

Natural Gas

	% of DFG (Volume)	SCF per 10 ⁶ Btu	Lbs. per 10 ⁶ Btu	PPM	Comments
CO ₂	10.12	1033.0	119.76		Orsat & Calculation
O ₂	3.00	306.0	25.80		Orsat & Calculation
CO	NIL	0.5	0.04	50	Colorimetric
N ₂	86.88	8873.0	654.80		Orsat & Calculation
H ₂ O		2237.0	106.16		Calculations
TOTAL	100.00	12449.5	906.56		
Particulates			0.001		EPA Method 5
NO _x	0.0085		0.12	100	Chemiluminescent
Hydrocarbons	0.001	0.1	0.004	10	Flame Ionization
SO _x	NOT APPLICABLE TO GAS				

Note: Emissions corrected to 3% O₂.

Conditions

H ₂	22.31% (Wt.)
C	68.98% (Wt.)
S	0.00% (Wt.)
HHV	1,000 Btu/ft. ³
Sp. Gr.	0.619

Propane

	% of DFG (Volume)	SCF per 10 ⁶ Btu	Lbs. per 10 ⁶ Btu	PPM	Comments
CO ₂	11.43	1190.60	138.00		Orsat & Calculation
O ₂	3.42	356.00	30.01		Orsat & Calculation
CO	NIL	0.20	0.07	50	Colorimetric
N ₂	85.15	8868.70	654.17		Orsat & Calculation
H ₂ O		1523.70	72.25		Calculations
TOTAL	100.00	11939.20	894.50		
Particulates			0.001		EPA Method 5
NO _x			0.15	120	Chemiluminescent
Hydrocarbons	0.001	0.10	0.008	10	Flame Ionization
SO _x	NOT APPLICABLE TO GAS				

Note: Emissions corrected to 3% O₂.

Conditions

H ₂	18.29% (Wt.)
C	81.71% (Wt.)
S	0.00% (Wt.)
HHV	2,500 Btu/ft. ³
Sp. Gr.	0.619

	% of DFG (Volume)	SCF per 10 ⁶ Btu	Lbs. per 10 ⁶ Btu	PPM	Comments
CO ₂	13.78	1493.95	173.21		Orsat & Calculation
O ₂	2.88	311.77	26.27		Orsat & Calculation
CO	NIL	0.55	0.04	100	Colorimetric
N ₂	83.34	9035.73	666.83		Orsat & Calculation
H ₂ O		1365.57	64.81		Calculations
TOTAL	100.00	12207.57	931.16		
Particulates	See Table Below				EPA Method 5
NO _x	See Table Below				Chemiluminescent
Hydrocarbons	0.001	0.20	0.01	20	Flame Ionization
SO _x	See Table Below				

Note: Emissions corrected to 3% O₂.

Conditions

H ₂	10.9% (Wt.)
C	86.6% (Wt.)
S	2.00% (Wt.)
HHV	18,330 Btu/lb
Sp. Gr.	0.986

SO₂ Emission

Weight % Sulfur	SO ₂ Lb./MMBtu	PPM*
0	0	0
0.2	0.208	112
0.4	0.417	225
0.6	0.625	337
0.8	0.833	449
1.0	1.042	561
1.2	1.250	673
1.4	1.458	786
1.6	1.670	898
1.8	1.875	1010
2.0	2.083	1122

*Based on 3% flue gas O₂.

NO_x Emission Data vs. Fuel – Bound Nitrogen At 15% Excess Air and with Standard Burner

Weight % Fuel-Bound Nitrogen	Lb./MMBtu	PPM
0.00	0.127	95
0.02	0.176	132
0.04	0.204	153
0.06	0.227	170
0.08	0.248	186
0.10	0.267	200
0.12	0.284	213
0.14	0.301	226

0.16	0.316	237
0.18	0.332	249
0.20	0.347	260
0.22	0.360	270
0.24	0.373	280
0.26	0.387	290
0.28	0.400	300
0.30	0.412	309
0.32	0.424	318
0.34	0.436	327
0.36	0.448	336
0.38	0.460	345
0.40	0.471	353
0.42	0.483	362
0.44	0.493	370
0.46	0.504	378
0.48	0.515	386
0.50	0.525	394

I. Stack Emissions (Particulates) E_s vs. Sulfur content of Fuel

% S (wt)	E_s Lbs./MMBtu
0.0	0.0080
0.2	0.0092
0.4	0.0109
0.6	0.0132
0.8	0.0163

1.0	0.0203
1.2	0.0259
1.4	0.0335
1.6	0.0436
1.8	0.0573
2.0	0.0758
2.2	0.1000
2.4	0.1100
2.6	0.1210
2.8	0.1320
3.0	0.1400

II. Particulate Emissions E_c vs. Conradson Carbon Residue Content of Fuel

% C. C. R.	E_c Lbs./MMBtu
0 – 9.0	0.0000
10.0	0.0007
11.0	0.0122
12.0	0.0238
13.0	0.0353
14.0	0.0469
15.0	0.0584
16.0	0.0700
17.0	0.0815
18.0	0.0931
19.0	0.1046
20.0	0.1162

21.0	0.1277
22.0	0.1392
23.0	0.1507
24.0	0.1622

III. Particulate Emission E_A vs. Ash content of Fuel

% Ash	E_A Lbs./MMBtu
0.000	0.0000
0.020	0.0111
0.040	0.0222
0.060	0.0333
0.080	0.0444
0.100	0.0555
0.120	0.0667
0.140	0.0778
0.160	0.0889
0.180	0.1000
0.200	0.1111
0.220	0.1222
0.240	0.1333
0.260	0.1444
0.280	0.1555
0.300	0.1667

To find the Total Particulate Emissions estimate, use the following formula: $E_T = E_S - E_G - E_A$

Molecular Weights Used

CO = 28 N₂ = 28
 CO₂ = 44 NO_x = 46 for NO₂
 H₂O = 18 SO_x = 64 for SO₂
 O₂ = 32 CH₄ = 16

Conversion Data

1 PPM = 1 Part Per Million = 0.0001%
 SCF = Standard Cubic Feet at 60 deg. F at 14.7 psia
 1 pound – Mole = 380 SCF

Low NOx Firetube Boilers

Natural Gas

	% of DFG (Volume)	SCF per 10 ⁶ Btu	Lbs. per 10 ⁶ Btu	PP M	Comments
CO ₂	10.10	1033.0	119.76		Orsat & Calculation
O ₂	3.00	306.0	25.80		Orsat & Calculation
CO	NIL	0.20	0.07	90	Colorimetric
N ₂	86.90	8873.0	654.80		Orsat & Calculation
H ₂ O		2237.0	106.16		Calculations
TOTAL	100.00	12449.	906.5		

		0	6		
Particulates			0.001		EPA Method 5
NO _x			0.035	30	Chemiluminescent
Hydrocarbons	0.001	0.1	0.004	10	Flame Ionization
SO _x	NOT APPLICABLE TO GAS				

Note: Emissions corrected to 3% O₂.

Conditions

H ₂	22.31% (Wt.)
C	68.98% (Wt.)
S	0.00% (Wt.)
HHV	1,000 Btu/ft. ³
Sp. Gr.	0.619

Propane

	% of DFG (Volume)	SCF per 10 ⁶ Btu	Lbs. per 10 ⁶ Btu	PPM	Comments
CO ₂	11.43	1190.60	138.00		Orsat & Calculation
O ₂	3.42	356.00	30.01		Orsat & Calculation
CO	NIL	0.36	0.13	90	Colorimetric

N ₂	85.15	8868.70	654.17		Orsat & Calculation
H ₂ O		1523.70	72.25		Calculations
TOTAL	100.00	11939.36	894.50		
Particulates			0.001		EPA Method 5
NO _x			0.04	35	Chemiluminescent
Hydrocarbons	0.001	0.10	0.008	10	Flame Ionization
SO _x	NOT APPLICABLE TO GAS				

Note: Emissions corrected to 3% O₂.

Conditions

H ₂	18.29% (Wt.)
C	81.71% (Wt.)
S	0.00% (Wt.)
HHV	2,500 Btu/ft. ³
Sp. Gr.	0.619

Amber 363 Oil

	% of DFG (Volume)	SCF per 10 ⁶ Btu	Lbs. per 10 ⁶ Btu	PPM	Comments
CO ₂	13.38	1453.55	168.5		Orsat &

			3		Calculation
O ₂	2.89	313.65	26.44		Orsat & Calculation
CO	NIL	1.10	0.08	100	Colorimetric
N ₂	83.73	9097.78	671.4 1		Orsat & Calculation
H ₂ O		1500.16	71.20		Calculations
TOTAL	100.00	12365.6 9	937.5 8		
Particulates			0.005		EPA Method 5
NO _x	0.003	0.44	0.05	40	Chemiluminescent
Hydrocarbons	0.001	0.24	0.01	20	Flame Ionization
SO _x	See Table Below				

Note: Emissions corrected to 3% O₂.
*Based on fuel bound nitrogen of 0.0003% (wt).

Conditions

H ₂	13.67% (Wt.)
C	85.88% (Wt.)
S	0.001% (Wt.)
HHV	19,860 Btu/lb
Sp. Gr.	0.859

SO₂ Emission

Weight % Sulfur	SO ₂ Lb./MMBtu	PPM*
0	0	0
0.2	0.208	112
0.4	0.417	225
0.6	0.625	337
0.8	0.833	449
1.0	1.042	561
1.2	1.250	673
1.4	1.458	786
1.6	1.670	898
1.8	1.875	1010
2.0	2.083	1122

*Based on 3% flue gas O₂.

Molecular Weights Used

CO	= 28	N ₂	= 28
CO ₂	= 44	NO _x	= 46 for NO ₂
H ₂ O	= 18	SO _x	= 64 for SO ₂
O ₂	= 32	CH ₄	= 16

Conversion Data

1 PPM = 1 Part Per Million = 0.0001%
 SCF = Standard Cubic Feet at 60 deg. F at 14.7 psia
 1 pound – Mole = 380 SCF