Emissions Calculation Guidance for Stationary Internal Combustion Engines

The first step in the process is to determine if the stationary internal combustion engine is used for only emergency purposes or for additional purposes such as maintenance activities, offsetting electrical rates, participates in a financial arrangement with another entity, or for peak shaving to reduce demand charges. The next step in the process is to calculate the potential to emit (PTE) given the emission factors for the fuel type and capacity of the engine.

For permitting purposes, emissions from non-emergency units must be calculated based on 8,760 hours of operation per year. Emissions from emergency units may be calculated based on 500 hours of operation per year.

Diesel Engine ≤ 600 HP Example:

In the first example, calculations are provided for emergency and non-emergency 74 horsepower (HP) diesel fired engines. Since the criteria pollutant of concern (the criteria pollutant emitted in greatest quantity) is nitrogen oxides (NOx), the other criteria pollutants are not included in the example calculations.

Non-Emergency:

$$N_2O\ (ton/year) = 74\ hp\ X\ 8760\frac{hour}{year}\ X\ 0.031\frac{lb}{hp-hr}\ \div 2000\frac{lb}{ton} = 10.05\frac{ton}{year}$$

Emergency:

$$N_2O\ (ton/year) = 74\ hp\ X\ 500\frac{hour}{year}\ X\ 0.031\frac{lb}{hp-hr}\ \div 2000\frac{lb}{ton} = 0.57\frac{ton}{year}$$

*Emission factors in lb/hp-hr were calculated using emission factors in lb/MMBTU and a brake specific fuel consumption of 7000 BTU/hp-hr (AP 42 Table 3.3-1).

Digester Gas Engine Example:

In the example provided below, calculations are provided for emergency and non-emergency 525 HP digester gas or methane fired engines. Since the criteria pollutant of concern is sulfur oxide (SO_2), the other criteria pollutants are not included in the example calculations.

Non-Emergency:

$$SO_2(ton/year) = 525\ hp\ X\ 8760\frac{hour}{year}\ X\ 0.0045\frac{lb}{hp-hr}\ \div 2000\frac{lb}{ton} = 10.35\frac{ton}{year}$$

Emergency:

$$SO_2\ (ton/year) = 525\ hp\ X\ 500\frac{hour}{year}\ X\ 0.0045\frac{lb}{hp-hr}\ \div 2000\frac{lb}{ton} = 0.58\frac{ton}{year}$$

*Emission factors in lb/hp-hr were calculated using emission factors in lb/MMBTU and a brake specific fuel consumption of 7000 BTU/hp-hr (AP 42 Table 3.3-1).

Gasoline Engine Example:

In the example provided below, calculations are provided for emergency and non-emergency 110 HP gasoline fired engines. Since the criteria pollutant of concern is volatile organic compounds (VOC), the other criteria pollutants are not included in the example calculations.

Non-Emergency:

$$VOC\ (ton/year) = 110\ hp\ X\ 8760\frac{hour}{year}\ X\ 0.0216\frac{lb}{hp-hr}\ \div 2000\frac{lb}{ton} = 10.41\frac{ton}{year}$$

Emergency:

$$VOC\ (ton/year) = 110\ hp\ X\ 500\frac{hour}{year}\ X\ 0.0216\frac{lb}{hp-hr}\ \div 2000\frac{lb}{ton} = 0.59\frac{ton}{year}$$

*Emission factors in lb/hp-hr were calculated using emission factors in lb/MMBTU and a brake specific fuel consumption of 7000 BTU/hp-hr (AP 42 Table 3.3-1).

Natural Gas, 4-Stroke Lean-Burn Engine Example:

In the example provided below, calculations are provided for emergency and non-emergency 0.60 MMBTU/hr natural gas 4-stroke lean-burn engines. Since the criteria pollutant of concern is nitrogen oxides (NOx), the other criteria pollutants are not included in the example calculations.

Non-Emergency:

$$NOx\ (ton/year) = 0.60\frac{MMBTU}{hr}\ X\ 8760\frac{hour}{year}\ X\ 4.08\ \frac{lb}{MMBTU}\ \div 2000\frac{lb}{ton} = 10.72\frac{ton}{year}$$

Emergency:

$$NOx\ (ton/year) = 0.60\frac{MMBTU}{hr}\ X\ 500\frac{hour}{year}\ X\ 4.08\ \frac{lb}{MMBTU}\ \div 2000\frac{lb}{ton} = 0.61\frac{ton}{year}$$

*Emission factors in lb/hp-hr were calculated using emission factors are from AP 42, Chapter 3, Table 3.2-2.

If your engine differs from the types in the examples, please review the emission factor table below and substitute the appropriate emission factor for your engine type in the calculation.

If you need help, please contact IDEM's Compliance and Technical Assistance Program at (800) 988-7901, ctap@idem.in.gov, or visit http://www.in.gov/idem/ctap/2328.htm.

Emission Factor Table

Below is a table with nitrogen oxides (NO_x) emission factors for diesel and natural gas fired engines as well as volatile organic compounds (VOC) for gasoline fired engines.

Fuel Type and Engine	NOx Emission Factor	VOC Emission Factor
Diesel Engine ≤ 600 HP	$0.031\frac{lb}{hp-hr}$	$0.0025\frac{lb}{hp-hr}$
Diesel Engine > 600 HP	$0.024\frac{lb}{hp-hr}$	$0.000705\frac{lb}{hp-hr}$
Gasoline Engine	$0.011\frac{lb}{hp-hr}$	$0.0216\frac{lb}{hp-hr}$
Natural Gas 4-Stroke Lean Burn	$4.08\ \frac{lb}{MMBTU}$	$0.118\frac{lb}{MMBTU}$
Natural Gas 2-Stroke Lean Burn	$3.17\ \frac{lb}{MMBTU}$	$0.12\frac{lb}{MMBTU}$
Natural Gas 4-Stroke Rich Burn	$2.27\ \frac{lb}{MMBTU}$	$0.0296\ \frac{lb}{MMBTU}$

Emission Factors from *AP-42 Compilation of Air Pollutant Emission Factors*, Fifth Edition, Volume I, Chapter 3. http://www.epa.gov/ttn/chief/ap42/ch03/index.html.