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Jet Airplane Formulas

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List of 17 Jet Airplane Formulas

Jet Airplane

1) Average Value Range Equation

Open Calculator

fx $$R_{AVG} = \frac{\Delta w_f}{c_t \cdot \left(\frac{F_D}{V}\right)}$$

ex $$151327.4\text{m} = \frac{300\text{kg}}{10.17\text{kg/h/N} \cdot \left(\frac{80\text{N}}{114\text{m/s}}\right)}$$

2) Breguet Endurance Equation

Open Calculator

fx $$E = \left(\frac{1}{c_t}\right) \cdot \left(\frac{C_L}{C_D}\right) \cdot \ln\left(\frac{W_0}{W_1}\right)$$

ex $$452.0581\text{s} = \left(\frac{1}{10.17\text{kg/h/N}}\right) \cdot \left(\frac{5}{2}\right) \cdot \ln\left(\frac{5000\text{kg}}{3000\text{kg}}\right)$$

3) Breguet Range

Open Calculator

fx $$R_{jet} = \frac{LD \cdot V \cdot \ln\left(\frac{W_i}{W_f}\right)}{[g] \cdot c_t}$$

ex $$7130.684\text{m} = \frac{2.50 \cdot 114\text{m/s} \cdot \ln\left(\frac{200\text{kg}}{100\text{kg}}\right)}{[g] \cdot 10.17\text{kg/h/N}}$$

4) Constant Speed Cruise using Range Equation

Open Calculator

fx $$R_{jet} = \frac{V}{c_t \cdot T_{total}} \cdot \int(1, x, W_1, W_0)$$

ex $$7130.309\text{m} = \frac{114\text{m/s}}{10.17\text{kg/h/N} \cdot 11319\text{N}} \cdot \int(1, x, 3000\text{kg}, 5000\text{kg})$$

5) Cruise Weight Fraction for Jet Aircraft

Open Calculator

fx $$FW_{\text{cruise jet}} = \exp\left(\frac{R_{\text{jet}} \cdot c \cdot (-1)}{0.866 \cdot 1.32 \cdot V_{L/D,max} \cdot LDmax_{ratio}}\right)$$

ex $$0.822972 = \exp\left(\frac{7130\text{m} \cdot 0.6\text{kg/h/W} \cdot (-1)}{0.866 \cdot 1.32 \cdot 1.05\text{m/s} \cdot 5.081527}\right)$$

6) Endurance for given Lift-to-Drag Ratio of Jet Airplane

Open Calculator

fx $$E = \left(\frac{1}{c_t}\right) \cdot LD \cdot \ln\left(\frac{W_0}{W_1}\right)$$

ex $$452.0581\text{s} = \left(\frac{1}{10.17\text{kg/h/N}}\right) \cdot 2.50 \cdot \ln\left(\frac{5000\text{kg}}{3000\text{kg}}\right)$$

7) Endurance of Jet Airplane

Open Calculator

fx $$E = C_L \cdot \frac{\ln\left(\frac{W_0}{W_1}\right)}{C_D \cdot c_t}$$

ex $$452.0581\text{s} = 5 \cdot \frac{\ln\left(\frac{5000\text{kg}}{3000\text{kg}}\right)}{2 \cdot 10.17\text{kg/h/N}}$$

8) Lift-to-Drag Ratio for given Endurance of Jet Airplane

Open Calculator

fx $$LD = c_t \cdot \frac{E}{\ln\left(\frac{W_0}{W_1}\right)}$$

ex $$2.5 = 10.17\text{kg/h/N} \cdot \frac{452.0581\text{s}}{\ln\left(\frac{5000\text{kg}}{3000\text{kg}}\right)}$$

9) Loiter Weight Fraction for Jet Aircraft

Open Calculator

fx $$F_{\text{loiter(jet)}} = \exp\left(\frac{(-1) \cdot E \cdot c}{LDmax_{ratio}}\right)$$

ex $$0.985283 = \exp\left(\frac{(-1) \cdot 452.0581\text{s} \cdot 0.6\text{kg/h/W}}{5.081527}\right)$$

10) Maximum Lift to Drag Ratio given Preliminary Endurance for Jet Aircraft

Open Calculator

fx $$LDmax_{ratio} = \frac{E \cdot c}{\ln\left(\frac{W_{L,beg}}{W_{L,end}}\right)}$$

ex $$5.070236 = \frac{452.0581\text{s} \cdot 0.6\text{kg/h/W}}{\ln\left(\frac{400\text{kg}}{394.1\text{kg}}\right)}$$

11) Maximum Lift to Drag Ratio given Range for Jet Aircraft

Open Calculator

fx $$LDmax_{ratio\ prop} = \frac{R_{jet} \cdot c}{V_{L/D,max} \cdot \ln\left(\frac{W_i}{W_f}\right)}$$

ex $$4.503307 = \frac{7130\text{m} \cdot 0.6\text{kg/h/W}}{1.05\text{m/s} \cdot \ln\left(\frac{450\text{kg}}{350\text{kg}}\right)}$$

12) Range of Jet Airplane

Open Calculator

fx $$R_{jet} = \left(\sqrt{\frac{8}{\rho_\infty \cdot S}}\right) \cdot \left(\frac{1}{c_t \cdot C_D}\right) \cdot \left(\sqrt{C_L}\right) \cdot \left(\left(\sqrt{W_0}\right) - \left(\sqrt{W_1}\right)\right)$$

ex $$7130.966\text{m} = \left(\sqrt{\frac{8}{1.225\text{kg/m}^3 \cdot 5.11\text{m}^2}}\right) \cdot \left(\frac{1}{10.17\text{kg/h/N} \cdot 2}\right) \cdot \left(\sqrt{5}\right) \cdot \left(\left(\sqrt{5000\text{kg}}\right) - \left(\sqrt{3000\text{kg}}\right)\right)$$

13) Specific Fuel Consumption given Preliminary Endurance for Jet Aircraft

Open Calculator

fx $$c = \frac{LDmax_{ratio} \cdot \ln\left(\frac{W_{L,beg}}{W_{L,end}}\right)}{E}$$

ex $$0.601336\text{kg/h/W} = \frac{5.081527 \cdot \ln\left(\frac{400\text{kg}}{394.1\text{kg}}\right)}{452.0581\text{s}}$$

14) Specific Fuel Consumption given Range for Jet Aircraft

Open Calculator

fx $$c = \frac{V_{L/D,max} \cdot LDmax_{ratio} \cdot \ln\left(\frac{W_i}{W_f}\right)}{R_{jet}}$$

ex $$0.677039\text{kg/h/W} = \frac{1.05\text{m/s} \cdot 5.081527 \cdot \ln\left(\frac{450\text{kg}}{350\text{kg}}\right)}{7130\text{m}}$$

15) Thrust-Specific Fuel Consumption for given Endurance and Lift-to-Drag Ratio of Jet Airplane

Open Calculator

fx $$c_t = \left(\frac{1}{E}\right) \cdot LD \cdot \ln\left(\frac{W_0}{W_1}\right)$$

ex $$10.17\text{kg/h/N} = \left(\frac{1}{452.0581\text{s}}\right) \cdot 2.50 \cdot \ln\left(\frac{5000\text{kg}}{3000\text{kg}}\right)$$

16) Thrust-Specific Fuel Consumption for given Endurance of Jet Airplane

Open Calculator

fx $$c_t = C_L \cdot \frac{\ln\left(\frac{W_0}{W_1}\right)}{C_D \cdot E}$$

ex $$10.17\text{kg/h/N} = 5 \cdot \frac{\ln\left(\frac{5000\text{kg}}{3000\text{kg}}\right)}{2 \cdot 452.0581\text{s}}$$

17) Thrust-Specific Fuel Consumption for given Range of Jet Airplane

Open Calculator

fx $$c_t = \left(\sqrt{\frac{8}{\rho_\infty \cdot S}}\right) \cdot \left(\frac{1}{R_{jet} \cdot C_D}\right) \cdot \left(\sqrt{C_L}\right) \cdot \left(\left(\sqrt{W_0}\right) - \left(\sqrt{W_1}\right)\right)$$

ex $$10.17138\text{kg/h/N} = \left(\sqrt{\frac{8}{1.225\text{kg/m}^3 \cdot 5.11\text{m}^2}}\right) \cdot \left(\frac{1}{7130\text{m} \cdot 2}\right) \cdot \left(\sqrt{5}\right) \cdot \left(\left(\sqrt{5000\text{kg}}\right) - \left(\sqrt{3000\text{kg}}\right)\right)$$

Variables Used

- **c** Specific Fuel Consumption *(Kilogram per Hour per Watt)*
- C_D Drag Coefficient
- C_L Lift Coefficient
- c_t Thrust-Specific Fuel Consumption *(Kilogram per Hour per Newton)*
- **E** Endurance of Aircraft *(Second)*
- F_D Drag Force *(Newton)*
- $F_{loiter(jet)}$ Loiter Weight Fraction for Jet aircraft
- $FW_{cruise\ jet}$ Cruise Weight Fraction Jet Aircraft
- **LD** Lift-to-Drag Ratio
- $LDmax_{ratio\ prop}$ Maximum Lift to Drag Ratio Jet Aircraft
- $LDmax_{ratio}$ Maximum Lift-to-Drag Ratio
- R_{AVG} Average Value Range Equation *(Meter)*
- R_{jet} Range of Jet Aircraft *(Meter)*
- **S** Reference Area *(Square Meter)*
- T_{total} Total Thrust *(Newton)*
- **V** Flight Velocity *(Meter per Second)*
- $V_{L/D,max}$ Velocity at Maximum Lift to Drag Ratio *(Meter per Second)*
- W_0 Gross Weight *(Kilogram)*
- W_1 Weight without Fuel *(Kilogram)*
- w_f Final Weight *(Kilogram)*
- W_f Weight at End of Cruise Phase *(Kilogram)*
- w_i Initial Weight *(Kilogram)*
- W_i Weight at Start of Cruise Phase *(Kilogram)*
- $W_{L,beg}$ Weight at Start of Loiter Phase *(Kilogram)*
- $W_{L,end}$ Weight at End of Loiter Phase *(Kilogram)*
- Δw_f Change in Weight *(Kilogram)*
- ρ_∞ Freestream Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **exp**, exp(Number)
  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Function: **int**, int(expr, arg, from, to)
  The definite integral can be used to calculate net signed area, which is the area above the x -axis minus the area below the x -axis.
- Function: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Function: **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: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3)
  Density 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 Watt (kg/h/W)
  Specific Fuel Consumption Unit Conversion

Check other formula lists

- **Jet Airplane Formulas**
- **Propeller-Driven Airplane Formulas**

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