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Compressor Formulas

Calculators! Examples! Conversions!

List of 14 Compressor Formulas

Compressor

1) Compressor work

fx $$W_c = h_2 - h_1$$

Open Calculator

ex $$160.9\text{KJ} = 548.5\text{KJ} - 387.6\text{KJ}$$

2) Compressor Work in Gas Turbine given Temperature

fx $$W_c = C_p \cdot (T_2 - T_1)$$

Open Calculator

ex $$152.0688\text{KJ} = 1.248\text{kJ/kg*K} \cdot (420\text{K} - 298.15\text{K})$$

3) Degree of Reaction for Compressor

fx $$R = \frac{\Delta E_{\text{rotor increase}}}{\Delta E_{\text{stage increase}}}$$

Open Calculator

ex $$0.25 = \frac{3\text{KJ}}{12\text{KJ}}$$

4) Efficiency of Compressor given Enthalpy

fx $$\eta_C = \frac{h_{2,\text{ideal}} - h_1}{h_{2,\text{actual}} - h_1}$$

Open Calculator

ex $$0.920735 = \frac{547.9\text{KJ} - 387.6\text{KJ}}{561.7\text{KJ} - 387.6\text{KJ}}$$

5) Efficiency of compressor in actual gas turbine cycle

Open Calculator

fx $$\eta_C = \frac{T_2 - T_1}{T_{2,actual} - T_1}$$

ex $$0.924156 = \frac{420K - 298.15K}{430K - 298.15K}$$

6) Impeller Outlet Diameter

Open Calculator

fx $$D_t = \frac{60 \cdot U_t}{\pi \cdot N}$$

ex $$0.544872m = \frac{60 \cdot 485m/s}{\pi \cdot 17000}$$

7) Isentropic Efficiency of Compression Machine

Open Calculator

fx $$\eta_C = \frac{W_{s,in}}{W_{in}}$$

ex $$0.927419 = \frac{230KJ}{248KJ}$$

8) Mean Diameter of Impeller

Open Calculator

fx $$D_m = \sqrt{\frac{D_t^2 + D_h^2}{2}}$$

ex $$0.536144m = \sqrt{\frac{(0.57m)^2 + (0.5m)^2}{2}}$$

9) Minimum Temperature Ratio

Open Calculator

fx $$T_r = \frac{P_r^{\frac{\gamma-1}{\gamma}}}{\eta_C \cdot \eta_T}$$

ex $$1.533919 = \frac{(2.4)^{\frac{1.4-1}{1.4}}}{0.92 \cdot 0.91}$$

10) Shaft Work in Compressible Flow Machines

Open Calculator

fx $$W_s = \left(h_1 + \frac{C_1^2}{2}\right) - \left(h_2 + \frac{C_2^2}{2}\right)$$

ex $$-160.57018\text{KJ} = \left(387.6\text{KJ} + \frac{(30.8\text{m/s})^2}{2}\right) - \left(548.5\text{KJ} + \frac{(17\text{m/s})^2}{2}\right)$$

11) Shaft Work in Compressible Flow Machines neglecting Inlet and Exit Velocities

Open Calculator

fx $$W_s = h_1 - h_2$$

ex $$-160.9\text{KJ} = 387.6\text{KJ} - 548.5\text{KJ}$$

12) Tip Velocity of Impeller given Hub Diameter

Open Calculator

fx $$U_t = \pi \cdot \frac{N}{60} \cdot \sqrt{\frac{D_t^2 + D_h^2}{2}}$$

ex $$477.2311 \text{m/s} = \pi \cdot \frac{17000}{60} \cdot \sqrt{\frac{(0.57\text{m})^2 + (0.5\text{m})^2}{2}}$$

13) Tip Velocity of Impeller given Mean Diameter

Open Calculator

fx $$U_t = \pi \cdot \left(2 \cdot D_m^2 - D_h^2\right)^{0.5} \cdot \frac{N}{60}$$

ex $$497.0334 \text{m/s} = \pi \cdot \left(2 \cdot (0.53\text{m})^2 - (0.5\text{m})^2\right)^{0.5} \cdot \frac{17000}{60}$$

14) Work Required to Drive Compressor Including Mechanical Losses

Open Calculator

fx $$W_c = \left(\frac{1}{\eta_m}\right) \cdot C_p \cdot (T_2 - T_1)$$

ex $$153.6048 \text{KJ} = \left(\frac{1}{0.99}\right) \cdot 1.248 \text{kJ/kg*K} \cdot (420\text{K} - 298.15\text{K})$$

Variables Used

- C_1 Compressor Inlet Velocity *(Meter per Second)*
- C_2 Compressor Exit Velocity *(Meter per Second)*
- C_p Specific Heat Capacity at Constant Pressure *(Kilojoule per Kilogram per K)*
- D_h Impeller Hub Diameter *(Meter)*
- D_m Mean Diameter of Impeller *(Meter)*
- D_t Impeller Tip Diameter *(Meter)*
- h_1 Enthalpy at Compressor Inlet *(Kilojoule)*
- h_2 Enthalpy at Exit of Compressor *(Kilojoule)*
- $h_{2,actual}$ Actual Enthalpy after Compression *(Kilojoule)*
- $h_{2,ideal}$ Ideal Enthalpy after Compression *(Kilojoule)*
- N RPM
- P_r Pressure Ratio
- R Degree of Reaction
- T_1 Temperature at Compressor Inlet *(Kelvin)*
- T_2 Temperature at Compressor Exit *(Kelvin)*
- $T_{2,actual}$ Actual Temperature at Compressor Exit *(Kelvin)*
- T_r Temperature Ratio
- U_t Tip Velocity *(Meter per Second)*
- W_c Compressor Work *(Kilojoule)*
- W_{in} Actual Work Input *(Kilojoule)*

- **W_s** Shaft Work *(Kilojoule)*
- **$W_{s,in}$** Isentropic Work Input *(Kilojoule)*
- **γ** Heat Capacity Ratio
- **$\Delta E_{rotor\ increase}$** Enthalpy Increase in Rotor *(Kilojoule)*
- **$\Delta E_{stage\ increase}$** Enthalpy Increase in Stage *(Kilojoule)*
- **η_C** Isentropic Efficiency of Compressor
- **η_m** Mechanical Efficiency
- **η_T** Efficiency of Turbine

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Kilojoule (KJ)
  Energy Unit Conversion
- Measurement: **Specific Heat Capacity** in Kilojoule per Kilogram per K (kJ/kg*K)
  Specific Heat Capacity Unit Conversion

Check other formula lists

- **Compressor Formulas**

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