Air Change Rate from a CO2 Tracer Decay

Air change rate and outdoor air flow of a room from the decay of carbon dioxide concentration towards the outdoor level after occupants leave.

Method: Tracer-gas concentration decay; Mass balance of a well-mixed room

Input parameters

Unit system: SI

Parameter	Value	Unit
Initial CO_2 concentration (ppm)	1,500.0	
Later CO_2 concentration (ppm)	800.00	
Outdoor CO_2 concentration (ppm)	420.00	
Time between readings	1.0000	h
Room volume	200.00	m^3

Calculated results

Parameter	Value	Unit
Air change rate	1.0445	1/h
Outdoor air flow	208.91	m^3/h
Time to halve the excess CO_2	39.815	min

Notes for this case

• Well-mixed decay with no sources: C − C_o = (C_0 − C_o)e^(−nt). Use only after occupants leave and with steady ventilation; several readings fitted on a log scale give a better estimate.

Formula and method

$$n = \frac{1}{t}\ln\frac{C_0 - C_o}{C - C_o}, \quad Q = nV$$

Variables

C_0	Initial CO_2 concentration (ppm)	-
C	Later CO_2 concentration (ppm)	-
C_o	Outdoor CO_2 concentration (ppm)	-
t	Time between readings	s
V	Room volume	m^3
n	Air change rate	1/s
Q	Outdoor air flow	m^3/s
$t_{1/2}$	Time to halve the excess CO_2	s

Method and standards

Tracer decay.

Assumptions and limits

- Well-mixed room; constant ventilation.

References

Tracer-gas concentration decay, Mass balance of a well-mixed room

Report details

Report reference	FCC-HPPY-0GKW (the same inputs always give the same reference)
Generated	23 November 2026, 17:51 UTC
Calculator	Air Change Rate from a CO2 Tracer Decay
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 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/hvac/loads/co2-decay-air-change-rate

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.