Texas Commission on Environmental Quality
Air Permits Division

New Source Review (NSR) Emission Calculations

This information is maintained by the Combustion/Coatings NSR Section and is subject to change. Last update was made **October 2006**. These emission calculations represent current NSR guidelines and are provided for informational purposes only. The emission calculations are subject to change based on TCEQ case by case evaluation. Please contact the appropriate Combustion/Coatings NSR Section management if there are questions related to the emission calculations.

Reciprocating Engines

I. **Calculations Based on Manufacturers' Data:** For most engines, the manufacturer will quote a guaranteed maximum emission rate limit for specific operating conditions. This data normally provides the emission rate in parts per million by volume (ppmv), grams of pollutant per brake horsepower hour (g/bhp-hr), pounds per hour (lb/hr) and tons per year (tpy). If the lb/hr and tpy emissions are not provided, calculate the emission rate limit in Table 1(a) for NO_x, CO, PM, and VOC, as follows:

A. **Manufacturer's Data:** This should include full load or all load emission rate data in g/hp-hr or ppmv for NO_x, CO, and VOC or total organic compounds (TOC). These rates can then be used to calculate the maximum allowable emission rate (in lb/hr) based on the maximum horsepower at which the engine will be operated, as follows:

$$\left[\frac{lbs}{hr}\right]_i = \left[\frac{g}{bhp-hr}\right]_i \times bhp_{\max} \times \frac{1lb}{454g}$$

if the TOC emission rate is given by the manufacturer, the VOC lb/hr can be calculated based on the fraction of non-methane, non-ethane hydrocarbons in the fuel (as a weight percent):

$$\left(\frac{lbs}{hr}\right)_{VOC} = \left(\frac{lbs}{hr}\right)_{TOC} \times \frac{\%VOC_{wt}}{100}$$

where the bhp_{max} is the maximum horsepower at which the engine or turbine will be permitted to operate. This horsepower may be less than the manufacturer's nameplate horsepower due to speed, temperature, or altitude derating or may simply reflect the desire of the applicant to accurately reflect the actual operating conditions in the terms of the permit. For example if a unit will never be operated above 75% of the rated load due to a physical limitation such as compressor rating, the applicant may chose to use the lower horsepower in calculating the emissions from the engine or turbine. If the engine will be derated based on temperature or altitude considerations, manufacturer's derating factors or American Petroleum Institute(API)

standardized derating methods may be used.

B. **Additional Abatement Equipment:** If abatement equipment, such as selective or non-selective catalytic reduction, will be used, data pertaining to both the engine and the abatement equipment will be required. You will have to submit detailed information concerning the operating parameters at which the engine and abatement equipment will properly function. The uncontrolled emission rates of all pollutants at these operating conditions can then be used, along with data from the abatement equipment manufacturer, to determine the actual emission rates. The data for the abatement equipment must be specifically quoted for these operating conditions, not for a general case. The calculations should then be done as follows:

$$\left[\frac{lbs}{hr}\right]_i = \left[\frac{g}{bhp-hr}\right]_i \times bhp_{\max} \times \frac{1lb}{454g} \times \left[1 - eff_{abate}\right]$$

where eff_{abate} is the quoted efficiency of the abatement device at the conditions corresponding to the maximum horsepower to be permitted.

II. **Calculations Based on Fuel Specifications:** These calculations normally apply only to residual sulfur which is contained in the fuel and is then oxidized in the combustion process and emitted as sulfur dioxide (SO_2). It is normally assumed that the sulfur in the fuel is completely oxidized by the engine. For gaseous fuels, these calculations should follow:

$$\left(\frac{lbs}{hr}\right)_{SO_2} = C_{fuel,S} \times Q_{fuel,\max} \times \left(\frac{0.165lbs}{scf}\right) \times 10^{-6}$$

Where $C_{fuel,S}$ is the concentration of the residual species in the fuel, expressed as $ppmv_d$, $Q_{fuel,max}$ is the fuel flow rate in scf/hr, and the factor of (0.165 lbs/scf) is derived from the ideal gas law and the molecular weight of SO_2. If the residual sulfur content in the gaseous fuel is specified in terms of grains of sulfur per scf (gr S/scf), the calculations should follow:

$$\left(\frac{lbs}{hr}\right)_{SO_2} = \left(\frac{gr\_S}{scf\_fuel}\right) \times \frac{1lb}{7000gr} \times Q_{fuel,\max} \times \left(\frac{64lbsSO_2}{32lbsS}\right)$$

For liquid fuels, the calculations should follow:

$$\left(\frac{lbs}{hr}\right)_{SO_2} = \left(\frac{lbs\_fuel}{hr}\right)_{\max} \times \frac{\%S_{wt}}{100} \times \left(\frac{64lbsSO_2}{32lbsS}\right)$$

These methods should cover most engine configurations, however, if your configuration does not fit into one of these categories, please contact the Combustion Section at (512) 239-1250 for

guidance.

CALCULATION OF FUGITIVE EMISSIONS

Fugitive emissions from flanges, valves, and seals can be estimated by using standardized factors developed by the EPA. These emissions should be calculated at sites that have significant numbers of these components. The estimated emissions from these sources can be reduced by following a maintenance and inspection programs. If you believe that there may be significant fugitive emissions at the site in question, it is always best to do these calculations. The approved factors for natural gas production facilities are:

for each valve: 0.00992 [all in lbs/hr/component]
for each relief valve: 0.0194
for each flange: 0.00086
for each connection: 0.00044
for each compressor seal: 0.0194
for each pump seal: 0.00529
for each open-ended line: 0.00441

These factors are for total hydrocarbons, you must multiply these factors by the weight fraction nonmethane, non-ethane hydrocarbons in the fluid you are handling. For example, for a site with 25 valves, 20 compressor seals, and 100 flanges, handling natural gas with a .40 weight fraction non-methane, non-ethane hydrocarbons, the calculations would be as follows:

25 valves * 0.00992 lbs/hr/valve =	0.25 lbs/hr +
20 compressor seals * 0.0194 lbs/hr/seal =	0.39 +
100 flanges * 0.00086 lbs/hr/flange =	0.09
	=0.73 lbs/hr total fugitives
	x 0.40
	=0.29 lbs/hr VOC fugitives

Creditable reductions from these emissions from maintenance and inspection programs, if any, will be worked out during the permit review.

Reference

Contaminant . . . . Includes all criteria pollutant categories
VOC . . . . . volatile organic compounds
No_x . . . . . nitrogen oxides
tpy . . . . . tons per year
SO_2 . . . . . sulfur dioxide
NAAQS . . . . . National Ambient Air Quality Standards
CO . . . . . carbon monoxide
PSD . . . . . Prevention of Significant Deterioration
PM . . . . . suspendable particulate matter, including PM_{10}
Nonattainment . . . . . Areas designated by EPA as not meeting the NAAQS for a particular contaminant
PM_{10} . . . . . PM less than 10 microns in size
Attainment . . . . . Areas designated as meeting the NAAQS for a particular contaminant