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Basics of Heat Transfer Formulas

Calculators! Examples! Conversions!

List of 17 Basics of Heat Transfer Formulas

Basics of Heat Transfer

1) Colburn Factor using Chilton Colburn Analogy

Open Calculator

fx $$j_H = \frac{Nu}{(Re) \cdot (Pr)^{\frac{1}{3}}}$$

ex $$0.004541 = \frac{12.6}{(3125) \cdot (0.7)^{\frac{1}{3}}}$$

2) Colburn J-Factor given Fanning Friction Factor

Open Calculator

fx $$j_H = \frac{f}{2}$$

ex $$0.0045 = \frac{0.009}{2}$$

3) Equivalent Diameter of Non-Circular Duct

Open Calculator

fx $$D_e = \frac{4 \cdot A_{cs}}{P}$$

ex $$1.25m = \frac{4 \cdot 25m^2}{80m}$$

4) Equivalent Diameter when Flow in Rectangular Duct

Open Calculator

fx $$D_e = \frac{4 \cdot L \cdot B}{2 \cdot (L + B)}$$

ex $$1.221429\text{m} = \frac{4 \cdot 1.9\text{m} \cdot 0.9\text{m}}{2 \cdot (1.9\text{m} + 0.9\text{m})}$$

5) Fanning Friction Factor given Colburn J-Factor

Open Calculator

fx $$f = 2 \cdot j_H$$

ex $$0.0092 = 2 \cdot 0.0046$$

6) Heat Transfer Coefficient based on Temperature Difference

Open Calculator

fx $$h_{ht} = \frac{q}{\Delta T_{Overall}}$$

ex $$0.312727\text{W/m}^2\text{*K} = \frac{17.2\text{W/m}^2}{55\text{K}}$$

7) Heat Transfer Coefficient given Local Heat Transfer Resistance of Air Film

Open Calculator

fx $$h_{ht} = \frac{1}{(A) \cdot HT_{Resistance}}$$

ex $$1.500375\text{W/m}^2\text{*K} = \frac{1}{(0.05\text{m}^2) \cdot 13.33\text{K/W}}$$

8) Heat Transfer from Stream of Gas flowing in Turbulent Motion

Open Calculator

fx $$h_{ht} = \frac{16.6 \cdot c_p \cdot (G)^{0.8}}{D^{0.2}}$$

ex $$2.930745 \text{W/m}^2\text{*K} = \frac{16.6 \cdot 0.0002 \text{kcal(IT)/kg*}^\circ\text{C} \cdot (0.1 \text{kg/s/m}^2)^{0.8}}{(0.24\text{m})^{0.2}}$$

9) Hydraulic Radius

Open Calculator

fx $$r_H = \frac{A_{cs}}{P}$$

ex $$0.3125\text{m} = \frac{25\text{m}^2}{80\text{m}}$$

10) Internal Diameter of Pipe given Heat Transfer Coefficient for Gas in Turbulent Motion

Open Calculator

fx $$D = \left(\frac{16.6 \cdot c_p \cdot (G)^{0.8}}{h}\right)^{\frac{1}{0.2}}$$

ex $$0.249748\text{m} = \left(\frac{16.6 \cdot 0.0002 \text{kcal(IT)/kg*}^\circ\text{C} \cdot (0.1 \text{kg/s/m}^2)^{0.8}}{2.5 \text{kcal(IT)/h*m}^2\text{*}^\circ\text{C}}\right)^{\frac{1}{0.2}}$$

11) J-Factor for Pipe Flow

Open Calculator

fx $$j_H = 0.023 \cdot (Re)^{-0.2}$$

ex $$0.0046 = 0.023 \cdot (3125)^{-0.2}$$

12) Local Heat Transfer Resistance of Air-Film

Open Calculator

fx $$HT_{Resistance} = \frac{1}{h_{ht} \cdot A}$$

ex $$13.33333 K/W = \frac{1}{1.5 W/m^2*K \cdot 0.05 m^2}$$

13) Log Mean Temperature Difference for CoCurrent Flow

Open Calculator

fx $$LMTD = \frac{(T_{ho} - T_{co}) - (T_{hi} - T_{ci})}{\ln\left(\frac{T_{ho} - T_{co}}{T_{hi} - T_{ci}}\right)}$$

ex $$18.20478 K = \frac{(20K - 10K) - (35K - 5K)}{\ln\left(\frac{20K - 10K}{35K - 5K}\right)}$$

14) Log Mean Temperature Difference for Counter Current Flow

Open Calculator

fx $$LMTD = \frac{(T_{ho} - T_{ci}) - (T_{hi} - T_{co})}{\ln\left(\frac{T_{ho} - T_{ci}}{T_{hi} - T_{co}}\right)}$$

ex $$19.57615 K = \frac{(20K - 5K) - (35K - 10K)}{\ln\left(\frac{20K - 5K}{35K - 10K}\right)}$$

15) Logarithmic Mean Area of Cylinder

Open Calculator

fx $$A_{mean} = \frac{A_o - A_i}{\ln\left(\frac{A_o}{A_i}\right)}$$

ex $$9.865214\text{m}^2 = \frac{12\text{m}^2 - 8\text{m}^2}{\ln\left(\frac{12\text{m}^2}{8\text{m}^2}\right)}$$

16) Reynolds Number given Colburn Factor

Open Calculator

fx $$Re = \left(\frac{j_H}{0.023}\right)^{\frac{-1}{0.2}}$$

ex $$3125 = \left(\frac{0.0046}{0.023}\right)^{\frac{-1}{0.2}}$$

17) Wetted Perimeter given Hydraulic Radius

Open Calculator

fx $$P = \frac{A_{cs}}{r_H}$$

ex $$80.64516\text{m} = \frac{25\text{m}^2}{0.31\text{m}}$$

Variables Used

- **A** Area *(Square Meter)*
- **A_{cs}** Cross Sectional Area of Flow *(Square Meter)*
- **A_i** Inner Area of Cylinder *(Square Meter)*
- **A_{mean}** Logarithmic Mean Area *(Square Meter)*
- **A_o** Outer Area of Cylinder *(Square Meter)*
- **B** Breadth of Rectangle *(Meter)*
- **c_p** Specific Heat Capacity *(Kilocalorie (IT) per Kilogram per Celcius)*
- **D** Internal Diameter of Pipe *(Meter)*
- **D_e** Equivalent Diameter *(Meter)*
- **f** Fanning Friction Factor
- **G** Mass Velocity *(Kilogram per Second per Square Meter)*
- **h** Heat Transfer Coefficient for Gas *(Kilocalorie (IT) per Hour per Square Meter per Celcius)*
- **h_{ht}** Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- **$HT_{Resistance}$** Local Heat Transfer Resistance *(Kelvin per Watt)*
- **j_H** Colburn's j-factor
- **L** Length of Rectangular Section *(Meter)*
- **$LMTD$** Log Mean Temperature Difference *(Kelvin)*
- **Nu** Nusselt Number
- **P** Wetted Perimeter *(Meter)*
- **Pr** Prandtl Number
- **q** Heat Transfer *(Watt per Square Meter)*

- r_H Hydraulic Radius *(Meter)*
- Re Reynolds Number
- T_{ci} Inlet Temperature of Cold Fluid *(Kelvin)*
- T_{co} Outlet Temperature of Cold Fluid *(Kelvin)*
- T_{hi} Inlet Temperature of Hot Fluid *(Kelvin)*
- T_{ho} Outlet Temperature of Hot Fluid *(Kelvin)*
- $\Delta T_{Overall}$ Overall Temperature Difference *(Kelvin)*

Constants, Functions, Measurements used

- Function: **ln**, ln(Number)
  Natural logarithm function (base e)
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Thermal Resistance** in Kelvin per Watt (K/W)
  Thermal Resistance Unit Conversion
- Measurement: **Specific Heat Capacity** in Kilocalorie (IT) per Kilogram per Celcius (kcal(IT)/kg*°C)
  Specific Heat Capacity Unit Conversion
- Measurement: **Heat Flux Density** in Watt per Square Meter (W/m²)
  Heat Flux Density Unit Conversion
- Measurement: **Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K), Kilocalorie (IT) per Hour per Square Meter per Celcius (kcal(IT)/h*m²*°C)
  Heat Transfer Coefficient Unit Conversion
- Measurement: **Mass Velocity** in Kilogram per Second per Square Meter (kg/s/m²)
  Mass Velocity Unit Conversion

Check other formula lists

- Basics of Heat Transfer Formulas
- Co-Relation of Dimensionless Numbers Formulas
- Critical Thickness of Insulation Formulas
- Effectiveness of Heat Exchanger Formulas
- Heat Exchanger Formulas
- Heat Exchanger and its Effectiveness Formulas
- Heat Transfer from Extended Surfaces (Fins) Formulas
- Heat Transfer from Extended Surfaces (Fins), Critical Thickness of Insulation and Thermal Resistance Formulas
- Thermal Resistance Formulas
- Unsteady State Heat Conduction Formulas