Ventilation Air to Remove Heat from a Room

Air flow to remove a heat load from a room (switchgear, transformer, pump or turbine room) for an allowed temperature rise, with air changes per hour.

Method: Energy balance on moist air; ASHRAE enthalpy (ASHRAE Handbook—Fundamentals ch. 1)

Input parameters

Unit system: SI

Parameter	Value	Unit
Heat to remove	40.000	kW
Inlet air temperature 0 °C or warmer (the moist-air properties used start at 0 °C).	35.000	°C
Allowed temperature rise	5.0000	K
Inlet relative humidity	50.000	%
Room volume (for air changes)	600.00	m³
Barometric pressure (absolute)	101.33	kPa

Calculated results

Parameter	Value	Unit
Dry-air mass flow	27,718	kg/h
Air flow at the inlet	24,887	m³/h
Air changes per hour	41.479	

Notes for this case

- Equipment makers limit room temperature; in hot climates ventilation may not be enough and cooling is needed.

Formula and method

$$\dot{m}_{da} = \frac{\dot{Q}}{h(T_1 + \Delta T, W) - h(T_1, W)}$$

Variables

$\dot{Q}$	Heat to remove	W
T_1	Inlet air temperature	K
ΔT	Allowed temperature rise	K
φ	Inlet relative humidity	-
V_r	Room volume (for air changes)	m³
p	Barometric pressure (absolute)	Pa
$\dot{m}_{da}$	Dry-air mass flow	kg/s
$\dot{V}$	Air flow at the inlet	m³/s
ACH	Air changes per hour	-

Method and standards

Energy balance.

Assumptions and limits

- Well-mixed room.

References

- Energy balance on moist air
- ASHRAE enthalpy (ASHRAE Handbook—Fundamentals ch. 1)

Report details

Report reference	FCC-ZPS4-9P4V (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/hvac/loads/ventilation-heat-removal

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.