Compressor Free Air Delivery at Site Altitude and Temperature

Mass flow and free air delivery of a compressor at site altitude and intake temperature compared with its rating, at constant intake volume.

Method: ISA pressure–altitude relation (ISO 2533) and ideal-gas density (definitions)

Input parameters

Unit system: SI

Parameter	Value	Unit
Rated FAD (at rated intake)	10.000	m³/min
Rated intake pressure	101.33	kPa
Rated intake temperature	20.000	°C
Site altitude	1,500.0	m
Site intake temperature	35.000	°C

Calculated results

Parameter	Value	Unit
Site ambient pressure (ISA)	84.556	kPa
Mass flow ratio	79.388	%
Delivery at site, as a volume at the rated intake conditions (mass-based)	7.9388	m³/min

Notes for this case

- Intake volume stays about the same, so mass flow follows intake density. Positive-displacement compressors also lose a little volumetric efficiency at higher pressure ratios; centrifugal machines change more.

Formula and method

$$p_s = p_0 \left(1 - \frac{Lz}{T_0}\right)^{g_0 M/(R^* L)} \quad \text{(ISO 2533)}, \quad \frac{\dot{m}_s}{\dot{m}_r} = \frac{p_s}{p_r}\frac{T_r}{T_s}$$

Variables

$\dot{V}_r$	Rated FAD (at rated intake)	m³/s
p_r	Rated intake pressure	Pa
T_r	Rated intake temperature	K
z	Site altitude	m
T_s	Site intake temperature	K
p_s	Site ambient pressure (ISA)	Pa
$\dot{m}_s/\dot{m}_r$	Mass flow ratio	-
$\dot{V}_{FAD,ref}$	Delivery at site, as a volume at the rated intake conditions (mass-based)	m³/s

Method and standards

Density ratio.

Assumptions and limits

- Constant intake volume: the site FAD (volume at site intake) stays near the rated value; the output is the site mass flow expressed as a volume at the rated intake conditions.
- Site pressure from FireCAD's ISO 2533 troposphere (p_0 101 325 Pa, T_0 288.15 K, L 0.0065 K/m).

References

• ISA pressure–altitude relation (ISO 2533) and ideal-gas density (definitions)

Report details

Report reference	FCC-VYSJ-67RA (the same inputs always give the same reference)
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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/mechanical/compressors/fad-altitude-temperature-correction

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.