

BCAS Factsheet FCT602-1

Difference between isentropic efficiency and specific power



What is the difference between isentropic efficiency and specific power?

Isentropic efficiency and specific power both evaluate air compressor performance, but they measure different aspects of it. To understand isentropic efficiency and specific power see BCAS Factsheets FCT600-1 and FCT601-1.

Key differences

Feature	Isentropic efficiency	Specific power
Definition	Compares actual vs ideal thermodynamic work	Measures total electrical power used per unit of air delivered
Focus	Thermodynamic losses (compression process only)	Overall system efficiency (including mechanical and electrical losses)
Formula	$\eta_s = \text{Isentropic work input} / \text{actual work input}$	Specific power = input power (kW) / free air delivered (FAD, m ³ /min)
What it shows	How closely compression follows a perfect isentropic process	How efficiently the compressor converts power into useful air
Includes motor losses?	No	Yes
Includes leakage, friction, drive losses?	Partially (only process losses)	Yes
Units	Dimensionless (or %)	kW/m ³ /min
Use case	Thermodynamic performance analysis	Real-world energy consumption and cost comparison

Example

Imagine two compressors that both compress air from 1 bar to 7 bar:

Metric	Compressor A	Compressor B
Isentropic efficiency	85%	78%
Specific power (kW/m ³ /min)	6.5	7.8

- Compressor A is both more thermodynamically efficient and more energy efficient overall
- But it is possible for a compressor to have high isentropic efficiency but poor specific power if, for example, the motor is inefficient or the system leaks

Summary

- **Isentropic efficiency:** How good is the compression process
- **Specific power:** How much energy is required to generate usable compressed air