Important Fluid Force Formulas PDF

Formulas
Examples
with Units

List of 14
Important Fluid Force Formulas

1) Applications of Fluid Force Formulas

1.1) Distance between Plates given Dynamic Viscosity of Fluid Formula

Evaluate Formula

Formula

$$y = \mu \cdot \frac{u}{\tau}$$

Example with Units

$$0.02\,\text{m} = 0.0796\,\text{Pa*s} \cdot \frac{14.7\,\text{m/s}}{58.506\,\text{Pa}}$$

1.2) Dynamic Viscosity of Fluids Formula

Evaluate Formula

Formula

$$\mu_d = \frac{\tau \cdot y}{u}$$

Example with Units

$$0.796\,\text{P} = \frac{58.506\,\text{Pa} \cdot 0.02\,\text{m}}{14.7\,\text{m/s}}$$

1.3) Dynamic Viscosity of Gases Formula

Evaluate Formula

Formula

$$\mu = \frac{a \cdot T^{\frac{1}{2}}}{1 + \frac{b}{T}}$$

Example with Units

$$0.0796\,\text{Pa*s} = \frac{0.008 \cdot 293\,\text{K}^{\frac{1}{2}}}{1 + \frac{211.053}{293\,\text{K}}}$$

1.4) Dynamic Viscosity of Liquids Formula

Evaluate Formula

Formula

$$\mu = A \cdot e^{\frac{B}{T}}$$

Example with Units

$$0.0796\,\text{Pa*s} = 0.04785 \cdot e^{\frac{149.12}{293\,\text{K}}}$$

1.5) Friction Factor given Frictional Velocity Formula

Evaluate Formula

Formula

$$f = 8 \cdot \left(\frac{V_f}{v_m}\right)^2$$

Example with Units

$$0.025 = 8 \cdot \left(\frac{0.9972\,\text{m/s}}{17.84\,\text{m/s}}\right)^2$$

1.6) Shear Stress using Dynamic Viscosity of Fluid Formula

Evaluate Formula

Formula

$$\tau = \mu \cdot \frac{u}{y}$$

Example with Units

$$58.506\,\text{Pa} = 0.0796\,\text{Pa*s} \cdot \frac{14.7\,\text{m/s}}{0.02\,\text{m}}$$

1.7) Torque given Thickness of Oil Formula

Evaluate Formula

Formula

$$T_d = \frac{\pi \cdot \mu \cdot \omega \cdot \left(r_o^{\,4} - r_i^{\,4} \right)}{2 \cdot h \cdot \sin\left(\theta \right)}$$

Example with Units

$$19.5055\,\text{N*m} = \frac{3.1416 \cdot 0.0796\,\text{Pa*s} \cdot 2\,\text{rad/s} \cdot \left(7\,\text{m}^{\,4} - 4\,\text{m}^{\,4} \right)}{2 \cdot 55\,\text{m} \cdot \sin\left(30° \right)}$$

1.8) Total Hydrostatic Force Formula

Evaluate Formula

Formula

$$F_h = \gamma \cdot h_c \cdot A_s$$

Example with Units

$$844.2878\,\text{N} = 7357.5\,\text{N/m}^3 \cdot 0.32\,\text{m} \cdot 0.3586\,\text{m}^2$$

1.9) Total Surface Area of Object Submerged in Liquid Formula

Evaluate Formula

Formula

$$A_s = \frac{F_h}{\gamma \cdot h_c}$$

Example with Units

$$0.3586\,\text{m}^2 = \frac{844.288\,\text{N}}{7357.5\,\text{N/m}^3 \cdot 0.32\,\text{m}}$$

2) Dynamic Force Equations Formulas

2.1) Body Force Formula

Evaluate Formula

Formula

$$F_b = \frac{F_m}{V_m}$$

Example with Units

$$9.81\,\text{N/m}^3 = \frac{9.3195\,\text{N}}{0.95\,\text{m}^3}$$

2.2) Force in Direction of Jet Striking Stationary Vertical Plate Formula

Evaluate Formula

Formula

$$F = \rho \cdot A_c \cdot v_j^{\,2}$$

Example with Units

$$64225.28\,\text{N} = 980\,\text{kg/m}^3 \cdot 0.025\,\text{m}^2 \cdot 51.2\,\text{m/s}^{\,2}$$

2.3) Inertial Force per Unit Area Formula

Evaluate Formula

Formula

$$F_i = v^{\,2} \cdot \rho$$

Example with Units

$$141120\,\text{N/m}^2 = 12\,\text{m/s}^{\,2} \cdot 980\,\text{kg/m}^3$$

2.4) Stokes Force Formula

Evaluate Formula

Formula

$$F_d = 6 \cdot \pi \cdot R \cdot \mu \cdot v_f$$

Example with Units

$$53.04\,\text{N} = 6 \cdot 3.1416 \cdot 1.01\,\text{m} \cdot 0.0796\,\text{Pa*s} \cdot 35\,\text{m/s}$$

2.5) Upthrust Force Formula

Evaluate Formula

Formula

$$F_t = V_i \cdot [g] \cdot \rho$$

Example with Units

$$11532.6204\,\text{N} = 1.2\,\text{m}^3 \cdot 9.8066\,\text{m/s}^2 \cdot 980\,\text{kg/m}^3$$

Variables used in list of Fluid Force Formulas above

- **A** Experimental Constant 'A'
- **a** Sutherland Experimental Constant 'a'
- A_c Cross Sectional Area of Jet *(Square Meter)*
- A_s Surface Area of The Object *(Square Meter)*
- **b** Sutherland Experimental Constant 'b'
- **B** Experimental Constant 'B'
- **f** Darcy's Friction Factor
- **F** Force Extracted by The Jet on Vertical Plate *(Newton)*
- F_b Body Force *(Newton per Cubic Meter)*
- F_d Stokes' Drag *(Newton)*
- F_h Hydrostatic Force *(Newton)*
- F_i Inertial Force Per Unit Area *(Newton per Square Meter)*
- F_m Force Acting on Mass *(Newton)*
- F_t Upthrust Force *(Newton)*
- **h** Thickness of Oil *(Meter)*
- h_c Vertical Distance From Centroid *(Meter)*
- **R** Radius of The Spherical Object *(Meter)*
- r_i Inner Radius of Disc *(Meter)*
- r_o Outer Radius of Disc *(Meter)*
- **T** Absolute Temperature of Fluid *(Kelvin)*
- T_d Torque Exerted on Disc *(Newton Meter)*
- **u** Velocity of Moving Plate *(Meter per Second)*
- **v** Speed of The Fluid *(Meter per Second)*
- V_f Friction Velocity *(Meter per Second)*
- V_i Volume Immersed *(Cubic Meter)*
- V_m Volume Occupied by Mass *(Cubic Meter)*
- **y** Distance Between Plates Carrying Fluid *(Meter)*
- **γ** Specific Weight of The Fluid *(Newton per Cubic Meter)*
- **θ** Tilt Angle *(Degree)*
- **μ** Dynamic Viscosity Fluid *(Pascal Second)*

Constants, Functions, Measurements used in list of Fluid Force Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[g]**, 9.80665 *Gravitational acceleration on Earth*
- constant(s): **e**, 2.71828182845904523536028747135266249 *Napier's constant*
- 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: **Temperature** in Kelvin (K) *Temperature Unit Conversion*
- Measurement: **Volume** in Cubic Meter (m^3) *Volume Unit Conversion*
- Measurement: **Area** in Square Meter (m^2) *Area Unit Conversion*
- Measurement: **Pressure** in Newton per Square Meter (N/m^2) *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: **Dynamic Viscosity** in Pascal Second (Pa*s), Poise (P) *Dynamic Viscosity Unit Conversion*
- Measurement: **Angular Velocity** in Radian per Second (rad/s) *Angular Velocity Unit Conversion*
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3) *Density Unit Conversion*
- Measurement: **Torque** in Newton Meter (N*m) *Torque Unit Conversion*

- μ_d Dynamic Viscosity of Fluid *(Poise)*
- v_f Velocity of Fluid *(Meter per Second)*
- v_j Velocity of Liquid Jet *(Meter per Second)*
- v_m Mean Velocity *(Meter per Second)*
- ρ Mass Density of Fluid *(Kilogram per Cubic Meter)*
- ω Angular Velocity *(Radian per Second)*
- τ Shear Stress on Lower Surface *(Pascal)*

- Measurement: **Specific Weight** in Newton per Cubic Meter (N/m³)
  Specific Weight Unit Conversion
- Measurement: **Pressure Gradient** in Newton per Cubic Meter (N/m³)
  Pressure Gradient Unit Conversion
- Measurement: **Stress** in Pascal (Pa)
  Stress Unit Conversion

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