Gas Turbine NOx and CO: lb/h to ppmvd at 15 % O_2

Converts NOx (as NO_2) and CO mass flows in gas turbine or HRSG exhaust to ppm by volume dry, corrected to a reference oxygen (15 %), by Ganapathy's Eqs. (19)–(20).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
NOx (as NO_2)	11.340	kg/h
CO	6.8039	kg/h
Exhaust gas flow (wet)	249.48	t/h
Exhaust molar mass (wet gas)	28.000	kg/kmol
Water vapour in the exhaust (vol, wet)	10.000	%
Oxygen in the exhaust (vol, wet)	11.500	%
Reference oxygen (dry)	15.000	%
O_2 in air used by the rule 21 % in Ganapathy's equations and EU practice; US EPA gas turbine rules often use 20.9 %.	21.000	%

Calculated results

Parameter	Value	Unit
NO_2 mole fraction, dry	30.739	ppm
Correction factor to the reference O_2	0.72973	
NOx, ppmvd at the reference O_2	22.431	ppm
CO, ppmvd at the reference O_2	22.105	ppm

Notes for this case

- Report NOx as NO_2; duct-burner contributions add to the turbine's own emissions.

Formula and method

$$V = \frac{w/M_{NO_2}}{W/MW} \cdot \frac{1}{1 - H_2O}, \quad V_{ref} = V \frac{O_{2,air} - O_{2,ref}}{O_{2,air} - O_2/(1 - H_2O)}$$

Variables

w_{NO_x}	NOx (as NO_2)	kg/s
w_{CO}	CO	kg/s
W	Exhaust gas flow	kg/s
MW	Exhaust molar mass	kg/kmol
H_2O	Water vapour in the exhaust (vol, wet)	-
O_2	Oxygen in the exhaust (vol, wet)	-
$O_{2,ref}$	Reference oxygen (dry)	-
$O_{2,air}$	O_2 in air used by the rule (21 % default; 20.9 % in US EPA practice)	-
V	NO_2 mole fraction, dry	-
F	Correction factor to the reference O_2	-
V_{NO_x}	NOx, ppmvd at the reference O_2	-
V_{CO}	CO, ppmvd at the reference O_2	-

Method and standards

Ganapathy's mole balance with the standard oxygen correction.

Assumptions and limits

- Ideal gas; exhaust analysis known. The exhaust flow and molar mass are on the wet basis (W/MW is the total wet kmol).
- In US units the NOx and CO flows are shown in lb/h.
- A note appears when the dry O_2 is above 18 %.

References

- Ganapathy
- Steam Plant Calculations Manual
- 2nd ed. (Marcel Dekker, 1993)
- Q2.26a
- Eqs. (19) and (20)
- Molar masses NO_2 and CO from IUPAC atomic masses

Report details

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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/gas-turbine-nox-co-ppmvd

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.