Adiabatic Compression Temperature (Ignition Check)

Gas temperature after rapid adiabatic compression to a final pressure, compared with an autoignition temperature (oxygen valves, air in hoses).

Method: Isentropic compression of an ideal gas (definitions)

Input parameters

Unit system: SI

Parameter	Value	Unit
Initial temperature	20.000	°C
Initial pressure (absolute)	1.0132	bar
Final pressure (absolute)	200.00	bar
Ratio of specific heats	1.4000	
Autoignition temperature of the material at risk	350.00	°C

Calculated results

Parameter	Value	Unit
Temperature after compression	1,053.9	°C
Margin to autoignition	-703.92	K

Notes for this case

- The compression temperature reaches the autoignition temperature: slow the valve opening or change materials.
- Screening estimate only, not a safety study or a basis for protective design.

Formula and method

$$T_2 = T_1 \left(\frac{p_2}{p_1} \right)^{(\gamma-1)/\gamma}$$

Variables

T_1	Initial temperature	K
p_1	Initial pressure (absolute)	Pa
p_2	Final pressure (absolute)	Pa
γ	Ratio of specific heats	-
T_{AIT}	Autoignition temperature of the material at risk	K
T_2	Temperature after compression	K
$T_{AIT} - T_2$	Margin to autoignition	K

Method and standards

Isentropic compression of the trapped gas, the textbook screening form. Oxygen-compatibility assessments (for example ASTM G74-type pneumatic impact tests) often model the rapid filling of a dead end differently, and the numbers differ; use this page as an indicator of the hazard, not as a substitute for those methods.

Assumptions and limits

- Ideal gas; no heat loss.

References

- Isentropic compression of an ideal gas (definitions)

Report details

Report reference	FCC-P3GN-6QNN (the same inputs always give the same reference)
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Calculator	Adiabatic Compression Temperature (Ignition Check)
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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/chemical/process-safety/adiabatic-compression-temperature

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.