

All MOR maintenance instructions must be adhered to by the owner/operator and any repair/rebuild must use original OEM parts and components (no will-fits). The MOR must guarantee durability and emissions for 3,500 hours operation. Applicable emissions levels are:

Hydrocarbon (HC) + Nitrous Oxide (NOx) 4.0 g/kW-hr (3.0 g/hp-hr)
Carbon monoxide (CO) 49.6 g/kW-hr (37.0 g/hp-hr)

4.0 EPA LSI regulations introduced January 1, 2007

Regulations introduced on Jan 1, 2007 for mobile LSI covered implementation of more stringent standards for CO and total HC plus NOx, and included transient-duty cycle testing (i.e. idle to full speed with load). This standard also is to apply for field testing but without a defined duty cycle.

Unless a sealed fuel system is used, evaporative standards are applied that include low permeation fuel lines, tank venting and fuel boiling. The engine must have the ability to diagnose malfunction of emission-related components and also maintain stoichiometric control of the air-fuel ratio. The MOR needs to guarantee durability and emissions for 5,000 hours operation. Applicable emissions levels are:

Hydrocarbon (HC) + Nitrous Oxide (NOx) 2.7 g/kW-hr (2.0 g/hp-hr)
Carbon monoxide (CO) 4.4 g/kW-hr (3.3 g/hp-hr)

5.0 Stationary SI engines greater than 25 HP and up to 500 HP

EPA 40CFR part 60, subpart JJJJ issued Jan. 18, 2008 details standards applicable July 1, 2008:

Hydrocarbon (HC) + Nitrous Oxide (NOx) 12.1 g/kW-hr (9.0 g/HP-hr)
or NMHC+NOx 11.3 g/kW-hr (8.4 g/hp-hr)

6.0 Emergency SI engines greater than 25 HP to 130 HP and above 130 HP

EPA 40CFR part 60, subpart JJJJ issued Jan. 18, 2008 details standards applicable January 1, 2009:

25 HP to 130 HP = Nitrous Oxide (NOx) 10.0 g/hp-hr; CO 387 g/HP-hr
130 HP and above = Nitrous Oxide (NOx) 2.0 g/hp-hr; CO 4.0 g/HP-hr; VOC* 1.0 g/HP-hr

* VOC = Volatile organic compounds

7.0 Spark Ignition Fuels

Natural Gas (NG) - NG is a gaseous fossil fuel consisting primarily of methane (CH₄ - approx. 70%) but includes quantities of ethane (C₂H₆), propane (C₃H₈), butane (C₄H₁₀) and pentane. Organo-sulphur compounds and hydrogen sulfide (H₂S) are removed prior to sale. NG is measured in standard cubic feet (at 60°F and 14.73psia). One cubic foot of NG produces around 1,026 British Thermal Units (BTU) and can vary slightly. Natural gas is sold and measured in therms (one therm = 100,000 BTU's or just over 97 cubic feet)

Liquid Petroleum Gas (LPG) - LPG is a petroleum fuel derived from both NG and crude oil, and a colorless gas typically composed mainly of propane and butane. One cubic foot of LPG produces around 1,450 BTU's, i.e. contains more energy than natural gas.



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