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Thermal Efficiency Formulas

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List of 17 Thermal Efficiency Formulas

Thermal Efficiency

1) Brake Thermal Efficiency

Open Calculator

fx $$\eta_{bth} = \frac{BP}{Q}$$

ex $$45.2381 = \frac{190kW}{4200J}$$

2) Brayton Cycle Efficiency

Open Calculator

fx $$BCE = 1 - \frac{1}{r_p^{\frac{Y-1}{Y}}}$$

ex $$0.668 = 1 - \frac{1}{(6)^{\frac{2.6-1}{2.6}}}$$

3) Carnot Cycle Efficiency of Heat Engine using Temperature of Source and Sink

Open Calculator

fx $$n' = 1 - \frac{T_i}{T_f}$$

ex $$0.115942 = 1 - \frac{305K}{345K}$$

4) Compressor Efficiency

Open Calculator

fx $$\mathrm{CE} = \frac{\mathrm{KE}}{\mathrm{W}}$$

ex $$0.3 = \frac{75\mathrm{J}}{250\mathrm{J}}$$

5) Cooled Compressor Efficiency

Open Calculator

fx $$\mathrm{CCE} = \frac{\mathrm{KE}}{\mathrm{W}}$$

ex $$0.3 = \frac{75\mathrm{J}}{250\mathrm{J}}$$

6) Diesel Efficiency

Open Calculator

fx $$\mathrm{DE} = 1 - \frac{1}{\mathrm{r}^{\mathrm{Y}} - 1} \cdot \left(\mathrm{Cr}^{\mathrm{Y}} - \frac{1}{\mathrm{Y} \cdot (\mathrm{Cr} - 1)} \right)$$

ex $$1.096396 = 1 - \frac{1}{(1.75)^{2.6} - 1} \cdot \left((1.2)^{2.6} - \frac{1}{2.6 \cdot (1.2 - 1)} \right)$$

7) Indicated Thermal Efficiency

Open Calculator

fx $$\mathrm{IDE} = \frac{\mathrm{BP}}{\mathrm{Q}}$$

ex $$45.2381 = \frac{190\mathrm{kW}}{4200\mathrm{J}}$$

8) Nozzle Efficiency

Open Calculator

fx $$\mathrm{NE} = \frac{\Delta \mathrm{KE}}{\mathrm{KE}}$$

ex $$1.2 = \frac{90\mathrm{J}}{75\mathrm{J}}$$

9) Otto Cycle Efficiency

Open Calculator

fx $$\mathrm{OTE} = 1 - \frac{\mathrm{T_i}}{\mathrm{T_f}}$$

ex $$0.115942 = 1 - \frac{305\mathrm{K}}{345\mathrm{K}}$$

10) Overall Efficiency given Boiler, Cycle, Turbine, Generator, and Auxiliary Efficiency

Open Calculator

fx $$\eta_\mathrm{o} = \eta_\mathrm{B} \cdot \eta_\mathrm{C} \cdot \eta_\mathrm{T} \cdot \eta_\mathrm{G} \cdot \eta_\mathrm{Aux}$$

ex $$0.143208 = 0.68 \cdot 0.54 \cdot 0.75 \cdot 0.65 \cdot 0.80$$

11) Ranking Cycle Efficiency

Open Calculator

fx $$\mathrm{RCE} = 1 - \mathrm{q'}$$

ex $$0.75 = 1 - 0.25$$

12) Thermal Efficiency given Mechanical Energy

Open Calculator

fx $$\eta_{\text{th m}} = \frac{W_{\text{net}}}{Q_{\text{in}}}$$

ex $$0.5 = \frac{320\text{J}}{640\text{J}}$$

13) Thermal Efficiency given Waste Energy

Open Calculator

fx $$\eta_{\text{th}} = 1 - \frac{Q_{\text{out}}}{Q_{\text{in}}}$$

ex $$0.46875 = 1 - \frac{340\text{J}}{640\text{J}}$$

14) Thermal Efficiency of Carnot Engine

Open Calculator

fx $$\eta_{\text{th c}} = 1 - \frac{T_{\text{L}}}{T_{\text{H}}}$$

ex $$0.491803 = 1 - \frac{310\text{K}}{610\text{K}}$$

15) Thermal Efficiency of Heat Engine

Open Calculator

fx $$\eta = \frac{W}{Q}$$

ex $$0.059524 = \frac{250\text{J}}{4200\text{J}}$$

16) Turbine Efficiency

Open Calculator

fx $$\eta_T = \frac{W}{KE}$$

ex $$3.333333 = \frac{250J}{75J}$$

17) Volumetric Efficiency given Compression and Pressure Ratio

Open Calculator

fx $$\eta_v = 1 + r + r \cdot r_p^{\frac{1}{Y}}$$

ex $$6.235997 = 1 + 1.75 + 1.75 \cdot (6)^{\frac{1}{2.6}}$$

Variables Used

- **BCE** Thermal Efficiency of Brayton Cycle
- **BP** Brake Power *(Kilowatt)*
- **CCE** Cooled Compressor Efficiency
- **CE** Compressor Efficiency
- **Cr** Cutoff Ratio
- **DE** Diesel Efficiency
- **IDE** Indicated Thermal Efficiency
- **KE** Kinetic Energy *(Joule)*
- **n'** Carnot Cycle Efficiency
- **NE** Nozzle Efficiency
- **OTE** OTE
- **q'** Heat Ratio
- **Q** Heat Energy *(Joule)*
- Q_{in} Thermal Energy *(Joule)*
- Q_{out} Waste Heat *(Joule)*
- **r** Compression Ratio
- r_p Pressure Ratio
- **RCE** Ranking Cycle
- T_f Final Temperature *(Kelvin)*
- T_H Absolute Temperature of Hot Reservoir *(Kelvin)*
- T_i Initial Temperature *(Kelvin)*
- T_L Absolute Temperature of Cold Reservoir *(Kelvin)*
- **W** Work *(Joule)*

- W_{net} Mechanical Energy *(Joule)*
- Y Gamma
- ΔKE Change in Kinetic Energy *(Joule)*
- η Thermal Efficiency of Heat Engine
- η_{Aux} Auxiliary Efficiency
- η_{B} Boiler Efficiency
- η_{bth} Brake Thermal Efficiency
- η_{C} Cycle Efficiency
- η_{G} Generator Efficiency
- η_{o} Overall Efficiency
- η_{T} Turbine Efficiency
- $\eta_{th\ c}$ Thermal Efficiency of Carnot Engine
- $\eta_{th\ m}$ Thermal Efficiency given Mechanical energy
- η_{th} Thermal efficiency given Waste energy
- η_{v} Volumetric Efficiency

Constants, Functions, Measurements used

- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Power** in Kilowatt (kW)
  Power Unit Conversion

Check other formula lists

- **Basics of Thermodynamics Formulas**
- **Closed System Work Formulas**
- **Coefficient of Performance Formulas**
- **Entropy Generation Formulas**
- **Heat Engine and Heat Pump Formulas**
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