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Cooling Loads Formulas

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List of 12 Cooling Loads Formulas

Cooling Loads

1) Air infiltration rate into room (CFM)

$$\text{fx } \text{CFM} = \text{ACH} \cdot \left(\frac{V}{60} \right)$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$\text{ex } 6400\text{ft}^3/\text{min} = 16 \cdot \left(\frac{400\text{ft}^3}{60} \right)$$

2) Average outside temperature on design day

$$\text{fx } t_o = t_{od} - \left(\frac{\text{DR}}{2} \right)$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$\text{ex } 169.3528\text{K} = 85^\circ\text{F} - \left(\frac{20^\circ\text{F}}{2} \right)$$

3) Cooling load for roof, wall or glass given Corrected Cooling Load Temperature Difference

$$\text{fx } Q = U_o \cdot A_r \cdot \text{CLTD}_c$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$\text{ex } 116538.8\text{Btu/h} = 0.25\text{W/m}^2\cdot\text{K} \cdot 5600\text{ft}^2 \cdot 13^\circ\text{F}$$



4) Cooling load from lighting

$$fx \quad Q_L = 3.4 \cdot W \cdot BF \cdot CLF_L$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 2203.2 \text{ Btu/h} = 3.4 \cdot 45 \text{ Btu/h} \cdot 1.2 \cdot 12.0$$

5) Corrected Cooling Load Temperature Difference given Cooling Load Temperature Difference

fx

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$CLTD_c = CL_{\Delta t} + LM + (78 - t_r) + (t_a - 85)$$

$$ex \quad 11.24^\circ \text{F} = 29^\circ \text{F} + 3.8 + (78 - 86^\circ \text{F}) + (74^\circ \text{F} - 85)$$

6) Equipment Total Cooling Load

$$fx \quad Q_T = Q_{ph} \cdot L_F$$

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e_img.jpg\)](#)

$$ex \quad 10 \text{ Btu/h} = 8 \text{ Btu/h} \cdot 1.25$$

7) Sensible Cooling load due to Equipment

fx

$$Q_{ph} = \frac{Q_T}{L_F}$$

[Open Calculator !\[\]\(28f72b996fc97883dfd9d4e8b1b16b4e_img.jpg\)](#)

$$ex \quad 11.36 \text{ Btu/h} = \frac{14.2 \text{ Btu/h}}{1.25}$$



8) Sensible Cooling Load due to infiltrating air

$$fx \quad Q_{ph} = 1.1 \cdot CFM \cdot TC$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 2972.691 \text{ Btu/h} = 1.1 \cdot 6400 \text{ ft}^3/\text{min} \cdot 12^\circ \text{F}$$

9) Sensible Cooling load from ventilation air

$$fx \quad Q_s = 1.1 \cdot VFM \cdot TC$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 24604.59 \text{ Btu/h} = 1.1 \cdot 25 \cdot 12^\circ \text{F}$$

10) Solar radiation cooling load for glass

$$fx \quad Q_{cl} = SHGF \cdot A_g \cdot SC \cdot CLF_G$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 29282.4 \text{ Btu/h} = 196 \text{ BTU/h} \cdot \text{ft}^2 \cdot 240 \text{ ft}^2 \cdot 0.75 \cdot 0.83$$

11) Total Cooling Load due to Equipment

$$fx \quad Q_T = Q_{ph} \cdot L_F$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 10 \text{ Btu/h} = 8 \text{ Btu/h} \cdot 1.25$$

12) Total heat removed from ventilation air

$$fx \quad Q_t = Q_s + Q_{lv}$$

[Open Calculator !\[\]\(40770d9ed6ed4f1222ebf89a1396e8b2_img.jpg\)](#)

$$ex \quad 20 \text{ Btu/h} = 10.0 \text{ Btu/h} + 10 \text{ Btu/h}$$



Variables Used

- **A_g** Area of Glass (Square Foot)
- **A_r** Area of Roof (Square Foot)
- **ACH** Number of Air Changes Per Hour
- **BF** Ballast Factor
- **CFM** Air Infiltration Rate into Room (Cubic Foot per Minute)
- **CL_{Δt}** Cooling Load Temperature Difference (Fahrenheit)
- **CLF_G** Cooling Load Factor for Glass
- **CLF_L** Cooling Load Factor for Lighting
- **CLTD_c** Corrected Cooling Load Temperature Difference (Fahrenheit)
- **DR** Daily Temperature Range (Fahrenheit)
- **L_F** Latent Factor
- **LM** Latitude Month Correction
- **Q** Cooling Load (Btu (IT) per Hour)
- **Q_{cl}** Solar Radiation Cooling Load for Glass (Btu (IT) per Hour)
- **Q_l** Cooling Load from Lighting (Btu (IT) per Hour)
- **Q_{lv}** Latent Cooling Loads from Ventilation Air (Btu (th) per Hour)
- **Q_{ph}** Sensible Cooling Load (Btu (th) per Hour)
- **Q_s** Sensible Cooling Loads from Ventilation Air (Btu (th) per Hour)
- **Q_t** Total Heat Removed from Ventilation Air (Btu (th) per Hour)
- **Q_T** Total Cooling Load (Btu (th) per Hour)
- **SC** Shading Coefficient



- **SHGF** Maximum Solar Heat Gain Factor (*Btu (th) per Hour per Square Foot*)
- **t_a** Average Outside Temperature (*Fahrenheit*)
- **t_o** Outside Temperature (*Kelvin*)
- **t_{od}** Outside Design Dry Bulb Temperature (*Fahrenheit*)
- **t_r** Room Temperature (*Fahrenheit*)
- **TC** Temperature Change Between Outdoor and Inside Air (*Fahrenheit*)
- **U_o** Overall Heat Transfer Coefficient (*Watt per Square Meter per Kelvin*)
- **V** Room Volume (*Cubic Foot*)
- **VFM** Air Ventilation Rate
- **W** Lighting Capacity (*Btu (IT) per Hour*)



Constants, Functions, Measurements used

- **Measurement: Temperature** in Kelvin (K), Fahrenheit (°F)
Temperature Unit Conversion 
- **Measurement: Volume** in Cubic Foot (ft³)
Volume Unit Conversion 
- **Measurement: Area** in Square Foot (ft²)
Area Unit Conversion 
- **Measurement: Power** in Btu (IT) per Hour (Btu/h), Btu (th) per Hour (Btu/h)
Power Unit Conversion 
- **Measurement: Volumetric Flow Rate** in Cubic Foot per Minute (ft³/min)
Volumetric Flow Rate Unit Conversion 
- **Measurement: Heat Flux Density** in Btu (th) per Hour per Square Foot (BTU/h*ft²)
Heat Flux Density Unit Conversion 
- **Measurement: Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K)
Heat Transfer Coefficient Unit Conversion 



Check other formula lists

- [Heat Transfer Formulas](#) 
- [Cooling Loads Formulas](#) 
- [Thermodynamics Factor Formulas](#) 

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