Emission Correction to Reference O_2 (ppm, mg/Nm³)

Stack emission concentrations corrected to a reference O_2 and a dry basis, and converted between ppm and mg/Nm³, as EU IED and India CPCB limits are stated.

Method: EU Directive 2010/75/EU (IED) Annex VI Part 2; India CPCB emission norms for thermal power plants (2015); …

Input parameters

Unit system: SI

Parameter	Value	Unit
Pollutant	NOx as NO_2	
Measured value in	ppm by volume	
Measured concentration, ppm	350.00	ppm
Measured concentration, mg/Nm³	700.00	mg/Nm³
Measured O_2	7.5000	%
Reference O_2 of the limit EU IED: 6 % solid fuels, 3 % liquid and gaseous fuels, 15 % gas turbines and engines. India CPCB thermal plants: 6 %.	6.0000	%
O_2 in air used by the rule 21 % in EU IED Annex VI and in India CPCB practice; 20.9 % in US EPA Method 19. Note that EPA concentrations are at 20 °C, while the mg/Nm³ here are at 0 °C (about 7 % higher).	21.000	%
Water vapour in the sample (0 for a dry analyser) For an in-situ or hot-wet analyser: the measured value and O_2 are converted to dry together.	0	%

Calculated results

Parameter	Value	Unit
At reference O_2, dry, mg/Nm³	798.20	mg/Nm³
At reference O_2, dry, ppm	388.89	ppm
Measured, dry basis, mg/Nm³	718.38	mg/Nm³
Measured, dry basis, ppm	350.00	ppm
Measured O_2, dry basis	7.5000	%
Correction factor	1.1111	
Molar mass used for ppm ↔ mg/Nm³	46.005	kg/kmol

Formula and method

$$c_d = \frac{c_m}{1 - y_{H_2O}} \qquad O_{2,d} = \frac{O_{2,m}}{1 - y_{H_2O}}$$

$$k = \frac{O_{2,air} - O_{2,ref}}{O_{2,air} - O_{2,d}} \qquad c_{ref} = k\, c_d$$

$$c\,[\mathrm{mg/Nm^3}] = c\,[\mathrm{ppm}] \times \frac{M}{V_{m,N}} \qquad V_{m,N} = 22.414\ \mathrm{m^3/kmol}$$

Variables

species	pollutant: NOx as NO_2, SO_2, CO, NO or dust	–

basis	measured value in ppm or mg/Nm³	–
c_m	measured concentration, ppm by volume	–
$c_{m,mg}$	measured concentration, mg/Nm³ (SI: kg per normal m³ at 0 °C)	kg/m³
$O_{2,m}$	measured O_2	–
$O_{2,ref}$	reference O_2 of the emission limit	–
$O_{2,air}$	O_2 in air used by the rule (21 % or 20.9 %)	–
y_{H_2O}	water vapour in the sample, 0 for a dry analyser	–
c_{ref}	concentration at reference O_2, dry, mg/Nm³	kg/m³
$c_{ref,ppm}$	concentration at reference O_2, dry, ppm	–
c_d	measured concentration, dry basis, mg/Nm³	kg/m³
$c_{d,ppm}$	measured concentration, dry basis, ppm	–
$O_{2,d}$	measured O_2, dry basis	–
k	correction factor	–
M	molar mass of the pollutant (NO_2 46.005, SO_2 64.058, CO 28.010, NO 30.006)	kg/kmol
$V_{m,N}$	molar volume of an ideal gas at 0 °C, 101.325 kPa	m³/kmol

Method and standards

EU Directive 2010/75/EU (Industrial Emissions Directive), Annex VI Part 2, gives the correction E_S = (21 − O_S)/(21 − O_M) · E_M on a dry basis at 273.15 K and 101.3 kPa, with reference O_2 of 6 % for solid fuels, 3 % for liquid and gaseous fuels and 15 % for gas turbines and engines. India's CPCB norms for thermal power plants (2015) are stated at 6 % O_2 dry. Molar masses from IUPAC atomic weights; the molar volume is R·273.15/101 325 (CODATA 2018).

Assumptions and limits

- Concentration and O_2 are measured on the same basis (both dry, or both wet with the water content entered).
- NOx is expressed as NO_2, as the IED and CPCB limits require.
- Normal conditions are 0 °C and 101.325 kPa; for limits at other reference conditions the mg/Nm³ figures differ. US EPA limits are at 20 °C (68 °F): a value here is about 7 % higher than the same gas expressed per dry standard m³ at 20 °C (multiply by 273.15/293.15 to convert).
- The correction is not meant for O_2 near 21 %; above about 18 % small O_2 errors dominate.

References

• EU Directive 2010/75/EU (IED) Annex VI Part 2
• India CPCB emission norms for thermal power plants (2015)
• US EPA Method 19 (20.9 % O_2 option)

Report details

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Method last reviewed	10 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	5 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/emission-o2-correction

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Reopens the calculator with the inputs of this report.