Cold Room Refrigeration Load

Daily heat load and refrigeration capacity of a cold room or freezer from wall transmission, air changes, product cooling and freezing, and internal loads.

Method: ASHRAE Handbook—Refrigeration; ch. 24 Refrigerated-facility loads (method); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Inside length	6.0000	m
Inside width	5.0000	m
Inside height	3.0000	m
U-value of walls, roof and floor	0.25000	W/(m²·K)
Room temperature	2.0000	°C
Room relative humidity	90.000	%
Outside air temperature	35.000	°C
Outside relative humidity	60.000	%
Air changes (door openings)	10.000	1/d
Product loaded per day	2,000.0	kg
Product temperature when loaded	30.000	°C
Specific heat of the product above freezing	3.6000	kJ/(kg·K)
Freezing point of the product	-2.0000	°C
Latent heat of freezing of the product	250.00	kJ/kg
Specific heat of the product below freezing	1.8000	kJ/(kg·K)
People, lights, fans and defrost (average)	1,500.0	W
Safety margin	10.000	%
Compressor running hours per day	18.000	h

Calculated results

Parameter	Value	Unit
Transmission through the envelope per day	24.948	kWh
Air changes per day	24.986	kWh
Product cooling and freezing per day	56.000	kWh
Internal loads per day	36.000	kWh
Total heat per day	141.93	kWh
Refrigeration capacity needed	8.6738	kW
Refrigeration capacity needed, in tons of refrigeration (same as Q)	2.4663	TR

Notes for this case

- Product cooled to room temperature within the day; respiration heat of fruit and vegetables, packaging and solar gain on the roof are not included. Saturation over ice below 0 °C (IAPWS R14-08).

Formula and method

$$E_t = U \cdot 2(LW + LH + WH)(T_o - T_r)\, t_d$$

$$E_a = LWH\,n\,t_d\,\rho_{da}(h_o - h_r)$$

$$E_p = m_p c_1 (T_{in} - T_r) \text{ or } m_p[c_1(T_{in} - T_f) + L_f + c_2(T_f - T_r)]$$

$$Q = \frac{(E_t + E_a + E_p + E_i)(1 + k_s)}{t_r}$$

Variables

L	Inside length	m
W	Inside width	m
H	Inside height	m
U	U-value of walls, roof and floor	W/(m²·K)
T_r	Room temperature	K
φ_r	Room relative humidity	-
T_o	Outside air temperature	K
φ_o	Outside relative humidity	-
n	Air changes (door openings)	1/s
m_p	Product loaded per day	kg
T_{in}	Product temperature when loaded	K
c_1	Specific heat of the product above freezing	J/(kg·K)
T_f	Freezing point of the product	K
L_f	Latent heat of freezing of the product	J/kg
c_2	Specific heat of the product below freezing	J/(kg·K)
Q_{int}	People, lights, fans and defrost (average)	W
k_s	Safety margin	-
t_r	Compressor running hours per day	s
E_t	Transmission through the envelope per day	J
E_a	Air changes per day	J
E_p	Product cooling and freezing per day	J
E_i	Internal loads per day	J
E	Total heat per day	J
Q	Refrigeration capacity needed	W
Q_{TR}	Refrigeration capacity needed, in tons of refrigeration (same as Q)	W
t_d	Seconds in a day	s
ρ_{da}	Dry air density in the room	kg/m³
h_o, h_r	Moist-air enthalpy outside and in the room	J/kg

Method and standards

The heat entering in a day by transmission, air exchange and product, plus internal gains, is removed in the compressor running hours. Moist-air enthalpy follows ASHRAE Fundamentals ch. 1, with saturation over ice below 0 °C.

Assumptions and limits

- Daily average; pull-down within the day.
- Respiration heat not included.
- Sea-level pressure (101 325 Pa); no altitude input. The air-change load uses the room's dry-air density and the outside enthalpy; the latent heat of frost formed on the coil is not included.

References

• ASHRAE Handbook—Refrigeration
• ch. 24 Refrigerated-facility loads (method)
• IAPWS R14-08 saturation over ice

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/cold-room-refrigeration-load

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.