

Important Lift and Drag Polar Formulas PDF



Formulas Examples with Units

List of 21 Important Lift and Drag Polar Formulas

1) Coefficient of Drag due to lift Formula ↻

Formula

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

Example

$$0.1926 = \frac{1.1^2}{3.1416 \cdot 0.5 \cdot 4}$$

Evaluate Formula ↻

2) Coefficient of drag given drag Formula ↻

Formula

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

Example with Units

$$30.0341 = \frac{1.1 \cdot 80 \text{ N}}{2.93 \text{ kg}}$$

Evaluate Formula ↻

3) Coefficient of lift given drag Formula ↻

Formula

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

Example with Units

$$1.0988 = \frac{2.93 \text{ kg} \cdot 30}{80 \text{ N}}$$

Evaluate Formula ↻

4) Drag Formula ↻

Formula

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

Example with Units

$$0.0888 \text{ N} = \frac{2.93 \text{ kg}}{1.1} / 30$$

Evaluate Formula ↻

5) Drag Coefficient for given parasite drag coefficient Formula ↻

Formula

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

Example

$$29.9926 = 29.80 + \left(\frac{1.1^2}{3.1416 \cdot 0.5 \cdot 4} \right)$$

Evaluate Formula ↻



6) Drag Coefficient for given zero-lift drag coefficient Formula ↻

Formula

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

Example

$$30.0926 = 29.9 + \left(\frac{1.1^2}{3.1416 \cdot 0.5 \cdot 4} \right)$$

Evaluate Formula ↻

7) Drag coefficient given Drag Force Formula ↻

Formula

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

Example with Units

$$29.9963 = \frac{80 \text{ N}}{2.667 \text{ Pa}}$$

Evaluate Formula ↻

8) Drag coefficient given lift coefficient Formula ↻

Formula

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

Example with Units

$$30.0752 = 1.1 \cdot \frac{80 \text{ N}}{2.926 \text{ N}}$$

Evaluate Formula ↻

9) Drag Force Given Lift Coefficient Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻

10) Drag given aerodynamic force Formula ↻

Formula

$$F_D = F - F_L$$

Example with Units

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

Evaluate Formula ↻

11) Drag given drag coefficient Formula ↻

Formula

$$F_D = C_D \cdot q$$

Example with Units

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

Evaluate Formula ↻

12) Induced Drag for Wings having Elliptic Lift Distribution Formula ↻

Formula

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

Example with Units

$$0.0045 \text{ N} = \frac{2.926 \text{ N}^2}{3.14 \cdot 2.667 \text{ Pa} \cdot 15 \text{ m}^2}$$

Evaluate Formula ↻



13) Induced Drag Given Span Efficiency Factor Formula

Formula

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

Example with Units

$$0.0046 \text{ N} = 30 \cdot 0.00001 \text{ kg/m}^3 \cdot 2.45 \text{ m/s}^2 \cdot \frac{5.08 \text{ m}^2}{2}$$

Evaluate Formula 

14) Lift coefficient given drag coefficient Formula

Formula

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

Example with Units

$$1.0972 = \frac{2.926 \text{ N}}{80 \text{ N}} \cdot 30$$

Evaluate Formula 

15) Lift coefficient given Lift Force Formula

Formula

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

Example with Units

$$1.0971 = \frac{2.926 \text{ N}}{2.667 \text{ Pa}}$$

Evaluate Formula 

16) Lift given aerodynamic force Formula

Formula

$$F_L = F - F_D$$

Example with Units

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

Evaluate Formula 

17) Lift given drag coefficient Formula

Formula

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

Example with Units

$$2.9333 \text{ N} = \frac{1.1}{30} \cdot 80 \text{ N}$$

Evaluate Formula 

18) Lift given induced drag Formula

Formula

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

Example with Units

$$2.9261 \text{ N} = \sqrt{0.004544 \text{ N} \cdot 3.14 \cdot 2.667 \text{ Pa} \cdot 15 \text{ m}^2}$$

Evaluate Formula 

19) Lift given Lift Coefficient Formula

Formula

$$F_L = C_L \cdot q$$

Example with Units

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

Evaluate Formula 

20) Modern Lift Equation Formula

Formula

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

Example with Units

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

Evaluate Formula 



21) Parasite Drag Coefficient at zero lift Formula

Formula

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

Example

$$29.81 = 30 - 0.19$$








Evaluate Formula 



Variables used in list of Lift and Drag Polar Formulas above

- **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)
- **W₀** Gross Weight (Kilogram)
- **ρ** Density of Material (Kilogram per Cubic Meter)
- **ρ_{air}** Air Density (Kilogram per Cubic Meter)

Constants, Functions, Measurements used in list of Lift and Drag Polar Formulas above

- **constant(s):** π ,
3.14159265358979323846264338327950288
Archimedes' constant
- **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: 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 



Download other Important Introduction and Governing Equations PDFs

- **Important Aircraft Dynamics Nomenclature Formulas** 
- **Important Atmosphere and Gas Properties Formulas** 
- **Important Lift and Drag Polar Formulas** 
- **Important Preliminary Aerodynamics Formulas** 

Try our Unique Visual Calculators

-  **Percentage change** 
-  **LCM of two numbers** 
-  **Proper fraction** 

Please **SHARE** this PDF with someone who needs it!

This PDF can be downloaded in these languages

[English](#) [Spanish](#) [French](#) [German](#) [Russian](#) [Italian](#) [Portuguese](#) [Polish](#) [Dutch](#)

7/9/2024 | 6:00:23 AM UTC

