Car Park Ventilation for Carbon Monoxide

Ventilation air flow for an enclosed car park to keep carbon monoxide below a limit from moving cars and their emission rate, with air changes.

Method: ASHRAE Handbook—HVAC Applications (2019); ch. 16 (enclosed vehicular facilities: dilution of CO)

Input parameters

Unit system: SI

Parameter	Value	Unit
Cars moving at the peak	40.000	
CO emission per moving car	180.00	g/h
CO limit	35.000	ppm
CO in outdoor air	2.0000	ppm
Air temperature	20.000	°C
Car park volume	15,000	m³

Calculated results

Parameter	Value	Unit
CO generation	7,200.0	g/h
Allowed rise above outdoor	38.426	mg/m³
Ventilation air flow	187,376	m³/h
Air changes per hour	12.492	

Notes for this case

• Steady-state dilution with perfect mixing. Emission per car depends on the fleet and whether engines are cold; modern cars emit far less than older design figures. Many codes also set a minimum air change rate; use the larger.

Formula and method

$$\dot{V} = \frac{NE}{(C_{lim} - C_o)\rho_{CO}}, \quad \rho_{CO} = \frac{pM_{CO}}{RT}$$

Variables

N	Cars moving at the peak	-
E	CO emission per moving car	kg/s
C_{lim}	CO limit	-
C_o	CO in outdoor air	-
T	Air temperature	K
p	Air pressure, standard atmosphere 101 325 Pa	Pa
M_{CO}	Molar mass of CO, 28.010 kg/kmol	kg/kmol
R	Universal gas constant, 8 314.462 618 J/(kmol·K)	J/(kmol·K)
ρ_{CO}	Density of pure CO at p and T	kg/m³
V	Car park volume	m³
G	CO generation	kg/s
ΔC	Allowed rise above outdoor	kg/m³
$\dot{V}$	Ventilation air flow	m³/s
ACH	Air changes per hour	-

Method and standards

Steady dilution.

Assumptions and limits

- Well mixed; steady state.
- The ppm-to-mass conversion is at one standard atmosphere (101 325 Pa).

References

• ASHRAE Handbook—HVAC Applications (2019)
• ch. 16 (enclosed vehicular facilities: dilution of CO)

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/hvac/loads/car-park-co-ventilation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.