NOx and CO: lb/MMBtu ↔ ppmvd at 3 % O_2 (Burners)

Factor between NOx or CO in lb/MMBtu and ppmvd at 3 % O_2, from flue gas per MMBtu, molar mass, moisture and oxygen (Ganapathy Eq. 21).

Method: Ganapathy; Steam Plant Calculations Manual; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Emission per unit heat fired (HHV)	0.10000	lb/MMBtu
Wet flue gas per unit heat fired (HHV) Ganapathy Table 2.10: natural gas 768–966, No. 2 oil 790–938 lb/MMBtu.	769.00	lb/MMBtu
Wet flue gas molar mass	27.520	kg/kmol
Water vapour (vol, wet)	19.910	%
Oxygen (vol, wet) The default 0 % is gas from theoretical air; enter the O_2 that goes with the flue gas flow and moisture above.	0	%
Reference oxygen (dry)	3.0000	%

Calculated results

Parameter	Value	Unit
ppmvd NOx per lb/MMBtu	832.51	
ppmvd CO per lb/MMBtu	1,367.4	
NOx at the entered rate	83.251	ppm
CO at the entered rate	136.74	ppm

Notes for this case

- Ganapathy shows the factor hardly changes with excess air: about 832 (NOx) and 1367 (CO) for natural gas, 783 and 1286 for No. 2 oil.

Formula and method

$$V_d = 10^6\, Y \frac{N}{M_i} \cdot \frac{MW}{W_{gm}} \cdot \frac{21 - O_{2,ref}}{21 - O_2 Y}, \quad Y = \frac{1}{1 - H_2O}$$

Variables

N	Emission per unit heat fired (HHV)	kg/J
W_{gm}	Wet flue gas per unit heat fired (HHV)	kg/J
MW	Wet flue gas molar mass	kg/kmol
H_2O	Water vapour (vol, wet)	-
O_2	Oxygen (vol, wet)	-
$O_{2,ref}$	Reference oxygen (dry)	-
k_{NO_x}	ppmvd NOx per lb/MMBtu	-
k_{CO}	ppmvd CO per lb/MMBtu	-
V_{NO_x}	NOx at the entered rate	-
V_{CO}	CO at the entered rate	-

Method and standards

Ganapathy's Eq. (21) with M_i = 46.005 (NO_2) and 28.010 (CO) kg/kmol from IUPAC atomic masses. The factors are per lb/MMBtu (HHV); for kg/GJ, convert the emission first (1 lb/MMBtu = 0.4299 kg/GJ).

Assumptions and limits

- Flue gas analysis per unit heat known, on the HHV basis, with its moisture and O_2 from the same case. The default O_2 is 0 % (theoretical air).

References

- Ganapathy
- Steam Plant Calculations Manual
- 2nd ed. (Marcel Dekker, 1993)
- Q2.26b
- Eq. (21) and Table 2.10

Report details

Report reference	FCC-K3M6-49K4 (the same inputs always give the same reference)
Generated	17 November 2026, 19:37 UTC
Calculator	NOx and CO: lb/MMBtu ↔ ppmvd at 3 % O_2 (Burners)
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/boilers-power-plant/emissions-stacks/nox-co-ppmvd-to-lb-per-mmbtu

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.