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# Turbofans Formulas

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# List of 10 Turbofans Formulas

## Turbofans

### 1) Bypass Exhaust Velocity given Turbofan Thrust

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

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

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

### 2) Bypass Mass Flow Rate

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

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

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

### 3) Bypass Mass Flow Rate given Turbofan Thrust

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

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d\_img.jpg\)](#)

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



#### 4) Bypass Ratio

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

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

#### 5) Cooling Effectiveness

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

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

#### 6) Core Exhaust Velocity given Turbofan Thrust

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

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

#### 7) Mass flow rate hot primary engine

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

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

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



### 8) Primary Mass flow Rate in Turbofan Engine

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

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

### 9) Total mass flow rate through turbofan engine

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

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

### 10) Turbofan thrust

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

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







## Variables Used

- **bpr** Bypass Ratio
- **$m_a$**  Mass Flow Rate (Kilogram per Second)
- **$\dot{m}_b$**  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)
- **$\epsilon$**  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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