Regulations & Emissions: Natural Gas Compressors

Simplifying Compliance

Air Quality

When a source is subject to any federal regulation, it signals that the source is engaging in activities that emit regulated pollutants and may be required to adhere to control technology requirements, emission limits, or work practice standards. It signals that the source needs to evaluate their potential emissions against the air permitting or registration requirements implemented by DAQ. These calculations will indicate the amount of air contaminants that the source may potentially emit if all units are operating at the maximum capacity, 24 hours a day. Assistance with appropriately conducting the potential-to-emit calculations for common air contaminant sources at natural gas compressor and dehydration stations is available below.

Natural Gas Engines

Reciprocating natural gas engines are utilized to power some compressor stations. These engines are stationary and fueled by natural gas from the pipeline.

40 CFR 63 Subpart ZZZZ
National Emission Standard for Hazardous Air Pollutants (NESHAP) for Stationary Reciprocating Internal Combustion Engines

40 CFR 60 Subpart JJJJ
New Source Performance Standard (NSPS) for Spark Ignition Engines

Dehydration Units

Natural gas is considered a 'dry' gas, yet it is not uncommon for water and hydrocarbons to condense out of the gas stream. Therefore, compressor stations frequently contain some form of a liquid separator or dehydration unit. These units ensure that the natural gas in the pipeline is as pure as possible.

40 CFR 63 Subpart HH
National Emission Standard for Hazardous Air Pollutants (NESHAP) for Oil and Natural Gas Production Facilities

40 CFR 63 Subpart HHH
National Emission Standard for Hazardous Air Pollutants (NESHAP) for Oil and Natural Gas Transmission and Storage Facilities

40 CFR 60 Subpart KKK
New Source Performance Standards (NSPS) for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants

40 CFR 60 Subpart LLL
New Source Performance Standards (NSPS) for SO2 Emissions from Onshore Natural Gas Processing

Reboiler/Boiler

A reboiler, or boiler, fueled by natural gas is utilized in tandem with the dehydration units to provide heat/steam for the dehydration process. The natural gas combusted to generate this heat is also an air contaminant source and must be included in the emission calculations.

Emission Controls

Additional control units may be applied to the process to reduce the pollutants emitted to the ambient air. Some common forms of control for natural gas engines, dehydration units and/or reboilers include afterburners, flash tank separators (FTS), condensers and flue gas recirculation.

ECAP

Contacts

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Reciprocating Internal Combustion Engine (RICE)

Spark Ignition (SI)

Potential to Emit Calculations

In lieu of AP-42 emission factors provided, you may use emission data provided by the manufacturer for the specific engine in question.

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The emission data must be the manufacturer-provided Exhaust Emission Data Sheet for the exact engine and fuel type.

Stroke	2	4	
Burn	Lean	Lean	Rich
SCC	2-02-002-52	2-02-002-54	2-02-002-53
Emission Factor	AP 42 3.2-1	AP 42 3.2-2	AP 42 3.2-3
EF Units	lb/MMBtu	lb/MMBtu	lb/MMBtu
CO	0.386	0.317	3.72
NOx	3.17	4.08	2.21
PT	9.91E-03	9.91E-03	0.0194
PM10	3.84E-02	7.71E-05	9.50E-03
PM2.5	3.84E-02	7.71E-05	9.50E-03
SO2	5.88E-04	5.88E-04	5.88E-04
VOCs	0.12	0.118	0.0296
CO2	110	110	110
Formaldehyde	0.0552	5.28E-02	0.0205
Benzene	1.94E-03	4.40E-04	1.58E-03
Ethyl Benzene	1.08E-04	3.97E-05	2.48E-05
Toluene	9.63E-04	4.08E-04	5.58E-04
Xylenes	2.68E-04	1.84E-04	1.95E-04

Calculating Emissions

MMBtu/hr x Emission Factor x Potential Operation Hours x Ton/lb = Ton/yr

$$\frac{\text{MMBtu}}{\text{hr}} \times \frac{\text{lb}}{\text{MMBtu}} \times \frac{8760\ \text{hr}}{\text{year}} \times \frac{1\ \text{ton}}{2{,}000\ \text{lb}} = \frac{\text{Ton Pollutant}}{\text{year}}$$

Conversions to MMBtu/hr for Engines

The MMBtu/hr for an engine can be determined by using the brake-specific fuel consumption (BSFC) or cubic feet per hour (cfh) fuel consumption for the engine. At least one of these values will be provided on the engine specification documentation. If you are unable to locate the information, contact the engine manufacturer.

Brake-Specific Fuel Consumption: BSFC (Btu/HP-hr)

$$\text{HP} \times \frac{\text{Btu}}{\text{HP-hr}} \times \frac{1\ \text{MMBtu}}{1{,}000{,}000\ \text{Btu}} = \frac{\text{MMBtu}}{\text{hr}}$$

Fuel Input
Cubic feet of Natural Gas per hour (cfh) & Heat Index of Fuel (Btu/scf)

$$\frac{\text{Cubic feet}}{\text{hr}} \times \frac{\text{Btu}}{\text{scf}} \times \frac{1\ \text{MMBtu}}{1{,}000{,}000\ \text{Btu}} = \frac{\text{MMBtu}}{\text{hr}}$$

Glycol Dehydration

The applicant is required to provide the lb/hour emissions for each unit. The way to obtain the emission rates is through entering dehydration unit specifications and natural gas sample data for the site through an analysis program. One such program is GRI Gly-Calc (Version 3.0 or greater).

Natural Gas Boiler/Reboiler < 100 MMBtu/hr

In lieu of AP-42 emission factors provided, you may use emission data provided by the manufacturer for the specific engine in question.

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The emission data must be the manufacturer-provided Exhaust Emission Data Sheet for the exact engine and fuel type.

SCC	2-02-002-52
Emission Factor	AP 42 3.2-1
EF Units	lb/MMscf
CO	0.386
NOx	3.17
PT	9.91E-03
PM10	3.84E-02
PM2.5	3.84E-02
SO2	5.88E-04
VOCs	0.12
CO2	110
N2O	0.0552
CH4	1.94E-03
CO2 eq[1]	1.08E-04
Formaldehyde	9.63E-04
Benzene	1.08E-04
Toluene	9.63E-04

[1] CO_2 equivalents (ton/MMscf): CO_2 = 1, N_2O = 298, CH_4 = 25; Reference GWP-AR4

Calculating Emissions

MMscf/hr x Emission Factor x Potential Operation Hours x Ton/lb = Ton/yr

$$\frac{\text{MMscf}}{\text{hr}} \times \frac{\text{lb}}{\text{MMscf}} \times \frac{8760\ \text{hr}}{\text{year}} \times \frac{1\ \text{ton}}{2{,}000\ \text{lb}} = \frac{\text{Ton Pollutant}}{\text{year}}$$

Conversion to MMscf/hr

The MMscf/hr for a boiler can be determined by using the heat index of the fuel. The heat index of fuel can be obtained from a sample analysis or fuel distributor. If unable to obtain the heat index of the site's fuel, use 1,020 BTU/scf for the heat index.

Heat Index of Fuel (Btu/scf)

$$\frac{\text{Btu}}{\text{hr}} \times \frac{\text{scf}}{1{,}020\ \text{Btu}} \times \frac{1\ \text{MMscf}}{1{,}000{,}000\ \text{scf}} = \frac{\text{MMscf}}{\text{hr}}$$