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# Hydrostatics Formulas

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# List of 28 Hydrostatics Formulas

## Hydrostatics

### 1) Coordinate measured Downward from Top given Effective Tension

$$\text{fx } z = - \left( \frac{T_e}{(\rho_s - \rho_m) \cdot [g] \cdot A_s} - L \right)$$

Open Calculator 

$$\text{ex } 5.999994 = - \left( \frac{402.22\text{kN}}{(7750\text{kg/m}^3 - 1440\text{kg/m}^3) \cdot [g] \cdot 0.65\text{m}^2} - 16\text{m} \right)$$

### 2) Coordinate measured Downward from Top given Tension on Vertical Drill String

$$\text{fx } z = - \left( \left( \frac{T}{\rho_s \cdot [g] \cdot A_s} \right) - L \right)$$

Open Calculator 

$$\text{ex } 6 = - \left( \left( \frac{494.01\text{kN}}{7750\text{kg/m}^3 \cdot [g] \cdot 0.65\text{m}^2} \right) - 16\text{m} \right)$$

### 3) Cross Section Area of Steel given Effective Tension

$$\text{fx } A_s = \frac{T_e}{(\rho_s - \rho_m) \cdot [g] \cdot (L - z)}$$

Open Calculator 

$$\text{ex } 0.65\text{m}^2 = \frac{402.22\text{kN}}{(7750\text{kg/m}^3 - 1440\text{kg/m}^3) \cdot [g] \cdot (16\text{m} - 6)}$$



#### 4) Cross Section Area of Steel in Pipe given Tension on Vertical Drill String



$$fx \quad A_s = \frac{T}{\rho_s \cdot [g] \cdot (L - z)}$$

[Open Calculator](#)

$$ex \quad 0.65m^2 = \frac{494.01kN}{7750kg/m^3 \cdot [g] \cdot (16m - 6)}$$

#### 5) Effective Tension given Buoyant Force acts in Direction opposite to Gravity Force



$$fx \quad T_e = (\rho_s - \rho_m) \cdot [g] \cdot A_s \cdot (L - z)$$

[Open Calculator](#)

$$ex \quad 402.2197kN = (7750kg/m^3 - 1440kg/m^3) \cdot [g] \cdot 0.65m^2 \cdot (16m - 6)$$

#### 6) Length of Pipe Hanging given Lower Section of Drill String Length in Compression



$$fx \quad L = \frac{L_c \cdot \rho_s}{\rho_m}$$

[Open Calculator](#)

$$ex \quad 15.98438m = \frac{2.97 \cdot 7750kg/m^3}{1440kg/m^3}$$



### 7) Length of Pipe Hanging in Well given Effective Tension

$$fx \quad L = \left( \left( \frac{T_e}{(\rho_s - \rho_m) \cdot [g] \cdot A_s} + z \right) \right)$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$ex \quad 16.00001m = \left( \left( \frac{402.22kN}{(7750kg/m^3 - 1440kg/m^3) \cdot [g] \cdot 0.65m^2} + 6 \right) \right)$$

### 8) Length of Pipe Hanging in Well given Tension on Vertical Drill String

$$fx \quad L = \left( \frac{T}{\rho_s \cdot [g] \cdot A_s} \right) + z$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 16m = \left( \frac{494.01kN}{7750kg/m^3 \cdot [g] \cdot 0.65m^2} \right) + 6$$

### 9) Length of Pipe Hanging in Well given Vertical Force at Bottom End of Drill String

$$fx \quad L = \frac{f_z}{\rho_m \cdot [g] \cdot A_s}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 15.99952m = \frac{146.86kN}{1440kg/m^3 \cdot [g] \cdot 0.65m^2}$$



## 10) Lower Section of Drill String Length that is in Compression

$$fx \quad L_c = \frac{\rho_m \cdot L}{\rho_s}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$ex \quad 2.972903 = \frac{1440\text{kg/m}^3 \cdot 16\text{m}}{7750\text{kg/m}^3}$$

## 11) Mass Density of Drilling Mud for Lower Section of Drill String Length in Compression

$$fx \quad \rho_m = \frac{L_c \cdot \rho_s}{L}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$ex \quad 1438.594\text{kg/m}^3 = \frac{2.97 \cdot 7750\text{kg/m}^3}{16\text{m}}$$

## 12) Mass Density of Drilling Mud given Vertical Force at Bottom End of Drill String

$$fx \quad \rho_m = \frac{f_z}{[g] \cdot A_s \cdot L}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$ex \quad 1439.957\text{kg/m}^3 = \frac{146.86\text{kN}}{[g] \cdot 0.65\text{m}^2 \cdot 16\text{m}}$$



### 13) Mass Density of Drilling Mud when Buoyant Force acts in Direction opposite to Gravity Force

$$\text{fx } \rho_m = - \left( \left( \frac{T_e}{[g] \cdot A_s \cdot (L - z)} - \rho_s \right) \right)$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

$$\text{ex } 1439.996\text{kg/m}^3 = - \left( \left( \frac{402.22\text{kN}}{[g] \cdot 0.65\text{m}^2 \cdot (16\text{m} - 6)} - 7750\text{kg/m}^3 \right) \right)$$

### 14) Mass Density of Steel for Lower Section of Drill String Length in Compression

$$\text{fx } \rho_s = \frac{\rho_m \cdot L}{L_c}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$\text{ex } 7757.576\text{kg/m}^3 = \frac{1440\text{kg/m}^3 \cdot 16\text{m}}{2.97}$$

### 15) Mass Density of Steel for Tension on Vertical Drill String

$$\text{fx } \rho_s = \frac{T}{[g] \cdot A_s \cdot (L - z)}$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60\_img.jpg\)](#)

$$\text{ex } 7750\text{kg/m}^3 = \frac{494.01\text{kN}}{[g] \cdot 0.65\text{m}^2 \cdot (16\text{m} - 6)}$$



## 16) Mass Density of Steel when Buoyant Force acts in Direction opposite to Gravity Force

$$fx \quad \rho_s = \left( \frac{T_e}{[g] \cdot A_s \cdot (L - z)} + \rho_m \right)$$

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)

$$ex \quad 7750.004 \text{kg/m}^3 = \left( \frac{402.22 \text{kN}}{[g] \cdot 0.65 \text{m}^2 \cdot (16 \text{m} - 6)} + 1440 \text{kg/m}^3 \right)$$

## 17) Tension on Vertical Drill String

$$fx \quad T = \rho_s \cdot [g] \cdot A_s \cdot (L - z)$$

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5\_img.jpg\)](#)

$$ex \quad 494.01 \text{kN} = 7750 \text{kg/m}^3 \cdot [g] \cdot 0.65 \text{m}^2 \cdot (16 \text{m} - 6)$$

## 18) Vertical Force at Bottom End of Drill String

$$fx \quad f_z = \rho_m \cdot [g] \cdot A_s \cdot L$$

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2\_img.jpg\)](#)

$$ex \quad 146.8644 \text{kN} = 1440 \text{kg/m}^3 \cdot [g] \cdot 0.65 \text{m}^2 \cdot 16 \text{m}$$

## Static Loads

## Archimedes Law and Buoyancy

## 19) Buoyant Force of Body Submerged in Fluid

$$fx \quad F_B = \nabla \cdot \rho \cdot [g]$$

[Open Calculator !\[\]\(df47d6bec273bbb8b349135fff3a20f7\_img.jpg\)](#)

$$ex \quad 4888.615 \text{N} = 0.5 \text{m}^3 \cdot 997 \text{kg/m}^3 \cdot [g]$$



## 20) Mass Density of Fluid for Buoyant Force Submerged in Fluid

$$\text{fx } \rho = \frac{F_B}{[g] \cdot \nabla}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107\_img.jpg\)](#)

$$\text{ex } 997\text{kg/m}^3 = \frac{4888.615\text{N}}{[g] \cdot 0.5\text{m}^3}$$

## 21) Volume of Submerged Part of Object given Buoyant Force of Body Submerged in Fluid

$$\text{fx } \nabla = \frac{F_B}{\rho \cdot [g]}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6\_img.jpg\)](#)

$$\text{ex } 0.5\text{m}^3 = \frac{4888.615\text{N}}{997\text{kg/m}^3 \cdot [g]}$$

## Drill String Buckling

## 22) Column Slenderness Ratio for Critical Buckling Load

$$\text{fx } L_{\text{cr ratio}} = \sqrt{\frac{A \cdot \pi^2 \cdot E}{P_{\text{cr}}}}$$

[Open Calculator !\[\]\(e9474ce1d70442456f8fe9c393ea149c\_img.jpg\)](#)

$$\text{ex } 160 = \sqrt{\frac{0.0688\text{m}^2 \cdot \pi^2 \cdot 2\text{E}11\text{N/m}^2}{5304.912\text{kN}}}$$






23) Critical Buckling Load [Open Calculator !\[\]\(666e09182d4cd268646ea700ea60dcdf\_img.jpg\)](#)


$$\text{fx } P_{\text{cr}} = A \cdot \left( \frac{\pi^2 \cdot E}{L_{\text{cr}}^2_{\text{ratio}}} \right)$$

$$\text{ex } 5304.912\text{kN} = 0.0688\text{m}^2 \cdot \left( \frac{\pi^2 \cdot 2\text{E}11\text{N/m}^2}{(160)^2} \right)$$

24) Cross Section Area of Column for Critical Buckling Load [Open Calculator !\[\]\(003082e50e3009141f59bd5df831749f\_img.jpg\)](#)

$$\text{fx } A = \frac{P_{\text{cr}} \cdot L_{\text{cr}}^2_{\text{ratio}}}{\pi^2 \cdot E}$$

$$\text{ex } 0.0688\text{m}^2 = \frac{5304.912\text{kN} \cdot (160)^2}{\pi^2 \cdot 2\text{E}11\text{N/m}^2}$$

25) Flow Velocity given Reynolds Number in Shorter Length of Pipe [Open Calculator !\[\]\(d3102649f02e825ddb76dc3de0190154\_img.jpg\)](#)

$$\text{fx } V_f = \frac{\text{Re} \cdot \nu}{D_p}$$

$$\text{ex } 1.119802\text{m/s} = \frac{1560 \cdot 7.25\text{St}}{1.01\text{m}}$$



## 26) Kinematic Viscosity of Fluid given Reynolds Number in Shorter Length of Pipe

$$\text{fx } v = \frac{V_f \cdot D_p}{\text{Re}}$$

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a\_img.jpg\)](#)

$$\text{ex } 7.251282\text{St} = \frac{1.12\text{m/s} \cdot 1.01\text{m}}{1560}$$

## 27) Pipe Diameter given Reynolds Number in Shorter Length of Pipe

$$\text{fx } D_p = \frac{\text{Re} \cdot v}{V_f}$$

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010\_img.jpg\)](#)

$$\text{ex } 1.009821\text{m} = \frac{1560 \cdot 7.25\text{St}}{1.12\text{m/s}}$$

## 28) Reynolds Number in Shorter Length of Pipe

$$\text{fx } \text{Re} = \frac{V_f \cdot D_p}{v}$$

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd\_img.jpg\)](#)

$$\text{ex } 1560.276 = \frac{1.12\text{m/s} \cdot 1.01\text{m}}{7.25\text{St}}$$












## Variables Used

- $\nabla$  Volume of Submerged part of Object (*Cubic Meter*)
- **A** Cross Section Area of Column (*Square Meter*)
- **A<sub>S</sub>** Cross Section Area of Steel in Pipe (*Square Meter*)
- **D<sub>p</sub>** Diameter of Pipe (*Meter*)
- **E** Elastic Modulus (*Newton per Square Meter*)
- **F<sub>B</sub>** Buoyant Force (*Newton*)
- **f<sub>Z</sub>** Vertical Force at Bottom end of Drill String (*Kilonewton*)
- **L** Length of Pipe Hanging in Well (*Meter*)
- **L<sub>C</sub>** Lower Section of Drill String Length
- **L<sub>Cratio</sub>** Column Slenderness Ratio
- **P<sub>cr</sub>** Critical Buckling Load for Drill String (*Kilonewton*)
- **Re** Reynolds Number
- **T** Tension on Vertical Drill String (*Kilonewton*)
- **T<sub>e</sub>** Effective Tension (*Kilonewton*)
- **v** Kinematic Viscosity (*Stokes*)
- **V<sub>f</sub>** Flow Velocity (*Meter per Second*)
- **z** Coordinate measured Downward from Top
- **ρ** Mass Density (*Kilogram per Cubic Meter*)
- **ρ<sub>m</sub>** Density of Drilling Mud (*Kilogram per Cubic Meter*)
- **ρ<sub>s</sub>** Mass Density of Steel (*Kilogram per Cubic Meter*)



# Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **Constant:** **[g]**, 9.80665  
*Gravitational acceleration on Earth*
- **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:** **Volume** in Cubic Meter (m<sup>3</sup>)  
*Volume Unit Conversion* 
- **Measurement:** **Area** in Square Meter (m<sup>2</sup>)  
*Area Unit Conversion* 
- **Measurement:** **Speed** in Meter per Second (m/s)  
*Speed Unit Conversion* 
- **Measurement:** **Force** in Kilonewton (kN), Newton (N)  
*Force Unit Conversion* 
- **Measurement:** **Mass Concentration** in Kilogram per Cubic Meter (kg/m<sup>3</sup>)  
*Mass Concentration Unit Conversion* 
- **Measurement:** **Kinematic Viscosity** in Stokes (St)  
*Kinematic Viscosity Unit Conversion* 
- **Measurement:** **Density** in Kilogram per Cubic Meter (kg/m<sup>3</sup>)  
*Density Unit Conversion* 
- **Measurement:** **Stress** in Newton per Square Meter (N/m<sup>2</sup>)  
*Stress Unit Conversion* 



## Check other formula lists

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