Clearance Volumetric Efficiency and Discharge Temperature

Clearance volumetric efficiency of a reciprocating compressor from the clearance ratio, pressure ratio and polytropic index, with the discharge temperature.

Method: Clearance volumetric efficiency η_v = 1 + c − c(p₂/p₁)^(1/n); polytropic $T_2/T_1 = r^{((n-1)/n)}$ (thermodynamics texts)

Input parameters

Unit system: SI

Parameter	Value	Unit
Clearance ratio (clearance / swept volume)	5.0000	%
Suction pressure (absolute)	2.0000	bar
Discharge pressure (absolute)	12.000	bar
Polytropic index of re-expansion and compression	1.1500	
Suction temperature	-5.0000	°C

Calculated results

Parameter	Value	Unit
Pressure ratio	6.0000	
Clearance volumetric efficiency	81.252	%
Discharge temperature (polytropic, ideal gas)	65.597	°C
Pressure ratio at which η_v falls to zero	33.155	

Notes for this case

- Real volumetric efficiency is lower still (valves, heating, leakage).

Formula and method

$$\eta_{v,c} = 1 + c - c\left(\frac{p_2}{p_1}\right)^{1/n}, \quad T_2 = T_1\left(\frac{p_2}{p_1}\right)^{(n-1)/n}$$

Variables

c	Clearance ratio (clearance / swept volume)	-
p_1	Suction pressure (absolute)	Pa
p_2	Discharge pressure (absolute)	Pa
n	Polytropic index of re-expansion and compression	-
T_1	Suction temperature	K
r	Pressure ratio	-
$\eta_{v,c}$	Clearance volumetric efficiency	-
T_2	Discharge temperature (polytropic, ideal gas)	K
r_{max}	Pressure ratio at which η_v falls to zero	-

Method and standards

Polytropic re-expansion.

Assumptions and limits

- Polytropic process, ideal gas.
- With zero clearance the limiting pressure ratio is infinite and is not shown.

References

- Clearance volumetric efficiency η_v = 1 + c − c(p₂/p₁)^(1/n); polytropic $T_2/T_1 = r^{((n-1)/n)}$ (thermodynamics texts)

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/hvac/refrigeration/clearance-volumetric-efficiency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.