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Heat Transfer Formulas

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List of 21 Heat Transfer Formulas

Heat Transfer

1) Average Coefficient of heat transfer for vapour condensing outside of horizontal tubes of diameter D

Open Calculator

fx $$h^{-} = 0.725 \cdot \left(\frac{\left(k^3\right) \cdot \left(\rho_f^2\right) \cdot g \cdot h_{fg}}{N \cdot d_t \cdot \mu_f \cdot \Delta T} \right)^{\frac{1}{4}}$$

ex $$390.5305 \text{W/m}^2\text{*K} = 0.725 \cdot \left(\frac{\left((10.18 \text{W/(m*K)})^3\right) \cdot \left((10 \text{kg/m}^3)^2\right) \cdot 9.8 \text{m/s}^2 \cdot 2260 \text{kJ/kg}}{11 \cdot 3000 \text{mm} \cdot 0.029 \text{N*s/m}^2 \cdot 29 \text{K}} \right)^{\frac{1}{4}}$$

2) Heat Rejection Factor

Open Calculator

fx $$HRF = \frac{R_E + W}{R_E}$$

ex $$1.6 = \frac{1000 \text{J/min} + 600 \text{J/min}}{1000 \text{J/min}}$$

3) Heat Rejection Factor given COP

Open Calculator

fx $$HRF = 1 + \left(\frac{1}{COP_r} \right)$$

ex $$1.5 = 1 + \left(\frac{1}{2} \right)$$

4) Heat Transfer in Condenser given Overall Heat Transfer Coefficient

Open Calculator

fx $$q = U \cdot SA \cdot \Delta T$$

ex $$19336.48 \text{W} = 641.13 \text{W/m}^2\text{*K} \cdot 1.04 \text{m}^2 \cdot 29 \text{K}$$

5) Heat Transfer in Condenser given Overall Thermal Resistance

Open Calculator

fx $$q = \frac{\Delta T}{R_{th}}$$

ex $$1450 \text{W} = \frac{29 \text{K}}{0.02 \text{K/W}}$$

6) Heat transfer takes place from outside surface to inside surface of tube

Open Calculator

fx $$q = \frac{k \cdot SA \cdot (T_2 - T_3)}{x}$$

ex $$7.540069\text{W} = \frac{10.18\text{W/(m*K)} \cdot 1.04\text{m}^2 \cdot (310\text{K} - 302\text{K})}{11233\text{mm}}$$

7) Heat Transfer takes place from vapour refrigerant to outside of tube

Open Calculator

fx $$q = h \cdot A \cdot (T_1 - T_2)$$

ex $$-6600\text{W} = 13.2\text{W/m}^2\text{*K} \cdot 50\text{m}^2 \cdot (300\text{K} - 310\text{K})$$

8) Load on Condenser

Open Calculator

fx $$Q_C = R_E + W$$

ex $$1600\text{J/min} = 1000\text{J/min} + 600\text{J/min}$$

9) Mean Surface area of Tube when Heat transfer takes place from outside to inside surface of tube

Open Calculator

fx $$SA = \frac{q \cdot x}{k \cdot (T_2 - T_3)}$$

ex $$1.03999\text{m}^2 = \frac{7.54\text{W} \cdot 11233\text{mm}}{10.18\text{W/(m*K)} \cdot (310\text{K} - 302\text{K})}$$

10) Overall Coefficient of Heat Transfer for Condensation on Vertical Surface

Open Calculator

fx $$U = 0.943 \cdot \left(\frac{\left(k^3\right) \cdot (\rho_f - \rho v) \cdot g \cdot h_{fg}}{\mu_f \cdot H \cdot \Delta T} \right)^{\frac{1}{4}}$$

ex $$641.1352\text{W/m}^2\text{*K} = 0.943 \cdot \left(\frac{\left((10.18\text{W/(m*K)})^3\right) \cdot (10\text{kg/m}^3 - 0.002\text{kg/m}^3) \cdot 9.8\text{m/s}^2 \cdot 2260\text{kJ/kg}}{0.029\text{N*s/m}^2 \cdot 1300\text{mm} \cdot 29\text{K}} \right)^{\frac{1}{4}}$$

11) Overall Temperature difference given Heat Transfer

Open Calculator

fx $$\Delta T_o = q \cdot R_{th}$$

ex $$0.1508\text{K} = 7.54\text{W} \cdot 0.02\text{K/W}$$

12) Overall Temperature difference when Heat Transfer from vapour refrigerant to outside of tube

Open Calculator

$$\Delta T_o = \frac{q}{h \cdot A}$$

$$0.011424\text{K} = \frac{7.54\text{W}}{13.2\text{W/m}^2\text{*K} \cdot 50\text{m}^2}$$

13) Overall Temperature difference when Heat transfer takes place from outside to inside surface of tube

Open Calculator

$$\Delta T_o = \frac{q \cdot x}{k \cdot SA}$$

$$7.999926\text{K} = \frac{7.54\text{W} \cdot 11233\text{mm}}{10.18\text{W/(m*K)} \cdot 1.04\text{m}^2}$$

14) Overall thermal resistance in condenser

Open Calculator

$$R_{th} = \frac{\Delta T_o}{q}$$

$$0.026525\text{K/W} = \frac{0.2\text{K}}{7.54\text{W}}$$

15) Refrigeration Capacity given Load on Condenser

Open Calculator

$$R_E = Q_C - W$$

$$1000\text{J/min} = 1600\text{J/min} - 600\text{J/min}$$

16) Temperature at Inside Surface of Tube given Heat Transfer

Open Calculator

$$T_3 = T_2 + \left(\frac{q \cdot x}{k \cdot SA}\right)$$

$$317.9999\text{K} = 310\text{K} + \left(\frac{7.54\text{W} \cdot 11233\text{mm}}{10.18\text{W/(m*K)} \cdot 1.04\text{m}^2}\right)$$

17) Temperature at Outside Surface of Tube given Heat Transfer

Open Calculator

$$T_2 = \left(\frac{q \cdot x}{k \cdot SA}\right) + T_3$$

$$309.9999\text{K} = \left(\frac{7.54\text{W} \cdot 11233\text{mm}}{10.18\text{W/(m*K)} \cdot 1.04\text{m}^2}\right) + 302\text{K}$$

18) Temperature at Outside Surface of Tube provided Heat Transfer

Open Calculator

fx $$T_2 = T_1 - \left(\frac{q}{h \cdot A}\right)$$

ex $$299.9886\text{K} = 300\text{K} - \left(\frac{7.54\text{W}}{13.2\text{W/m}^2\text{*K} \cdot 50\text{m}^2}\right)$$

19) Temperature of Refrigerant Vapour condensing Film given Heat Transfer

Open Calculator

fx $$T_1 = \left(\frac{q}{h \cdot A}\right) + T_2$$

ex $$310.0114\text{K} = \left(\frac{7.54\text{W}}{13.2\text{W/m}^2\text{*K} \cdot 50\text{m}^2}\right) + 310\text{K}$$

20) Thickness of Tube when Heat transfer takes places from outside to inside surface of tube

Open Calculator

fx $$x = \frac{k \cdot SA \cdot (T_2 - T_3)}{q}$$

ex $$11233.1\text{mm} = \frac{10.18\text{W/(m*K)} \cdot 1.04\text{m}^2 \cdot (310\text{K} - 302\text{K})}{7.54\text{W}}$$

21) Work done by Compressor given Load on Condenser

Open Calculator

fx $$W = Q_C - R_E$$

ex $$600\text{J/min} = 1600\text{J/min} - 1000\text{J/min}$$

Variables Used

- **A** Area *(Square Meter)*
- **COP_r** Coefficient of Performance of Refrigerator
- **d_t** Diameter of Tube *(Millimeter)*
- **g** Acceleration due to Gravity *(Meter per Square Second)*
- **h** Coefficient of Heat Transfer *(Watt per Square Meter per Kelvin)*
- **H** Height of Surface *(Millimeter)*
- **$\bar{h}$** Average Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- **h_{fg}** Latent Heat of Vaporization *(Kilojoule per Kilogram)*
- **HRF** Heat Rejection Factor
- **k** Thermal Conductivity *(Watt per Meter per K)*
- **N** Number of Tubes
- **q** Heat Transfer *(Watt)*
- **Q_C** Load on Condenser *(Joule per Minute)*
- **R_E** Refrigeration Capacity *(Joule per Minute)*
- **R_{th}** Thermal Resistance *(Kelvin per Watt)*
- **SA** Surface Area *(Square Meter)*
- **T_1** Vapour condensing film temperature *(Kelvin)*
- **T_2** Outside Surface Temperature *(Kelvin)*
- **T_3** Inside Surface temperature *(Kelvin)*
- **U** Overall Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- **W** Compressor Work Done *(Joule per Minute)*
- **x** Tube Thickness *(Millimeter)*
- **ΔT** Temperature Difference *(Kelvin)*
- **ΔT_o** Overall Temperature Difference *(Kelvin)*
- **μ_f** Viscosity of Film *(Newton Second per Square Meter)*
- **ρ_f** Density of Liquid Condensate *(Kilogram per Cubic Meter)*
- **ρv** Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Temperature Difference** in Kelvin (K)
  Temperature Difference Unit Conversion
- Measurement: **Thermal Resistance** in Kelvin per Watt (K/W)
  Thermal Resistance Unit Conversion
- Measurement: **Thermal Conductivity** in Watt per Meter per K (W/(m*K))
  Thermal Conductivity Unit Conversion
- Measurement: **Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K)
  Heat Transfer Coefficient Unit Conversion
- Measurement: **Dynamic Viscosity** in Newton Second per Square Meter (N*s/m²)
  Dynamic Viscosity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Latent Heat** in Kilojoule per Kilogram (kJ/kg)
  Latent Heat Unit Conversion
- Measurement: **Rate of Heat Transfer** in Joule per Minute (J/min)
  Rate of Heat Transfer Unit Conversion

Check other formula lists

- **Ducts Formulas**

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