



# Laminar Flow around a Sphere Stokes' Law Formulas

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## List of 18 Laminar Flow around a Sphere Stokes' Law Formulas

### Laminar Flow around a Sphere Stokes' Law 🗗

1) Coefficient of Drag given density

$$\left| \mathbf{C}_{\mathrm{D}} = rac{24 \cdot F_{\mathrm{D}} \cdot \mu}{
ho \cdot V_{\mathrm{mean}} \cdot D_{\mathrm{S}}} 
ight|$$

Open Calculator

2) Coefficient of Drag given Drag Force

$$\mathbf{E} \mathbf{C}_{\mathrm{D}} = rac{\mathbf{F}_{\mathrm{D}}}{\mathbf{A} \cdot \mathbf{V}_{\mathrm{mean}} \cdot \mathbf{V}_{\mathrm{mean}} \cdot \mathbf{
ho} \cdot 0.5}$$

Open Calculator 🗗

$$\boxed{0.010783 = \frac{1.1 kN}{2 m^2 \cdot 10.1 m/s \cdot 10.1 m/s \cdot 1000 kg/m^3 \cdot 0.5}}$$

3) Coefficient of Drag given Reynolds Number

$$\mathrm{C_D} = rac{24}{\mathrm{Re}}$$

Open Calculator

$$0.01 = rac{24}{2400}$$





#### 4) Density of Fluid given Drag Force

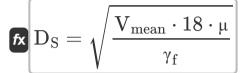
 $ho = rac{F_D}{A \cdot V_{mean} \cdot V_{mean} \cdot C_D \cdot 0.5}$ 

Open Calculator 🗗

1.1kN

ex 
$$1078.326 ext{kg/m}^3 = rac{1.1 ext{kN}}{2 ext{m}^2 \cdot 10.1 ext{m/s} \cdot 10.1 ext{m/s} \cdot 0.01 \cdot 0.5}$$

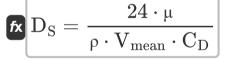
#### 5) Diameter of Sphere for given Fall Velocity



Open Calculator

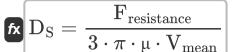
ex 
$$0.013749 \text{m} = \sqrt{\frac{10.1 \text{m/s} \cdot 18 \cdot 10.2 \text{P}}{9.81 \text{kN/m}^3}}$$

#### 6) Diameter of Sphere given Coefficient of Drag





## 7) Diameter of Sphere given Resistance Force on Spherical Surface



Open Calculator

$$= \frac{0.97 \text{kN}}{3 \cdot \pi \cdot 10.2 \text{P} \cdot 10.1 \text{m/s}}$$

#### 8) Drag Force given Coefficient of Drag

 $ag{fc} F_{
m D} = C_{
m D} \cdot A \cdot V_{
m mean} \cdot V_{
m mean} \cdot 
ho \cdot 0.5$ ex  $1.0201 \mathrm{kN} = 0.01 \cdot 2 \mathrm{m}^2 \cdot 10.1 \mathrm{m/s} \cdot 10.1 \mathrm{m/s} \cdot 1000 \mathrm{kg/m}^3 \cdot 0.5$ 

## 9) Dynamic Viscosity of fluid given Resistance Force on Spherical Surface

$$\mu = rac{F_{
m resistance}}{3 \cdot \pi \cdot D_{
m S} \cdot V_{
m mean}}$$

Open Calculator

Open Calculator

ex  $10.19012P = \frac{0.97 \text{kN}}{3 \cdot \pi \cdot 10 \text{m} \cdot 10.1 \text{m/s}}$ 

#### 10) Dynamic Viscosity of fluid given Terminal Fall Velocity

$$\mu = \left(rac{D_S^2}{18 \cdot V_{terminal}}
ight) \cdot (\gamma_f - S)$$

Open Calculator

 $oxed{ex} 10.27211 \mathrm{P} = \left(rac{(10 \mathrm{m})^2}{18 \cdot 49 \mathrm{m/s}}
ight) \cdot (9.81 \mathrm{kN/m^3} - 0.75 \mathrm{kN/m^3})}$ 





#### 11) Projected Area given Drag Force

 $ext{fx} A = rac{ ext{F}_{ ext{D}}}{ ext{C}_{ ext{D}} \cdot ext{V}_{ ext{mean}} \cdot ext{p} \cdot 0.5}$ 

Open Calculator 🖸

OD (mean (mean post

 $ext{ex} \ 2.156651 ext{m}^2 = rac{1.1 ext{kN}}{0.01 \cdot 10.1 ext{m/s} \cdot 10.1 ext{m/s} \cdot 1000 ext{kg/m}^3 \cdot 0.5}$ 

#### 12) Resistance Force on Spherical Surface

fx  $F_{
m resistance} = 3 \cdot \pi \cdot \mu \cdot V_{
m mean} \cdot D_{
m S}$ 

Open Calculator

ex  $0.970941 \mathrm{kN} = 3 \cdot \pi \cdot 10.2 \mathrm{P} \cdot 10.1 \mathrm{m/s} \cdot 10 \mathrm{m}$ 

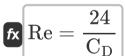
#### 13) Resistance Force on Spherical Surface given Specific Weights

 $\mathbf{F}_{ ext{resistance}} = \left(rac{\pi}{6}
ight) \cdot \left(\mathrm{D_S^3}
ight) \cdot \left(\gamma_{\mathrm{f}}
ight)$ 

Open Calculator 🗗

 $= \sum_{k=0}^{\infty} 5.136504 \text{kN} = \left(\frac{\pi}{6}\right) \cdot \left(\left(10\text{m}\right)^3\right) \cdot \left(9.81 \text{kN/m}^3\right)$ 

#### 14) Reynolds Number given Coefficient of Drag



Open Calculator

 $\boxed{ 2400 = \frac{24}{0.01} }$ 





#### 15) Terminal Fall Velocity 🚰

 $V_{
m terminal} = \left(rac{D_S^2}{18 \cdot \mu}
ight) \cdot (\gamma_f - S)^2$ 

Open Calculator 🗗

#### 16) Velocity of Sphere given Coefficient of Drag

 $\left| \mathbf{V}_{\mathrm{mean}} = rac{24 \cdot \mu}{
ho \cdot C_{\mathrm{D}} \cdot D_{\mathrm{S}}} 
ight|$ 

Open Calculator

 $0.2448 ext{m/s} = rac{24 \cdot 10.2 ext{P}}{1000 ext{kg/m}^3 \cdot 0.01 \cdot 10 ext{m}}$ 

#### 17) Velocity of Sphere given Drag Force

 $V_{
m mean} = \sqrt{rac{F_D}{A \cdot C_D \cdot 
ho \cdot 0.5}}$ 

Open Calculator

ex  $10.48809 \mathrm{m/s} = \sqrt{\frac{1.1 \mathrm{kN}}{2 \mathrm{m}^2 \cdot 0.01 \cdot 1000 \mathrm{kg/m}^3 \cdot 0.5}}$ 



#### 18) Velocity of Sphere given Resistance Force on Spherical Surface 🗗



Open Calculator

$$extbf{V}_{ ext{mean}} = rac{ ext{F}_{ ext{resistance}}}{3 \cdot \pi \cdot \mu \cdot ext{D}_{ ext{S}}}$$

$$extbf{ex} 10.09022 ext{m/s} = rac{0.97 ext{kN}}{3 \cdot \pi \cdot 10.2 ext{P} \cdot 10 ext{m}}$$



#### Variables Used

- A Cross Sectional Area of Pipe (Square Meter)
- C<sub>D</sub> Coefficient of Drag
- **D**<sub>S</sub> Diameter of Sphere (Meter)
- F<sub>D</sub> Drag Force (Kilonewton)
- Fresistance Resistance Force (Kilonewton)
- Re Reynolds Number
- S Specific Weight of Liquid in Piezometer (Kilonewton per Cubic Meter)
- V<sub>mean</sub> Mean Velocity (Meter per Second)
- V<sub>terminal</sub> Terminal Velocity (Meter per Second)
- Vf Specific Weight of Liquid (Kilonewton per Cubic Meter)
- µ Dynamic Viscosity (Poise)
- p Density of Fluid (Kilogram per Cubic Meter)





#### Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
   Archimedes' constant
- 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: Area in Square Meter (m²)

  Area Unit Conversion
- Measurement: Speed in Meter per Second (m/s)
   Speed Unit Conversion
- Measurement: Force in Kilonewton (kN)
   Force Unit Conversion
- Measurement: Dynamic Viscosity in Poise (P)
   Dynamic Viscosity Unit Conversion
- Measurement: Density in Kilogram per Cubic Meter (kg/m³)
   Density Unit Conversion
- Measurement: Specific Weight in Kilonewton per Cubic Meter (kN/m³)
   Specific Weight Unit Conversion





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- Laminar Flow between Parallel Plates, both Plates at Rest Formulas
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