Heat Pump and Refrigerator COP from Cycle Enthalpies

Heating and cooling capacity, compressor power and COP of a vapour-compression heat pump or refrigerator from the enthalpies you read from refrigerant tables.

Method: First law on the vapour-compression cycle with isenthalpic throttling

Input parameters

Unit system: SI

Parameter	Value	Unit
Refrigerant mass flow	360.00	kg/h
Enthalpy at compressor inlet	400.00	kJ/kg
Enthalpy at compressor outlet	440.00	kJ/kg
Enthalpy at condenser outlet (= evaporator inlet)	250.00	kJ/kg

Calculated results

Parameter	Value	Unit
Heating capacity (condenser)	19.000	kW
Cooling capacity (evaporator)	15.000	kW
Compressor power to the refrigerant	4.0000	kW
Heating COP	4.7500	
Cooling COP	3.7500	

Notes for this case

- Throttling keeps enthalpy constant, so the evaporator inlet has h_3. Motor and mechanical losses lower the real COP.

Formula and method

$$COP_h = \frac{h_2 - h_3}{h_2 - h_1}, \quad COP_c = \frac{h_1 - h_3}{h_2 - h_1}$$

Variables

$\dot{m}$	Refrigerant mass flow	kg/s
h_1	Enthalpy at compressor inlet	J/kg
h_2	Enthalpy at compressor outlet	J/kg
h_3	Enthalpy at condenser outlet (= evaporator inlet)	J/kg
$\dot{Q}_h$	Heating capacity (condenser)	W
$\dot{Q}_c$	Cooling capacity (evaporator)	W
P	Compressor power to the refrigerant	W
COP_h	Heating COP	-
COP_c	Cooling COP	-

Method and standards

First law.

Assumptions and limits

- Ideal throttling, steady flow.

References

- First law on the vapour-compression cycle with isenthalpic throttling

Report details

Report reference	FCC-C4HS-RE8F (the same inputs always give the same reference)
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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/hvac/refrigeration/heat-pump-cop-enthalpies

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.