Isentropic Compressible Flow: Mach Number Relations

Stagnation-to-static temperature, pressure and density ratios and the area ratio A/A* of an ideal gas at a Mach number, from the ratio of specific heats.

Method: Isentropic flow of a perfect gas (Anderson, Modern Compressible Flow)

Input parameters

Unit system: SI

Parameter	Value	Unit
Mach number	0.60000	
Ratio of specific heats	1.4000	

Calculated results

Parameter	Value	Unit
Temperature ratio	1.0720	
Pressure ratio	1.2755	
Density ratio	1.1898	
Area ratio to the sonic throat	1.1882	
Critical pressure ratio	0.52828	

Formula and method

$$\frac{T_0}{T} = 1 + \frac{\gamma - 1}{2} M^2, \quad \frac{p_0}{p} = \left(\frac{T_0}{T}\right)^{\gamma/(\gamma-1)}, \quad \frac{A}{A^*} = \frac{1}{M}\left[\frac{2}{\gamma+1}\frac{T_0}{T}\right]^{\frac{\gamma+1}{2(\gamma-1)}}$$

Variables

M	Mach number	-
γ	Ratio of specific heats	-
T_0/T	Temperature ratio	-
p_0/p	Pressure ratio	-
ρ_0/ρ	Density ratio	-
A/A^*	Area ratio to the sonic throat	-
p^*/p_0	Critical pressure ratio	-

Method and standards

Energy and isentropic relations for a perfect gas.

Assumptions and limits

- Perfect gas, isentropic.

References

- Isentropic flow of a perfect gas (Anderson, Modern Compressible Flow)

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/fluid-mechanics/compressible-isentropic-flow

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Reopens the calculator with the inputs of this report.