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Lift and Drag Requirements Formulas

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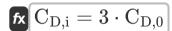
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List of 19 Lift and Drag Requirements Formulas

Lift and Drag Requirements 🔗

1) Coefficient of Drag due to Lift for Minimum Power required 🔗

Open Calculator 🔗

fx $\mathrm{C_{D,i} = 3 \cdot C_{D,0}}$

ex $0.93 = 3 \cdot 0.31$

2) Coefficient of Drag for given Thrust and Weight 🔗

Open Calculator 🔗

fx $\mathrm{C_D = \dfrac{T \cdot C_L}{W_{body}}}$

ex $0.497738 = \dfrac{100N \cdot 1.1}{221N}$

3) Coefficient of Drag for given Thrust-to-Weight Ratio 🔗

Open Calculator 🔗

fx $\mathrm{C_D = C_L \cdot TW}$

ex $0.495 = 1.1 \cdot 0.45$

4) Coefficient of Lift for given thrust and weight ⤴

fx $C_L = W_{body} \cdot \dfrac{C_D}{T}$

Open Calculator ⤴

ex $1.105 = 221N \cdot \dfrac{0.5}{100N}$

5) Coefficient of Lift for given Thrust-to-Weight Ratio ⤴

fx $C_L = \dfrac{C_D}{TW}$

Open Calculator ⤴

ex $1.111111 = \dfrac{0.5}{0.45}$

6) Drag for Level and Unaccelerated Flight ⤴

fx $F_D = T \cdot \cos(\sigma_T)$

Open Calculator ⤴

ex $99.995N = 100N \cdot \cos(0.01rad)$

7) Drag for Level and Unaccelerated Flight at Negligible Thrust Angle ⤴

fx $F_D = P_{dynamic} \cdot A \cdot C_D$
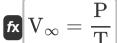
Open Calculator ⤴

ex $100N = 10Pa \cdot 20m^2 \cdot 0.5$
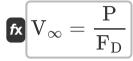
8) Freestream Velocity given required Power 🔗

Open Calculator 🔗

$$fx \quad V_\infty = \frac{P}{T}$$

$$ex \quad 30\text{m/s} = \frac{3000\text{W}}{100\text{N}}$$

9) Freestream Velocity given Total Drag Force 🔗

Open Calculator 🔗

$$fx \quad V_\infty = \frac{P}{F_D}$$

$$ex \quad 30.003\text{m/s} = \frac{3000\text{W}}{99.99\text{N}}$$

10) Lift Coefficient given Minimum required Thrust 🔗
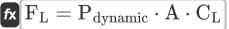
fx

Open Calculator 🔗

$$C_L = \sqrt{\pi \cdot e \cdot AR \cdot \left(\left(\frac{T}{P_{\text{dynamic}} \cdot A} \right) - C_{D,0} \right)}$$

$$ex \quad 1.103486 = \sqrt{\pi \cdot 0.51 \cdot 4 \cdot \left(\left(\frac{100\text{N}}{10\text{Pa} \cdot 20\text{m}^2} \right) - 0.31 \right)}$$
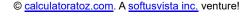
11) Lift for Level and Unaccelerated Flight at Negligible Thrust Angle 🔗

Open Calculator 🔗

$$fx \quad F_L = P_{\text{dynamic}} \cdot A \cdot C_L$$

$$ex \quad 220\text{N} = 10\text{Pa} \cdot 20\text{m}^2 \cdot 1.1$$
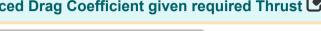
12) Lift for Unaccelerated Flight 🔗

fx $F_L = W_{body} - T \cdot \sin(\sigma_T)$

Open Calculator 🔗

ex $220N = 221N - 100N \cdot \sin(0.01rad)$

13) Lift-Induced Drag Coefficient given required Thrust 🔗

fx $C_{D,i} = \left(\dfrac{T}{P_{dynamic} \cdot S} \right) - C_{D,0}$

Open Calculator 🔗

ex $0.94 = \left(\dfrac{100N}{10Pa \cdot 8m^2} \right) - 0.31$
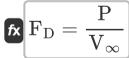
14) Lift-to-Drag Ratio given required Thrust of Aircraft 🔗

fx $LD = \dfrac{W_{body}}{T}$

Open Calculator 🔗

ex $2.21 = \dfrac{221N}{100N}$

15) Total Drag Force given required Power 🔗

fx $F_D = \dfrac{P}{V_\infty}$

Open Calculator 🔗

ex $100N = \dfrac{3000W}{30m/s}$

16) Zero-lift drag coefficient at minimum required thrust

fx
$$C_{D0,min} = \frac{C_L^2}{\pi \cdot e \cdot AR}$$

ex
$$0.188801 = \frac{(1.1)^2}{\pi \cdot 0.51 \cdot 4}$$

Open Calculator
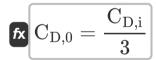
17) Zero-Lift Drag Coefficient for given Lift Coefficient

fx
$$C_{D,0} = \left(\frac{T}{P_{dynamic} \cdot A} \right) - \left(\frac{C_L^2}{\pi \cdot e \cdot AR} \right)$$

ex
$$0.311199 = \left(\frac{100N}{10Pa \cdot 20m^2} \right) - \left(\frac{(1.1)^2}{\pi \cdot 0.51 \cdot 4} \right)$$

Open Calculator

18) Zero-Lift Drag Coefficient for Minimum Power required

fx
$$C_{D,0} = \frac{C_{D,i}}{3}$$

ex
$$0.31 = \frac{0.93}{3}$$

Open Calculator

19) Zero-Lift Drag Coefficient given required Thrust 📲

Open Calculator 📲

fx $$C_{D,0} = \left(\frac{T}{P_{dynamic} \cdot S} \right) - C_{D,i}$$

ex $$0.32 = \left(\frac{100N}{10Pa \cdot 8m^2} \right) - 0.93$$

Variables Used

- **A** Area *(Square Meter)*
- **AR** Aspect Ratio of a Wing
- **C_D** Drag Coefficient
- **$C_{D,0}$** Zero Lift Drag Coefficient
- **$C_{D,i}$** Coefficient Of Drag Due to Lift
- **$C_{D0,min}$** Zero-Lift Drag Coefficient at Minimum Thrust
- **C_L** Lift Coefficient
- **e** Oswald Efficiency Factor
- **F_D** Drag Force *(Newton)*
- **F_L** Lift Force *(Newton)*
- **LD** Lift-to-Drag Ratio
- **P** Power *(Watt)*
- **$P_{dynamic}$** Dynamic Pressure *(Pascal)*
- **S** Reference Area *(Square Meter)*
- **T** Thrust *(Newton)*
- **TW** Thrust-to-Weight Ratio
- **V_∞** Freestream Velocity *(Meter per Second)*
- **W_{body}** Weight of Body *(Newton)*
- **σ_T** Thrust Angle *(Radian)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant

- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.

- Function: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.

- 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: **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 Watt (W)
  Power Unit Conversion ⬀

- Measurement: **Force** in Newton (N)
  Force Unit Conversion ⬀

- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion ⬀

Check other formula lists

- **Lift and Drag Requirements Formulas**

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