Important Newtonian Flow Formulas PDF

Formulas
Examples
with Units

List of 14
Important Newtonian Flow Formulas

1) Coefficient of Drag Equation with Angle of Attack Formula

Evaluate Formula

Formula

$$C_D = 2 \cdot \left(\sin\left(\alpha \right) \right)^3$$

Example with Units

$$0.0137 = 2 \cdot \left(\sin\left(10.94° \right) \right)^3$$

2) Coefficient of Drag Equation with Coefficient of Normal Force Formula

Evaluate Formula

Formula

$$C_D = \mu \cdot \sin\left(\alpha \right)$$

Example with Units

$$0.0854 = 0.45 \cdot \sin\left(10.94° \right)$$

3) Coefficient of Lift Equation with Angle of Attack Formula

Evaluate Formula

Formula

$$C_L = 2 \cdot \left(\sin\left(\alpha \right) \right)^2 \cdot \cos\left(\alpha \right)$$

Example with Units

$$0.0707 = 2 \cdot \left(\sin\left(10.94° \right) \right)^2 \cdot \cos\left(10.94° \right)$$

4) Coefficient of Lift Equation with Coefficient of Normal Force Formula

Evaluate Formula

Formula

$$C_L = \mu \cdot \cos\left(\alpha \right)$$

Example with Units

$$0.4418 = 0.45 \cdot \cos\left(10.94° \right)$$

5) Drag Force with Angle of Attack Formula

Evaluate Formula

Formula

$$F_D = \frac{F_L}{\cot\left(\alpha \right)}$$

Example with Units

$$77.4142\,\text{N} = \frac{400.5\,\text{N}}{\cot\left(10.94° \right)}$$

6) Exact Normal Shock Wave Maximum Coefficient of Pressure Formula

Evaluate Formula

Formula

$$C_{p,max} = \frac{2}{Y \cdot M^2} \cdot \left(\frac{P_T}{P} - 1 \right)$$

Example with Units

$$2.9102 = \frac{2}{1.6 \cdot 8^2} \cdot \left(\frac{120000\,\text{Pa}}{800\,\text{Pa}} - 1 \right)$$

7) Force Exerted on Surface given Static Pressure Formula

Evaluate Formula

Formula

$$F = A \cdot \left(p - p_{static} \right)$$

Example with Units

$$2.52\,\text{N} = 2.1\,\text{m}^2 \cdot \left(251.2\,\text{Pa} - 250\,\text{Pa} \right)$$

8) Lift Force with Angle of Attack Formula

Evaluate Formula

Formula

$$F_L = F_D \cdot \cot(\alpha)$$

Example with Units

$$413.8778\,\text{N} = 80\,\text{N} \cdot \cot(10.94°)$$

9) Mass Flux Incident on Surface Area Formula

Evaluate Formula

Formula

$$G = \rho \cdot v \cdot A \cdot \sin(\theta)$$

Example with Units

$$2.4068\,\text{kg/s/m}^2 = 0.11\,\text{kg/m}^3 \cdot 60\,\text{m/s} \cdot 2.1\,\text{m}^2 \cdot \sin(10°)$$

10) Maximum Pressure Coefficient Formula

Evaluate Formula

Formula

$$C_{p,max} = \frac{P_T - P}{0.5 \cdot \rho \cdot V_\infty^2}$$

Example with Units

$$225.6635 = \frac{120000\,\text{Pa} - 800\,\text{Pa}}{0.5 \cdot 0.11\,\text{kg/m}^3 \cdot 98\,\text{m/s}^2}$$

11) Modified Newtonian Law Formula

Evaluate Formula

Formula

$$C_p = C_{p,max} \cdot (\sin(\theta))^2$$

Example with Units

$$0.0181 = 0.60 \cdot (\sin(10°))^2$$

12) Pressure Coefficient for Slender 2D Bodies Formula

Evaluate Formula

Formula

$$C_p = 2 \cdot \left((\theta)^2 + k_{curvature} \cdot y \right)$$

Example with Units

$$0.5409 = 2 \cdot \left((10°)^2 + 0.2\,\text{m} \cdot 1.2\,\text{m} \right)$$

13) Pressure Coefficient for Slender Bodies of Revolution Formula

Evaluate Formula

Formula

$$C_p = 2 \cdot (\theta)^2 + k_{curvature} \cdot y$$

Example with Units

$$0.3009 = 2 \cdot (10°)^2 + 0.2\,\text{m} \cdot 1.2\,\text{m}$$

14) Time Rate of Change of Momentum of Mass Flux Formula

Evaluate Formula

Formula

$$F = \rho_{Fluid} \cdot u_{Fluid}^2 \cdot A \cdot (\sin(\theta))^2$$

Example with Units

$$1.3535\,\text{N} = 9.5\,\text{kg/m}^3 \cdot 1.5\,\text{m/s}^2 \cdot 2.1\,\text{m}^2 \cdot (\sin(10°))^2$$

Variables used in list of Newtonian Flow Formulas above

- **A** Area *(Square Meter)*
- C_D Drag Coefficient
- C_L Lift Coefficient
- C_p Pressure Coefficient
- $C_{p,max}$ Maximum Pressure Coefficient
- **F** Force *(Newton)*
- F_D Drag Force *(Newton)*
- F_L Lift Force *(Newton)*
- **G** Mass Flux(g) *(Kilogram per Second per Square Meter)*
- $k_{curvature}$ Curvature of Surface *(Meter)*
- **M** Mach Number
- **p** Surface Pressure *(Pascal)*
- **P** Pressure *(Pascal)*
- p_{static} Static Pressure *(Pascal)*
- P_T Total Pressure *(Pascal)*
- u_{Fluid} Fluid Velocity *(Meter per Second)*
- **v** Velocity *(Meter per Second)*
- V_∞ Freestream Velocity *(Meter per Second)*
- **y** Distance of Point from Centroidal Axis *(Meter)*
- **Y** Specific Heat Ratio
- **α** Angle of Attack *(Degree)*
- **θ** Angle of Inclination *(Degree)*
- **μ** Coefficient of Force
- **ρ** Density of Material *(Kilogram per Cubic Meter)*
- ρ_{Fluid} Density of Fluid *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Newtonian Flow Formulas above

- Functions: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Functions: **cot**, cot(Angle)
  Cotangent is a trigonometric function that is defined as the ratio of the adjacent side to the opposite side in a right triangle.
- Functions: **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.
- Measurement: **Length** in Meter (m)
  Length 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: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Mass Flux** in Kilogram per Second per Square Meter (kg/s/m²)
  Mass Flux Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

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