

# Important Aerodynamic Design Formulas PDF



**Formulas  
Examples  
with Units**

## List of 13 Important Aerodynamic Design Formulas

### 1) Aerofoil Thickness for 4 Digit Series Formula ↻

Formula

Evaluate Formula ↻

$$y_t = \frac{t \cdot \left( 0.2969 \cdot x^{0.5} - 0.1260 \cdot x - 0.3516 \cdot x^2 + 0.2843 \cdot x^3 - 0.1015 \cdot x^4 \right)}{0.2}$$

Example with Units

$$0.0662 \text{ m} = \frac{0.15 \text{ m} \cdot \left( 0.2969 \cdot 0.5^{0.5} - 0.1260 \cdot 0.5 - 0.3516 \cdot 0.5^2 + 0.2843 \cdot 0.5^3 - 0.1015 \cdot 0.5^4 \right)}{0.2}$$

### 2) Aspect Ratio of Wing Formula ↻

Formula

Example with Units

Evaluate Formula ↻

$$AR_w = \frac{b_w^2}{S_{wet}}$$

$$23.0404 = \frac{15.3 \text{ m}^2}{10.16 \text{ m}^2}$$

### 3) Equivalent Parasite Drag Area Formula ↻

Formula

Example with Units

Evaluate Formula ↻

$$A = \Phi_f \cdot \mu_f \cdot S_{wet}$$

$$10.9655 \text{ m}^2 = 1.499 \cdot 0.72 \cdot 10.16 \text{ m}^2$$

### 4) Form Factor given Flat Plate Area Formula ↻

Formula

Example with Units

Evaluate Formula ↻

$$\Phi_f = \frac{A}{\mu_f \cdot S_{wet}}$$

$$1.4996 = \frac{10.97 \text{ m}^2}{0.72 \cdot 10.16 \text{ m}^2}$$

### 5) Gross Weight given Drag Formula ↻

Formula

Example with Units

Evaluate Formula ↻

$$W_0 = F_D \cdot \left( \frac{C_L}{C_D} \right)$$

$$58.6667 \text{ kg} = 80 \text{ N} \cdot \left( \frac{1.1}{1.5} \right)$$



## 6) Skin Friction Coefficient given Flat Plate Area Formula

Formula

$$\mu_f = \frac{A}{\Phi_f \cdot S_{wet}}$$

Example with Units

$$0.7203 = \frac{10.97 \text{ m}^2}{1.499 \cdot 10.16 \text{ m}^2}$$

Evaluate Formula 

## 7) Span given Aspect Ratio Formula

Formula

$$b_W = \sqrt{AR_W \cdot S_{wet}}$$

Example with Units

$$15.2999 \text{ m} = \sqrt{23.04 \cdot 10.16 \text{ m}^2}$$

Evaluate Formula 

## 8) Span given Induced Drag Formula

Formula

$$b_W = \frac{F_L}{\sqrt{\pi \cdot D_i \cdot q}}$$

Example with Units

$$15.0786 \text{ m} = \frac{110 \text{ N}}{\sqrt{3.1416 \cdot 8.47 \text{ N} \cdot 2 \text{ Pa}}}$$

Evaluate Formula 

## 9) Taper Ratio of Airfoil Formula

Formula

$$\Lambda = \frac{C_{tip}}{C_{root}}$$

Example with Units

$$0.4286 = \frac{3 \text{ m}}{7 \text{ m}}$$

Evaluate Formula 

## 10) Thrust-to-Weight Ratio given Minimum Coefficient of Drag Formula

Formula

$$TW = \left( \frac{C_{Dmin}}{W_S} + k \cdot \left( \frac{n}{q} \right)^2 \cdot W_S \right) \cdot q$$

Example with Units

$$0.641 = \left( \frac{1.3}{5 \text{ Pa}} + 0.04 \cdot \left( \frac{1.10}{2 \text{ Pa}} \right)^2 \cdot 5 \text{ Pa} \right) \cdot 2 \text{ Pa}$$

Evaluate Formula 

## 11) Tip Speed Ratio with Blade Number Formula

Formula

$$\lambda = \frac{4 \cdot \pi}{N}$$

Example

$$1.1424 = \frac{4 \cdot 3.1416}{11}$$

Evaluate Formula 

## 12) Wetted Area given Aspect Ratio Formula

Formula

$$S_{wet} = \frac{b_W^2}{AR_W}$$

Example with Units

$$10.1602 \text{ m}^2 = \frac{15.3 \text{ m}^2}{23.04}$$

Evaluate Formula 



### 13) Wetted Area given Flat Plate Area Formula

Formula

$$S_{\text{wet}} = \frac{A}{\Phi_f \cdot \mu_f}$$

Example with Units

$$10.1642 \text{ m}^2 = \frac{10.97 \text{ m}^2}{1.499 \cdot 0.72}$$

Evaluate Formula 



## Variables used in list of Aerodynamic Design Formulas above

- **A** Flat Plate Area (Square Meter)
- **AR<sub>w</sub>** Aspect Ratio in Lateral Plane
- **b<sub>w</sub>** Lateral Plane Span (Meter)
- **C<sub>D</sub>** Drag Coefficient
- **C<sub>Dmin</sub>** Minimum Drag Coefficient
- **C<sub>L</sub>** Lift Coefficient
- **C<sub>root</sub>** Root Chord Length (Meter)
- **C<sub>tip</sub>** Tip Chord Length (Meter)
- **D<sub>i</sub>** Induced Drag (Newton)
- **F<sub>D</sub>** Drag Force (Newton)
- **F<sub>L</sub>** Lift Force (Newton)
- **k** Lift Induced Drag Constant
- **n** Load Factor
- **N** Number of Blades
- **q** Dynamic Pressure (Pascal)
- **S<sub>wet</sub>** Aircraft Wetted Area (Square Meter)
- **t** Maximum Thickness (Meter)
- **TW** Thrust-to-Weight Ratio
- **W<sub>0</sub>** Gross Weight (Kilogram)
- **W<sub>S</sub>** Wing Loading (Pascal)
- **x** Position along the Chord
- **y<sub>t</sub>** Half Thickness (Meter)
- **λ** Tip Speed Ratio
- **Λ** Taper Ratio
- **μ<sub>f</sub>** Skin Friction Coefficient
- **Φ<sub>f</sub>** Form Factor Drag

## Constants, Functions, Measurements used in list of Aerodynamic Design Formulas above

- **constant(s):** pi, 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 (m<sup>2</sup>)  
*Area Unit Conversion* ↻
- **Measurement: Pressure** in Pascal (Pa)  
*Pressure Unit Conversion* ↻
- **Measurement: Force** in Newton (N)  
*Force Unit Conversion* ↻



## Download other Important Conceptual Design PDFs

- [Important Aerodynamic Design Formulas](#) 
- [Important Design Process Formulas](#) 
- [Important Structural Design Formulas](#) 
- [Important Weight Estimation Formulas](#) 

## Try our Unique Visual Calculators

-  [Percentage of number](#) 
-  [LCM calculator](#) 
-  [Simple 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 | 6:05:26 AM UTC

