Federal CAA Toolbox

Generators

Air Force activities use generators for various purposes including emergency and non-emergency power generation, welding operations, temporary lighting, and crane operations. These emission sources can be categorized as internal combustion engines.

As with external combustion sources, the types and amounts of pollutants emitted depend on the fuel used. IC engines are typically fueled by diesel, gasoline, propane, or jet fuel.

Emissions Estimation Methodology

In the absence of federally enforceable permit conditions that would limit a unit's emissions, PTE emissions can be calculated based on the rated capacity of the engine (i.e., brake horsepower) and the maximum potential number of hours of annual operation. The rated capacity is specific to each individual IC engine and is available in the manufacturer's literature that accompanied the IC engine when it was delivered. If this information is not available, the manufacturer should be able to provide this information if given the engine model and serial numbers. These numbers are often times included on a metal identification plate located on the engine.

Other factors can be used to reduce the maximum potential annual number of hours of operation. See the example presented in the discussion of potential emissions in the Overview of Emissions Estimating.

EPA guidance (White Paper, 6 September 1995) states that 500 hours may be used when calculating PTE emissions from emergency IC engines. (Please note: some states, namely

Connecticut, do not accept this EPA guidance.)

Alternatively, IC engine emissions can be estimated based on the fuel heat input in million British thermal units (MMBtu). Heat input is based on the fuel used and the heating value of the fuel. Maximum potential heat input can be calculated using the following equation:

$$Q = U_{max} \times H_V \times \rho \times t / (eff \times 10^6)$$

where:

Q	=	Annual amount of heat input, MMBtu;
U_{max}	=	Maximum potential fuel usage of the engine, gal/hr;
H_V	=	Heating value of the fuel used; Btu/lb;
ρ	=	Fuel density, lb/gal;
t	=	Maximum potential annual number of hours of operation, hr/yr; and
eff	=	Engine efficiency, fraction.

Values for engine efficiency can be obtained for specific engines from the manufacturer if the engine model and serial number are available. In the absence of manufacturer's data, 80% is a good assumption. Fuel density and heating values are given in the following Table 1:

Table 1. Density and Heating Values for Gasoline and Diesel (No. 2) Oil

Fuel	Density (lb/gal)	Heating Value (Btu/lb)
Diesel	7.2	19,300
Gasoline	6.1	20,300

Reference: Footnote c, Table 3.3-1, AP-42.

Actual emissions are calculated based on either the total annual number of hours operated or the actual amount of fuel used. Hour meter readings are usually the most easily obtained records of engine operation.

Sample Calculations

If using the unit's brake horsepower and hours of operation, emissions from IC engines can be calculated as follows:

$$AE_i = EF_i \times bhp \times t$$

where:

EF_i	=	Emission factor for chemical *i*, lb/bhp-hr;
bhp	=	Engine rated brake horsepower; and
t	=	Total annual number of hours of operation, hr/yr.

The rated bhp can either be obtained from the manufacturer or the engine literature that came with the engine. Emission factors are available from AP-42 in Section 3.3 for gasoline and diesel-fired IC engines.

Criteria pollutant, and sometimes toxic, emission factors in lb/bhp-hr are available from the manufacturer and should be used before any generally published engine emission factors.

Fuel used	=	diesel;
Rated horsepower	=	250 bhp;
t_{PTE}	=	8,760 hr/yr;
t_{Actual}	=	2,080 hr/yr; and
EF_i	=	0.031 lb/bhp-hr for *i* = NO_x (AP-42, Table 3.3-1).

Potential Emissions

$$AE_i = EF_i \times bhp \times t_{PTE}$$

$$AE_{NOx} = (0.031) \times (250) \times (8,760)$$

$$= \underline{67,890 \text{ lb/yr}}$$

$$= (67,890) / (8,760) = \underline{7.75 \text{ lb/hr}}$$

Actual Emissions

$$AE_i = EF_i \times bhp \times t_{Actual}$$

$$AE_{NOx} = (0.031) \times (250) \times (2{,}080)$$

$$= \underline{16{,}120 \text{ lb/yr}}$$

$$= (16{,}120) / (2{,}080) = \underline{7.75 \text{ lb/hr}}$$

The following equation is used to estimate annual emissions from IC engines if using the heat input and number of hours of operation:

$$AE_i = EF_i \times Q$$

where:

EF_i = Emission factor for chemical i, lb/MMBtu;
Q = Annual heat input (see equation as stated earlier).

As stated earlier, emission factors are available from AP-42 in Section 3.3 for gasoline and diesel-fired IC engines.

Fuel used = diesel;
U_{max} = 18 gal/hr;
H_V = 19,300 Btu/lb (AP-42, Table 3.3.-1);
ρ = 7.5 lb/gal;
t_{PTE} = 8,760 hr/yr;
t_{Actual} = 2,080 hr/yr;
eff = 0.80 (80% estimated); and
EF_i = 4.41 lb/MMBtu for i = NO_x (AP-42, Table 3.3-1).

Potential Emissions

$$AE_i = EF_i \times Q$$

$$AE_i = EF_i \times [U_{max} \times H_V \times \rho \times t / (eff \times 10^6)]$$

$$AE_{NOx} = (4.41) \times \frac{(18) \times (19{,}300) \times (7.5) \times (8{,}760)}{(0.80) \times (10^6)}$$

$$= \underline{125{,}818 \text{ lb/yr}}$$

$$= (125{,}818) / (8{,}760) = \underline{14.4 \text{ lb/hr}}$$

Actual Emissions

$$AE_i = EF_i \times Q$$

$$AE_i = EF_i \times [U_{max} \times H_V \times \rho \times t / (eff \times 10^6)]$$

$$AE_{NOx} = (4.41) \times \frac{(18) \times (19{,}300) \times (7.5) \times (2{,}080)}{(0.80) \times (10^6)}$$

$$= \underline{29{,}875 \text{ lb/yr}}$$

$$= (29{,}875) / (2{,}080) = \underline{14.4 \text{ lb/hr}}$$

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