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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

$$\text{fx } C_D = \frac{24 \cdot F_D \cdot \mu_{\text{viscosity}}}{\rho \cdot V_{\text{mean}} \cdot D_S}$$

[Open Calculator](#)

$$\text{ex } 0.002666 = \frac{24 \cdot 1.1\text{kN} \cdot 10.2\text{P}}{1000\text{kg/m}^3 \cdot 10.1\text{m/s} \cdot 10\text{m}}$$

2) Coefficient of Drag given Drag Force

$$\text{fx } C_D = \frac{F_D}{A \cdot V_{\text{mean}} \cdot V_{\text{mean}} \cdot \rho \cdot 0.5}$$

[Open Calculator](#)

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

3) Coefficient of Drag given Reynolds Number

$$\text{fx } C_D = \frac{24}{\text{Re}}$$

[Open Calculator](#)

$$\text{ex } 0.01 = \frac{24}{2400}$$



4) Density of Fluid given Drag Force

$$\text{fx } \rho = \frac{F_D}{A \cdot V_{\text{mean}} \cdot V_{\text{mean}} \cdot C_D \cdot 0.5}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

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

5) Diameter of Sphere for given Fall Velocity

$$\text{fx } D_S = \sqrt{\frac{V_{\text{mean}} \cdot 18 \cdot \mu_{\text{viscosity}}}{\gamma_f}}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

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

6) Diameter of Sphere given Coefficient of Drag

$$\text{fx } D_S = \frac{24 \cdot \mu_{\text{viscosity}}}{\rho \cdot V_{\text{mean}} \cdot C_D}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{ex } 0.242376 \text{ m} = \frac{24 \cdot 10.2 \text{ P}}{1000 \text{ kg/m}^3 \cdot 10.1 \text{ m/s} \cdot 0.01}$$



7) Diameter of Sphere given Resistance Force on Spherical Surface

$$\text{fx } D_S = \frac{F_{\text{resistance}}}{3 \cdot \pi \cdot \mu_{\text{viscosity}} \cdot V_{\text{mean}}}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$\text{ex } 9.990312\text{m} = \frac{0.97\text{kN}}{3 \cdot \pi \cdot 10.2\text{P} \cdot 10.1\text{m/s}}$$

8) Drag Force given Coefficient of Drag

$$\text{fx } F_D = C_D \cdot A \cdot V_{\text{mean}} \cdot V_{\text{mean}} \cdot \rho \cdot 0.5$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$\text{ex } 1.0201\text{kN} = 0.01 \cdot 2\text{m}^2 \cdot 10.1\text{m/s} \cdot 10.1\text{m/s} \cdot 1000\text{kg/m}^3 \cdot 0.5$$

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

$$\text{fx } \mu_{\text{viscosity}} = \frac{F_{\text{resistance}}}{3 \cdot \pi \cdot D_S \cdot V_{\text{mean}}}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

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

10) Dynamic Viscosity of fluid given Terminal Fall Velocity

$$\text{fx } \mu_{\text{viscosity}} = \left(\frac{D_S^2}{18 \cdot V_{\text{terminal}}} \right) \cdot (\gamma_f - S)$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$\text{ex } 10.27211\text{P} = \left(\frac{(10\text{m})^2}{18 \cdot 49\text{m/s}} \right) \cdot (9.81\text{kN/m}^3 - 0.75\text{kN/m}^3)$$



11) Projected Area given Drag Force

$$\text{fx } A = \frac{F_D}{C_D \cdot V_{\text{mean}} \cdot V_{\text{mean}} \cdot \rho \cdot 0.5}$$

Open Calculator 

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

12) Resistance Force on Spherical Surface

$$\text{fx } F_{\text{resistance}} = 3 \cdot \pi \cdot \mu_{\text{viscosity}} \cdot V_{\text{mean}} \cdot D_S$$

Open Calculator 

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

13) Resistance Force on Spherical Surface given Specific Weights

$$\text{fx } F_{\text{resistance}} = \left(\frac{\pi}{6}\right) \cdot (D_S^3) \cdot (\gamma_f)$$

Open Calculator 

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

14) Reynolds Number given Coefficient of Drag

$$\text{fx } \text{Re} = \frac{24}{C_D}$$

Open Calculator 

$$\text{ex } 2400 = \frac{24}{0.01}$$



15) Terminal Fall Velocity [Open Calculator !\[\]\(eafc244b53721dd1ec133f0772f70fc7_img.jpg\)](#)

$$\text{fx } V_{\text{terminal}} = \left(\frac{D_S^2}{18 \cdot \mu_{\text{viscosity}}} \right) \cdot (\gamma_f - S)$$

$$\text{ex } 49.34641\text{m/s} = \left(\frac{(10\text{m})^2}{18 \cdot 10.2\text{P}} \right) \cdot (9.81\text{kN/m}^3 - 0.75\text{kN/m}^3)$$

16) Velocity of Sphere given Coefficient of Drag [Open Calculator !\[\]\(10f8862fc183b400327470ea85afe9ae_img.jpg\)](#)

$$\text{fx } V_{\text{mean}} = \frac{24 \cdot \mu_{\text{viscosity}}}{\rho \cdot C_D \cdot D_S}$$

$$\text{ex } 0.2448\text{m/s} = \frac{24 \cdot 10.2\text{P}}{1000\text{kg/m}^3 \cdot 0.01 \cdot 10\text{m}}$$

17) Velocity of Sphere given Drag Force [Open Calculator !\[\]\(35dc653d59570f8f891c312eeece91a2_img.jpg\)](#)

$$\text{fx } V_{\text{mean}} = \sqrt{\frac{F_D}{A \cdot C_D \cdot \rho \cdot 0.5}}$$

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



18) Velocity of Sphere given Resistance Force on Spherical Surface

fx

$$V_{\text{mean}} = \frac{F_{\text{resistance}}}{3 \cdot \pi \cdot \mu_{\text{viscosity}} \cdot D_S}$$

[Open Calculator !\[\]\(83f22ed94ec5517769dd76d702c6bfd8_img.jpg\)](#)

ex

$$10.09022\text{m/s} = \frac{0.97\text{kN}}{3 \cdot \pi \cdot 10.2\text{P} \cdot 10\text{m}}$$



Variables Used

- **A** Cross Sectional Area of Pipe (Square Meter)
- **C_D** Coefficient of Drag
- **D_S** Diameter of Sphere (Meter)
- **F_D** Drag Force (Kilonewton)
- **F_{resistance}** Resistance Force (Kilonewton)
- **Re** Reynolds Number
- **S** Specific Weight of Liquid in Piezometer (Kilonewton per Cubic Meter)
- **V_{mean}** Mean Velocity (Meter per Second)
- **V_{terminal}** Terminal Velocity (Meter per Second)
- **Y_f** Specific Weight of Liquid (Kilonewton per Cubic Meter)
- **μ_{viscosity}** Dynamic Viscosity (Poise)
- **ρ** Density of Fluid (Kilogram per Cubic Meter)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **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 around a Sphere– Stokes' Law Formulas** 
- **Laminar Flow between Parallel Flat Plates, one plate moving and other at rest, Couette Flow Formulas** 
- **Laminar Flow between Parallel Plates, both plates at rest Formulas** 
- **Laminar Flow of Fluid in an Open Channel Formulas** 
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