

Important Thrust Generation Formulas PDF



Formulas Examples with Units

List of 21 Important Thrust Generation Formulas

1) Flight Speed given Ideal Thrust Formula ↻

Formula

$$V = V_e - \frac{T_{\text{ideal}}}{m_a}$$

Example with Units

$$111 \text{ m/s} = 248 \text{ m/s} - \frac{479.5 \text{ N}}{3.5 \text{ kg/s}}$$

Evaluate Formula ↻

2) Flight Speed given Momentum of Ambient Air Formula ↻

Formula

$$V = \frac{M}{m_a}$$

Example with Units

$$111 \text{ m/s} = \frac{388.5 \text{ kg} \cdot \text{m/s}}{3.5 \text{ kg/s}}$$

Evaluate Formula ↻

3) Flight Speed given Ram Drag and Mass Flow Rate Formula ↻

Formula

$$V = \frac{D_{\text{ram}}}{m_a}$$

Example with Units

$$111.1429 \text{ m/s} = \frac{389 \text{ N}}{3.5 \text{ kg/s}}$$

Evaluate Formula ↻

4) Gross thrust Formula ↻

Formula

$$T_G = m_a \cdot V_e$$

Example with Units

$$868 \text{ N} = 3.5 \text{ kg/s} \cdot 248 \text{ m/s}$$

Evaluate Formula ↻

5) Gross Thrust Coefficient Formula ↻

Formula

$$C_{Tg} = \frac{T_G}{F_i}$$

Example with Units

$$0.8189 = \frac{868 \text{ N}}{1060 \text{ N}}$$

Evaluate Formula ↻

6) Ideal Thrust given Effective Speed Ratio Formula ↻

Formula

$$T_{\text{ideal}} = m_a \cdot V \cdot \left(\left(\frac{1}{\alpha} \right) - 1 \right)$$

Example with Units

$$479.6564 \text{ N} = 3.5 \text{ kg/s} \cdot 111 \text{ m/s} \cdot \left(\left(\frac{1}{0.4475} \right) - 1 \right)$$

Evaluate Formula ↻



7) Ideal Thrust of Jet Engine Formula

Formula

$$T_{\text{ideal}} = m_a \cdot (V_e - V)$$

Example with Units

$$479.5 \text{ N} = 3.5 \text{ kg/s} \cdot (248 \text{ m/s} - 111 \text{ m/s})$$

Evaluate Formula 

8) Mass Flow given Momentum in Ambient Air Formula

Formula

$$m_a = \frac{M}{V}$$

Example with Units

$$3.5 \text{ kg/s} = \frac{388.5 \text{ kg} \cdot \text{m/s}}{111 \text{ m/s}}$$

Evaluate Formula 

9) Mass Flow Rate given Ideal Thrust Formula

Formula

$$m_a = \frac{T_{\text{ideal}}}{V_e - V}$$

Example with Units

$$3.5 \text{ kg/s} = \frac{479.5 \text{ N}}{248 \text{ m/s} - 111 \text{ m/s}}$$

Evaluate Formula 

10) Mass Flow Rate given Ram Drag and Flight Speed Formula

Formula

$$m_a = \frac{D_{\text{ram}}}{V}$$

Example with Units

$$3.5045 \text{ kg/s} = \frac{389 \text{ N}}{111 \text{ m/s}}$$

Evaluate Formula 

11) Momentum of Ambient Air Formula

Formula

$$M = m_a \cdot V$$

Example with Units

$$388.5 \text{ kg} \cdot \text{m/s} = 3.5 \text{ kg/s} \cdot 111 \text{ m/s}$$

Evaluate Formula 

12) Momentum Thrust Formula

Formula

$$T_{\text{ideal}} = m_a \cdot ((1 + f) \cdot V_e - V)$$

Example with Units

$$487.312 \text{ N} = 3.5 \text{ kg/s} \cdot ((1 + 0.009) \cdot 248 \text{ m/s} - 111 \text{ m/s})$$

Evaluate Formula 

13) Ram drag Formula

Formula

$$D_{\text{ram}} = m_a \cdot V$$

Example with Units

$$388.5 \text{ N} = 3.5 \text{ kg/s} \cdot 111 \text{ m/s}$$

Evaluate Formula 

14) Specific thrust Formula

Formula

$$I_{\text{sp}} = V_e - V$$

Example with Units

$$137 \text{ m/s} = 248 \text{ m/s} - 111 \text{ m/s}$$

Evaluate Formula 



15) Specific Thrust given Effective Speed Ratio Formula

Formula

$$I_{sp} = V_e \cdot (1 - \alpha)$$

Example with Units

$$137.02 \text{ m/s} = 248 \text{ m/s} \cdot (1 - 0.4475)$$

Evaluate Formula 

16) Thrust given aircraft forward speed, velocity of exhaust Formula

Formula

$$T_{ideal} = m_a \cdot (V_e - V)$$

Example with Units

$$479.5 \text{ N} = 3.5 \text{ kg/s} \cdot (248 \text{ m/s} - 111 \text{ m/s})$$

Evaluate Formula 

17) Thrust power Formula

Formula

$$T_p = m_a \cdot V \cdot (V_e - V)$$

Example with Units

$$53.2245 \text{ kW} = 3.5 \text{ kg/s} \cdot 111 \text{ m/s} \cdot (248 \text{ m/s} - 111 \text{ m/s})$$

Evaluate Formula 

18) Thrust power specific fuel consumption Formula

Formula

$$\text{TPSFC} = \frac{m_f}{T_p}$$

Example with Units

$$2.1 \text{ kg/h/kW} = \frac{0.0315 \text{ kg/s}}{54 \text{ kW}}$$

Evaluate Formula 

19) Thrust specific fuel consumption Formula

Formula

$$\text{TSFC} = \frac{f_a}{I_{sp}}$$

Example with Units

$$0.0158 \text{ kg/h/N} = \frac{0.0006}{137.02 \text{ m/s}}$$

Evaluate Formula 

20) Total Thrust given Efficiency and Enthalpy Formula

Formula

$$T_{total} = m_a \cdot \left(\left(\sqrt{2 \cdot \Delta h_{nozzle} \cdot \eta_{nozzle}} \right) - V + \left(\sqrt{\eta_T \cdot \eta_{transmission} \cdot \Delta h_{turbine}} \right) \right)$$

Evaluate Formula 

Example with Units

$$591.9372 \text{ N} = 3.5 \text{ kg/s} \cdot \left(\left(\sqrt{2 \cdot 12 \text{ kJ} \cdot .24} \right) - 111 \text{ m/s} + \left(\sqrt{0.86 \cdot 0.97 \cdot 50 \text{ kJ}} \right) \right)$$

21) Velocity after Expansion given Ideal Thrust Formula

Formula

$$V_e = \frac{T_{ideal}}{m_a} + V$$

Example with Units

$$248 \text{ m/s} = \frac{479.5 \text{ N}}{3.5 \text{ kg/s}} + 111 \text{ m/s}$$

Evaluate Formula 



Variables used in list of Thrust Generation Formulas above

- C_{Tg} Gross Thrust Coefficient
- D_{ram} Ram Drag (Newton)
- f Fuel Air Ratio
- f_a Fuel to Air Ratio
- F_i Ideal Gross Thrust (Newton)
- I_{sp} Specific Thrust (Meter per Second)
- M Momentum of Ambient Air (Kilogram Meter per Second)
- m_a Mass Flow Rate (Kilogram per Second)
- m_f Fuel Flow Rate (Kilogram per Second)
- T_G Gross Thrust (Newton)
- T_{ideal} Ideal Thrust (Newton)
- T_P Thrust Power (Kilowatt)
- T_{total} Total Thrust (Newton)
- **TPSFC** Thrust Power Specific Fuel Consumption (Kilogram per Hour per Kilowatt)
- **TSFC** Thrust-Specific Fuel Consumption (Kilogram per Hour per Newton)
- V Flight Speed (Meter per Second)
- V_e Exit Velocity (Meter per Second)
- α Effective Speed Ratio
- Δh_{nozzle} Enthalpy Drop in Nozzle (Kilojoule)
- $\Delta h_{turbine}$ Enthalpy Drop in Turbine (Kilojoule)
- η_{nozzle} Nozzle Efficiency
- η_T Turbine Efficiency
- $\eta_{transmission}$ Efficiency of Transmission

Constants, Functions, Measurements used in list of Thrust Generation Formulas above

- **Functions:** **sqrt**, sqrt(Number)
A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- **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:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Mass Flow Rate** in Kilogram per Second (kg/s)
Mass Flow Rate Unit Conversion 
- **Measurement:** **Momentum** in Kilogram Meter per Second (kg*m/s)
Momentum Unit Conversion 
- **Measurement:** **Thrust Specific Fuel Consumption** in Kilogram per Hour per Newton (kg/h/N)
Thrust Specific Fuel Consumption Unit Conversion 
- **Measurement:** **Specific Fuel Consumption** in Kilogram per Hour per Kilowatt (kg/h/kW)
Specific Fuel Consumption Unit Conversion 



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