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Lift and Drag Polar Formulas

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List of 21 Lift and Drag Polar Formulas

Lift and Drag Polar

1) Coefficient of Drag due to lift

Open Calculator

fx $$C_{D,i} = \frac{C_L^2}{\pi \cdot e_{oswald} \cdot AR}$$

ex $$0.192577 = \frac{(1.1)^2}{\pi \cdot 0.5 \cdot 4}$$

2) Coefficient of drag given drag

Open Calculator

fx $$C_D = \frac{C_L \cdot F_D}{W_0}$$

ex $$30.03413 = \frac{1.1 \cdot 80\text{N}}{2.93\text{kg}}$$

3) Coefficient of lift given drag

Open Calculator

fx $$C_L = \frac{W_0 \cdot C_D}{F_D}$$

ex $$1.09875 = \frac{2.93\text{kg} \cdot 30}{80\text{N}}$$

4) Drag

Open Calculator

fx $$D = \frac{W_0}{C_L} / C_D$$

ex $$0.088788\text{N} = \frac{2.93\text{kg}}{1.1} / 30$$

5) Drag Coefficient for given parasite drag coefficient

Open Calculator

fx $$C_D = C_{D,e} + \left(\frac{C_L^2}{\pi \cdot e_{oswald} \cdot AR} \right)$$

ex $$29.99258 = 29.80 + \left(\frac{(1.1)^2}{\pi \cdot 0.5 \cdot 4} \right)$$

6) Drag Coefficient for given zero-lift drag coefficient

Open Calculator

fx $$C_D = C_{D,0} + \left(\frac{C_L^2}{\pi \cdot e_{oswald} \cdot AR} \right)$$

ex $$30.09258 = 29.9 + \left(\frac{(1.1)^2}{\pi \cdot 0.5 \cdot 4} \right)$$

7) Drag coefficient given Drag Force

Open Calculator

fx $$C_D = \frac{F_D}{q}$$

ex $$29.99625 = \frac{80N}{2.667Pa}$$

8) Drag coefficient given lift coefficient

Open Calculator

fx $$C_D = C_L \cdot \frac{F_D}{F_L}$$

ex $$30.07519 = 1.1 \cdot \frac{80N}{2.926N}$$

9) Drag Force Given Lift Coefficient

Open Calculator

fx $$F_D = F_L \cdot \frac{C_D}{C_L}$$

ex $$79.8N = 2.926N \cdot \frac{30}{1.1}$$

10) Drag given aerodynamic force

Open Calculator

fx $$F_D = F - F_L$$

ex $$80N = 82.926N - 2.926N$$

11) Drag given drag coefficient

Open Calculator

fx $$F_D = C_D \cdot q$$

ex $$80.01\text{N} = 30 \cdot 2.667\text{Pa}$$

12) Induced Drag for Wings having Elliptic Lift Distribution

Open Calculator

fx $$D_i = \frac{F_L^2}{3.14 \cdot q \cdot b_W^2}$$

ex $$0.004544\text{N} = \frac{(2.926\text{N})^2}{3.14 \cdot 2.667\text{Pa} \cdot (15\text{m})^2}$$

13) Induced Drag Given Span Efficiency Factor

Open Calculator

fx $$D_i = C_D \cdot \rho \cdot v^2 \cdot \frac{S_{ref}}{2}$$

ex $$0.004574\text{N} = 30 \cdot 0.00001\text{kg/m}^3 \cdot (2.45\text{m/s})^2 \cdot \frac{5.08\text{m}^2}{2}$$

14) Lift coefficient given drag coefficient

Open Calculator

fx $$C_L = \frac{F_L}{F_D} \cdot C_D$$

ex $$1.09725 = \frac{2.926\text{N}}{80\text{N}} \cdot 30$$

15) Lift coefficient given Lift Force

Open Calculator

fx $$C_L = \frac{F_L}{q}$$

ex $$1.097113 = \frac{2.926\text{N}}{2.667\text{Pa}}$$

16) Lift given aerodynamic force

Open Calculator

fx $$F_L = F - F_D$$

ex $$2.926\text{N} = 82.926\text{N} - 80\text{N}$$

17) Lift given drag coefficient

Open Calculator

fx $$F_L = \frac{C_L}{C_D} \cdot F_D$$

ex $$2.933333\text{N} = \frac{1.1}{30} \cdot 80\text{N}$$

18) Lift given induced drag

Open Calculator

fx $$F_L = \sqrt{D_i \cdot 3.14 \cdot q \cdot b_W^2}$$

ex $$2.926084\text{N} = \sqrt{0.004544\text{N} \cdot 3.14 \cdot 2.667\text{Pa} \cdot (15\text{m})^2}$$

19) Lift given Lift Coefficient

Open Calculator

fx $$F_L = C_L \cdot q$$

ex $$2.9337\text{N} = 1.1 \cdot 2.667\text{Pa}$$

20) Modern Lift Equation

Open Calculator

fx $$L = \frac{C_L \cdot \rho_{air} \cdot S \cdot u_f^2}{2}$$

ex $$2231.46\text{N} = \frac{1.1 \cdot 1.225\text{kg/m}^3 \cdot 23\text{m}^2 \cdot (12\text{m/s})^2}{2}$$

21) Parasite Drag Coefficient at zero lift

Open Calculator

fx $$C_{D,0} = C_D - C_{D,i}$$

ex $$29.81 = 30 - 0.19$$

Variables Used

- **AR** Aspect Ratio of a Wing
- b_W Lateral Plane Span *(Meter)*
- C_D Drag Coefficient
- $C_{D,0}$ Zero-Lift Drag Coefficient
- $C_{D,e}$ Parasite Drag coefficient
- $C_{D,i}$ Coefficient of Drag due to Lift
- C_L Lift Coefficient
- **D** Drag *(Newton)*
- D_i Induced Drag *(Newton)*
- e_{oswald} Oswald Efficiency Factor
- **F** Aerodynamic Force *(Newton)*
- F_D Drag Force *(Newton)*
- F_L Lift Force *(Newton)*
- **L** Lift on Airfoil *(Newton)*
- **q** Dynamic Pressure *(Pascal)*
- **S** Aircraft Gross Wing Area *(Square Meter)*
- S_{ref} Reference Area *(Square Meter)*
- u_f Fluid Velocity *(Meter per Second)*
- **v** Velocity *(Meter per Second)*
- W_0 Gross Weight *(Kilogram)*
- **ρ** Density of Material *(Kilogram per Cubic Meter)*
- ρ_{air} Air Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- 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: **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: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

Check other formula lists

- **Atmosphere and Gas Properties Formulas**
- **Lift and Drag Polar Formulas**

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