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Turbofans Formulas

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List of 10 Turbofans Formulas

Turbofans 🔗

1) Bypass Exhaust Velocity given Turbofan Thrust 🔗

Open Calculator 🔗

$$fx \quad V_{j,b} = \frac{T - m_c \cdot (V_{j,c} - V)}{\dot{m}_b} + V$$

$$ex \quad 249.9922 \text{m/s} = \frac{17.8 \text{kN} - 43 \text{kg/s} \cdot (300 \text{m/s} - 198 \text{m/s})}{258 \text{kg/s}} + 198 \text{m/s}$$

2) Bypass Mass Flow Rate 🔗

Open Calculator 🔗

$$fx \quad \dot{m}_b = m_a - m_c$$

$$ex \quad 258 \text{kg/s} = 301 \text{kg/s} - 43 \text{kg/s}$$

3) Bypass Mass Flow Rate given Turbofan Thrust 🔗

Open Calculator 🔗

$$fx \quad \dot{m}_b = \frac{T - m_c \cdot (V_{j,c} - V)}{V_{j,b} - V}$$

$$ex \quad 257.9615 \text{kg/s} = \frac{17.8 \text{kN} - 43 \text{kg/s} \cdot (300 \text{m/s} - 198 \text{m/s})}{250 \text{m/s} - 198 \text{m/s}}$$

4) Bypass Ratio ⌇

Open Calculator ⌇

$$fx \quad bpr = \frac{\dot{m}_b}{m_c}$$

$$ex \quad 6 = \frac{258kg/s}{43kg/s}$$

5) Cooling Effectiveness ⌇

Open Calculator ⌇

$$fx \quad \varepsilon = \frac{T_g - T_m}{T_g - T_c}$$

$$ex \quad 0.649351 = \frac{1400K - 900K}{1400K - 630K}$$

6) Core Exhaust Velocity given Turbofan Thrust ⌇

Open Calculator ⌇

$$fx \quad V_{j,c} = \frac{T - \dot{m}_b \cdot (V_{j,b} - V)}{m_c} + V$$

$$ex \quad 299.9535m/s = \frac{17.8kN - 258kg/s \cdot (250m/s - 198m/s)}{43kg/s} + 198m/s$$

7) Mass flow rate hot primary engine ⌇

Open Calculator ⌇

$$fx \quad m_c = m_a - \dot{m}_b$$

$$ex \quad 43kg/s = 301kg/s - 258kg/s$$

8) Primary Mass flow Rate in Turbofan Engine ↗

fx $\quad m_c = \dfrac{T - \dot{m}_b \cdot (V_{j,b} - V)}{V_{j,c} - V}$

ex $\quad 42.98039 \text{kg/s} = \dfrac{17.8 \text{kN} - 258 \text{kg/s} \cdot (250 \text{m/s} - 198 \text{m/s})}{300 \text{m/s} - 198 \text{m/s}}$

9) Total mass flow rate through turbofan engine ↗

fx $\quad m_a = m_c + \dot{m}_b$

ex $\quad 301 \text{kg/s} = 43 \text{kg/s} + 258 \text{kg/s}$

10) Turbofan thrust ↗

fx $\quad T = m_c \cdot (V_{j,c} - V) + \dot{m}_b \cdot (V_{j,b} - V)$

ex

$17.802 \text{kN} = 43 \text{kg/s} \cdot (300 \text{m/s} - 198 \text{m/s}) + 258 \text{kg/s} \cdot (250 \text{m/s} - 198 \text{m/s})$

Variables Used

- **bpr** Bypass Ratio
- **m$_a$** Mass Flow Rate *(Kilogram per Second)*
- **ṁ$_b$** Mass Flow Rate Bypass *(Kilogram per Second)*
- **m$_c$** Mass Flow Rate Core *(Kilogram per Second)*
- **T** Turbofan Thrust *(Kilonewton)*
- **T$_c$** Temperature of Cooling Air *(Kelvin)*
- **T$_g$** Temperature of Hot Gas Stream *(Kelvin)*
- **T$_m$** Temperature of Metal *(Kelvin)*
- **V** Flight Speed *(Meter per Second)*
- **V$_{j,b}$** Exit Velocity Bypass Nozzle *(Meter per Second)*
- **V$_{j,c}$** Exit Velocity Core Nozzle *(Meter per Second)*
- **ε** Cooling Effectiveness

Constants, Functions, Measurements used

- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion 🔗

- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion 🔗

- Measurement: **Force** in Kilonewton (kN)
  Force Unit Conversion 🔗

- Measurement: **Mass Flow Rate** in Kilogram per Second (kg/s)
  Mass Flow Rate Unit Conversion 🔗

Check other formula lists

- **Turbofans Formulas** ⬀

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