Refrigerant Compressor Power and Discharge Enthalpy

Discharge enthalpy, isentropic and shaft power and electrical input of a refrigerant compressor from table enthalpies, mass flow and efficiencies.

Method: ASHRAE Handbook—Refrigeration (2018); ch. 2 (compression process: $h_2 = h_1 + (h_{2s} - h_1)/\eta_s$)

Input parameters

Unit system: SI

Parameter	Value	Unit
Suction enthalpy	400.00	kJ/kg
Isentropic discharge enthalpy	430.00	kJ/kg
Isentropic efficiency	70.000	%
Refrigerant mass flow	1,800.0	kg/h
Motor and drive efficiency	92.000	%

Calculated results

Parameter	Value	Unit
Actual discharge enthalpy	442.86	kJ/kg
Isentropic power	15.000	kW
Shaft power	21.429	kW
Electrical input	23.292	kW

Notes for this case

- Read h_1 at suction pressure and temperature and h_{2s} at discharge pressure and the suction entropy from the refrigerant's tables or chart. Then the discharge temperature is the table temperature at discharge pressure and h_2.

Formula and method

$$h_2 = h_1 + \frac{h_{2s} - h_1}{\eta_s}, \quad W = \frac{\dot{m}(h_{2s} - h_1)}{\eta_s}, \quad W_e = \frac{W}{\eta_m}$$

Variables

h_1	Suction enthalpy	J/kg
h_{2s}	Isentropic discharge enthalpy	J/kg
η_s	Isentropic efficiency	-
$\dot{m}$	Refrigerant mass flow	kg/s
η_m	Motor and drive efficiency	-
h_2	Actual discharge enthalpy	J/kg
W_s	Isentropic power	W
W	Shaft power	W
W_e	Electrical input	W

Method and standards

Compression process.

Assumptions and limits

- Steady adiabatic compression.

References

- ASHRAE Handbook—Refrigeration (2018)
- ch. 2 (compression process: $h_2 = h_1 + (h_{2s} - h_1)/\eta_s$)

Report details

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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/refrigerant-compressor-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.