Compressor Intake Air Temperature: Energy Saving

Power saved by drawing compressor intake air from a cooler place, as compression work for the same mass flow is proportional to inlet temperature.

Method: Compression work proportional to absolute inlet temperature; Bureau of Energy Efficiency; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Present intake temperature (inside the compressor room)	40.000	°C
Cooler intake temperature (outside air)	30.000	°C
Compressor power at present	110.00	kW
Running hours per year	6,000.0	h
Electricity price per kWh (your currency)	8.0000	

Calculated results

Parameter	Value	Unit
Power saved as a share	3.1934	%
Power saved	3.5127	kW
Energy saved in a year	21.076	MWh
Cost saved in a year	168,609	

Notes for this case

• For the same mass of air and pressure ratio, compression work is proportional to the absolute inlet temperature, so drawing air at T_c instead of T_h saves 1 − T_c/T_h of the power: about 1 % for every 3 K. Compressor rooms often run 10–15 K above outside; a duct from a shaded outside intake recovers it. The figure assumes the plant needs the same mass of air; a fixed-volume compressor delivers more mass with cooler air, which shows up as shorter loaded time.

Formula and method

$$\frac{\Delta P}{P} = 1 - \frac{T_c}{T_h}$$

Variables

T_h	Present intake temperature (inside the compressor room)	K
T_c	Cooler intake temperature (outside air)	K
P	Compressor power at present	W
t	Running hours per year	s
c	Electricity price per kWh (your currency)	-
$1 - T_c/T_h$	Power saved as a share	-
ΔP	Power saved	W
ΔE	Energy saved in a year	J
ΔC	Cost saved in a year	-

Method and standards

Intake temperature.

Assumptions and limits

- Same mass flow and pressure ratio; ideal-gas compression.

References

Compression work proportional to absolute inlet temperature, Bureau of Energy Efficiency, Energy Efficiency in Electrical Utilities (Guide Book 3), ch. 3 Compressed air system

Report details

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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/mechanical/compressors/compressor-intake-temperature-saving

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.