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Turbojets Formulas

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List of 14 Turbojets Formulas

Turbojets

1) Exhaust Velocity given Gross Thrust in Turbojet

Open Calculator

fx $$V_e = \frac{T_G - (p_e - p_\infty) \cdot A_e}{m_a \cdot (1 + f)}$$

ex $$212.7201\text{m/s} = \frac{1124\text{N} - (982\text{Pa} - 101\text{Pa}) \cdot 0.0589\text{m}^2}{5\text{kg/s} \cdot (1 + 0.008)}$$

2) Exhaust Velocity given Thrust in Turbojet

Open Calculator

fx $$V_e = \frac{T - A_e \cdot (p_e - p_\infty)}{m_a \cdot (1 + f)} + V$$

ex $$212.7597\text{m/s} = \frac{469\text{N} - 0.0589\text{m}^2 \cdot (982\text{Pa} - 101\text{Pa})}{5\text{kg/s} \cdot (1 + 0.008)} + 130\text{m/s}$$

3) Flight Speed given Thrust in Turbojet

Open Calculator

fx $$V = V_e - \frac{T - A_e \cdot (p_e - p_\infty)}{m_a \cdot (1 + f)}$$

ex $$130.2403\text{m/s} = 213\text{m/s} - \frac{469\text{N} - 0.0589\text{m}^2 \cdot (982\text{Pa} - 101\text{Pa})}{5\text{kg/s} \cdot (1 + 0.008)}$$

4) Gross Thrust of Turbojet given Net Thrust

Open Calculator

fx $$T_G = T + D_{ram}$$

ex $$1124\text{N} = 469\text{N} + 655\text{N}$$

5) Mass Flow Rate in Turbojet given Thrust

Open Calculator

$$m_a = \frac{T - A_e \cdot (p_e - p_\infty)}{(V_e - V) \cdot (1 + f)}$$

$$4.985527\text{kg/s} = \frac{469\text{N} - 0.0589\text{m}^2 \cdot (982\text{Pa} - 101\text{Pa})}{(213\text{m/s} - 130\text{m/s}) \cdot (1 + 0.008)}$$

6) Mass Flow Rate of Exhaust Gases

Open Calculator

$$m_{total} = m_a + m_f$$

$$5.033\text{kg/s} = 5\text{kg/s} + 0.033\text{kg/s}$$

7) Mass Flow Rate of Exhaust Gases given Fuel Air Ratio

Open Calculator

$$m_{total} = m_a \cdot (1 + f)$$

$$5.04\text{kg/s} = 5\text{kg/s} \cdot (1 + 0.008)$$

8) Mass Flow Rate of Turbojet given Gross Thrust

Open Calculator

$$m_a = \frac{T_G - (p_e - p_\infty) \cdot A_e}{(1 + f) \cdot V_e}$$

$$4.993429\text{kg/s} = \frac{1124\text{N} - (982\text{Pa} - 101\text{Pa}) \cdot 0.0589\text{m}^2}{(1 + 0.008) \cdot 213\text{m/s}}$$

9) Net Thrust of Turbojet given Gross Thrust

Open Calculator

$$T = T_G - D_{ram}$$

$$469\text{N} = 1124\text{N} - 655\text{N}$$

10) Net Thrust Produced by Turbojet

Open Calculator

$$T = m_a \cdot (1 + f) \cdot (V_e - V) + A_e \cdot (p_e - p_\infty)$$

ex

$$470.2109\text{N} = 5\text{kg/s} \cdot (1 + 0.008) \cdot (213\text{m/s} - 130\text{m/s}) + 0.0589\text{m}^2 \cdot (982\text{Pa} - 101\text{Pa})$$

11) Nozzle Exit Area in Turbojet

Open Calculator

$$A_e = \frac{T - m_a \cdot (1 + f) \cdot (V_e - V)}{p_e - p_\infty}$$

ex

$$0.057526\text{m}^2 = \frac{469\text{N} - 5\text{kg/s} \cdot (1 + 0.008) \cdot (213\text{m/s} - 130\text{m/s})}{982\text{Pa} - 101\text{Pa}}$$

12) Ram Drag of Turbojet given Gross Thrust

Open Calculator

$$D_{ram} = T_G - T$$

ex

$$655\text{N} = 1124\text{N} - 469\text{N}$$

13) Thermal efficiency of turbojet engine

Open Calculator

$$\eta_{th} = \frac{P}{m_f \cdot Q}$$

ex

$$0.682689 = \frac{980\text{kW}}{0.033\text{kg/s} \cdot 43500\text{kJ/kg}}$$

14) Turbojet Gross Thrust

Open Calculator

$$T_G = m_a \cdot (1 + f) \cdot V_e + (p_e - p_\infty) \cdot A_e$$

ex

$$1125.411\text{N} = 5\text{kg/s} \cdot (1 + 0.008) \cdot 213\text{m/s} + (982\text{Pa} - 101\text{Pa}) \cdot 0.0589\text{m}^2$$

Variables Used

- A_e Nozzle Exit Area *(Square Meter)*
- D_{ram} Ram Drag of Turbojet *(Newton)*
- f Fuel Air Ratio
- m_a Mass Flow Rate Turbojet *(Kilogram per Second)*
- m_f Fuel Flow Rate *(Kilogram per Second)*
- m_{total} Total Mass Flow Rate Turbojet *(Kilogram per Second)*
- P Propulsive Power *(Kilowatt)*
- p_∞ Ambient Pressure *(Pascal)*
- p_e Nozzle Exit Pressure *(Pascal)*
- Q Fuel Calorific Value *(Kilojoule per Kilogram)*
- T Net Thrust of Turbojet *(Newton)*
- T_G Gross Thrust of Turbojet *(Newton)*
- V Flight Speed *(Meter per Second)*
- V_e Exit Velocity *(Meter per Second)*
- η_{th} Turbojet Thermal Efficiency

Constants, Functions, Measurements used

- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Force** in Newton (N)
  Force 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

Check other formula lists

- **Turbofans Formulas**
- **Turbojets Formulas**

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