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Efficiency Metrics Formulas

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List of 12 Efficiency Metrics Formulas

Efficiency Metrics

1) Change in Kinetic Energy of Jet Engine

Open Calculator

fx $$\Delta KE = \frac{\left(\left(m_a + m_f\right) \cdot V_e^2\right) - \left(m_a \cdot V^2\right)}{2}$$

ex $$87.03894KJ = \frac{\left(\left(3.5kg/s + 0.0315kg/s\right) \cdot \left(248m/s\right)^2\right) - \left(3.5kg/s \cdot \left(111m/s\right)^2\right)}{2}$$

2) Effective speed ratio

Open Calculator

fx $$\alpha = \frac{V}{V_e}$$

ex $$0.447581 = \frac{111m/s}{248m/s}$$

3) Isentropic Efficiency of Expansion Machine

Open Calculator

fx $$\eta_T = \frac{W_{actual}}{W_{s,out}}$$

ex $$0.859504 = \frac{104KJ}{121KJ}$$

4) Net work output in simple gas turbine cycle

Open Calculator

fx $$W_{Net} = C_p \cdot \left(\left(T_3 - T_4\right) - \left(T_2 - T_1\right)\right)$$

ex $$57.408KJ = 1.248kJ/kg*K \cdot \left(\left(555K - 439K\right) - \left(370K - 300K\right)\right)$$

5) Overall Efficiency given Specific Fuel Consumption

Open Calculator

$$\eta_o = \frac{V}{TSFC \cdot Q}$$

$$0.612273 = \frac{111\text{m/s}}{0.015\text{kg/h/N} \cdot 43510\text{kJ/kg}}$$

6) Overall Efficiency of Propulsive System

Open Calculator

$$\eta_{O,prop} = \eta_{th} \cdot \eta_{transmission} \cdot \eta_{propulsive}$$

$$0.03849 = 0.064 \cdot 0.97 \cdot 0.62$$

7) Propulsive efficiency

Open Calculator

$$\eta_{propulsive} = \frac{T_P}{P}$$

$$0.620618 = \frac{54\text{kW}}{87.01\text{kW}}$$

8) Propulsive efficiency given aircraft velocity

Open Calculator

$$\eta_{propulsive} = \frac{2 \cdot V}{V_e + V}$$

$$0.618384 = \frac{2 \cdot 111\text{m/s}}{248\text{m/s} + 111\text{m/s}}$$

9) Propulsive Efficiency given Effective Speed Ratio

Open Calculator

$$\eta_{propulsive} = \frac{2 \cdot \alpha}{1 + \alpha}$$

$$0.618307 = \frac{2 \cdot 0.4475}{1 + 0.4475}$$

10) Propulsive power

Open Calculator

fx $$P = \frac{1}{2} \cdot \left(\left(m_a + m_f \right) \cdot V_e^2 - \left(m_a \cdot V^2 \right) \right)$$

ex $$87.03894\text{kW} = \frac{1}{2} \cdot \left(\left(3.5\text{kg/s} + 0.0315\text{kg/s} \right) \cdot \left(248\text{m/s} \right)^2 - \left(3.5\text{kg/s} \cdot \left(111\text{m/s} \right)^2 \right) \right)$$

11) Thermal Efficiency of Jet Engines given Effective Speed Ratio

Open Calculator

fx $$\eta_{th} = \frac{V_e^2 \cdot \left(1 - \alpha^2 \right)}{2 \cdot f \cdot Q}$$

ex $$0.062805 = \frac{\left(248\text{m/s} \right)^2 \cdot \left(1 - \left(0.4475 \right)^2 \right)}{2 \cdot 0.009 \cdot 43510\text{kJ/kg}}$$

12) Transmission Efficiency given Output and Input of Transmission

Open Calculator

fx $$\eta_{transmission} = \frac{P_{out}}{P_{in}}$$

ex $$0.963636 = \frac{106\text{kW}}{110\text{kW}}$$

Variables Used

- C_p Specific Heat Capacity at Constant Pressure *(Kilojoule per Kilogram per K)*
- **f** Fuel Air Ratio
- m_a Mass Flow Rate *(Kilogram per Second)*
- m_f Fuel Flow Rate *(Kilogram per Second)*
- **P** Propulsive Power *(Kilowatt)*
- P_{in} Transmission Input Power *(Kilowatt)*
- P_{out} Transmission Output Power *(Kilowatt)*
- **Q** Fuel Calorific Value *(Kilojoule per Kilogram)*
- T_1 Temperature at Inlet of Compressor *(Kelvin)*
- T_2 Temperature at Exit of Compressor *(Kelvin)*
- T_3 Temperature at Inlet of Turbine *(Kelvin)*
- T_4 Temperature at Exit of Turbine *(Kelvin)*
- T_P Thrust Power *(Kilowatt)*
- **TSFC** Thrust-Specific Fuel Consumption *(Kilogram per Hour per Newton)*
- **V** Flight Speed *(Meter per Second)*
- V_e Exit Velocity *(Meter per Second)*
- W_{actual} Actual Work *(Kilojoule)*
- W_{Net} Net Work Output *(Kilojoule)*
- $W_{s,out}$ Isentropic Work Output *(Kilojoule)*
- **α** Effective Speed Ratio
- **ΔKE** Change in Kinetic Energy *(Kilojoule)*
- η_o Overall Efficiency
- $\eta_{O,prop}$ Propulsive System Overall Efficiency
- $\eta_{propulsive}$ Propulsive Efficiency
- η_T Turbine Efficiency

- η_{th} Thermal Efficiency
- $\eta_{transmission}$ Efficiency of Transmission

Constants, Functions, Measurements used

- 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: **Power** in Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Specific Heat Capacity** in Kilojoule per Kilogram per K (kJ/kg*K)
  Specific Heat Capacity Unit Conversion
- Measurement: **Mass Flow Rate** in Kilogram per Second (kg/s)
  Mass Flow Rate Unit Conversion
- Measurement: **Specific Energy** in Kilojoule per Kilogram (kJ/kg)
  Specific Energy Unit Conversion
- Measurement: **Thrust Specific Fuel Consumption** in Kilogram per Hour per Newton (kg/h/N)
  Thrust Specific Fuel Consumption Unit Conversion

Check other formula lists

- **Efficiency Metrics Formulas**
- **Thrust Generation Formulas**

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