Evaporator Defrost Energy, Time and Heat Added to the Room

Heat to melt the frost on an evaporator and warm the coil, the defrost time with a given heater power and efficiency, and the heat left in the cold room.

Method: ASHRAE Handbook—Refrigeration (2018); ch. 14 (forced-circulation air coolers: defrost)

Input parameters

Unit system: SI

Parameter	Value	Unit
Frost mass	20.000	kg
Coil metal mass	150.00	kg
Coil metal specific heat	0.70000	kJ/(kg·K)
Coil temperature at start	-25.000	°C
Coil temperature at end	10.000	°C
Defrost heater power	12.000	kW
Defrost efficiency (to frost and coil)	40.000	%

Calculated results

Parameter	Value	Unit
Useful heat (frost + coil)	11.396	MJ
Heat supplied	28.490	MJ
Defrost time	39.569	min
Heat left in the room and coil (supplied less frost melting)	20.769	MJ

Notes for this case

• Ice specific heat 2.1 kJ/(kg·K), latent heat of fusion 333.55 kJ/kg; melt water drains away. Only 20–50 % of electric defrost heat reaches the frost; the rest warms the room and coil and returns as refrigeration load.

Formula and method

$$E_u = m_f[c_i(0 - t_0) + L_f] + m_c c_c (t_1 - t_0), \quad t_d = \frac{E_u}{\eta_d P_h}$$

Variables

m_f	Frost mass	kg
m_c	Coil metal mass	kg
c_c	Coil metal specific heat	J/(kg·K)
t_0	Coil temperature at start	K
t_1	Coil temperature at end	K
P_h	Defrost heater power	W
η_d	Defrost efficiency (to frost and coil)	-
E_u	Useful heat (frost + coil)	J
E_s	Heat supplied	J
t_d	Defrost time	s
E_r	Heat left in the room and coil (supplied less frost melting)	J
c_i	Specific heat of ice, fixed at 2 100 J/(kg·K)	J/(kg·K)
L_f	Latent heat of fusion of ice, fixed at 333 550 J/kg	J/kg

Method and standards

Energy balance.

Assumptions and limits

- Lumped coil; frost at coil temperature.
- c_i and L_f are fixed values, not inputs.
- E_r includes the heat that re-warms the coil; all of it returns as refrigeration load after defrost.

References

• ASHRAE Handbook—Refrigeration (2018)
• ch. 14 (forced-circulation air coolers: defrost)

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/defrost-energy

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.