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# Laminar Flow between Parallel Plates, both plates at rest Formulas

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# List of 30 Laminar Flow between Parallel Plates, both plates at rest Formulas

## Laminar Flow between Parallel Plates, both plates at rest

### 1) Discharge given Mean Velocity of Flow

$$fx \quad Q = w \cdot V_{\text{mean}}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

$$ex \quad 97.2\text{m}^3/\text{s} = 3\text{m} \cdot 32.4\text{m}/\text{s}$$

### 2) Discharge given Viscosity

$$fx \quad Q = dp|dr \cdot \frac{w^3}{12 \cdot \mu}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

$$ex \quad 37.5\text{m}^3/\text{s} = 17\text{N}/\text{m}^3 \cdot \frac{(3\text{m})^3}{12 \cdot 10.2\text{P}}$$

### 3) Distance between Plates given Discharge

$$fx \quad w = \left( \frac{Q \cdot 12 \cdot \mu}{dp|dr} \right)^{\frac{1}{3}}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d\_img.jpg\)](#)

$$ex \quad 3.408514\text{m} = \left( \frac{55\text{m}^3/\text{s} \cdot 12 \cdot 10.2\text{P}}{17\text{N}/\text{m}^3} \right)^{\frac{1}{3}}$$




4) Distance between Plates given Maximum Velocity between Plates 

$$fx \quad w = \sqrt{\frac{8 \cdot \mu \cdot V_{\max}}{dp|dr}}$$

Open Calculator 

$$ex \quad 2.987976m = \sqrt{\frac{8 \cdot 10.2P \cdot 18.6m/s}{17N/m^3}}$$

5) Distance between Plates given Mean Velocity of Flow 

$$fx \quad w = \frac{Q}{V_{\text{mean}}}$$

Open Calculator 

$$ex \quad 1.697531m = \frac{55m^3/s}{32.4m/s}$$


6) Distance between Plates given Mean Velocity of Flow with Pressure Gradient 

$$fx \quad w = \sqrt{\frac{12 \cdot \mu \cdot V_{\text{mean}}}{dp|dr}}$$

Open Calculator 

$$ex \quad 4.829907m = \sqrt{\frac{12 \cdot 10.2P \cdot 32.4m/s}{17N/m^3}}$$




7) Distance between Plates given Pressure Difference 

$$\text{fx } w = \sqrt{12 \cdot V_{\text{mean}} \cdot \mu \cdot \frac{L_p}{\Delta P}}$$

Open Calculator 


$$\text{ex } 1.726782\text{m} = \sqrt{12 \cdot 32.4\text{m/s} \cdot 10.2\text{P} \cdot \frac{0.10\text{m}}{13.3\text{N/m}^2}}$$

8) Distance between Plates given Pressure Head Drop 

$$\text{fx } w = \sqrt{\frac{12 \cdot \mu \cdot L_p \cdot V_{\text{mean}}}{\gamma_f \cdot h_{\text{location}}}}$$

Open Calculator 

$$\text{ex } 1.458653\text{m} = \sqrt{\frac{12 \cdot 10.2\text{P} \cdot 0.10\text{m} \cdot 32.4\text{m/s}}{9.81\text{kN/m}^3 \cdot 1.9\text{m}}}$$


9) Distance between Plates given Shear Stress Distribution Profile 

$$\text{fx } w = 2 \cdot \left( R - \left( \frac{\tau}{dp|dr} \right) \right)$$

Open Calculator 

$$\text{ex } 2.847059\text{m} = 2 \cdot \left( 6.9\text{m} - \left( \frac{93.1\text{Pa}}{17\text{N/m}^3} \right) \right)$$




10) Distance between Plates using Velocity Distribution Profile 

$$fx \quad w = \frac{\left( \frac{-v \cdot 2 \cdot \mu}{dp|dr} \right) + (R^2)}{R}$$

Open Calculator 

$$ex \quad 5.829217m = \frac{\left( \frac{-61.57m/s \cdot 2 \cdot 10.2P}{17N/m^3} \right) + ((6.9m)^2)}{6.9m}$$

11) Horizontal Distance given Shear Stress Distribution Profile 

$$fx \quad R = \frac{w}{2} + \left( \frac{\tau}{dp|dr} \right)$$

Open Calculator 

$$ex \quad 6.976471m = \frac{3m}{2} + \left( \frac{93.1Pa}{17N/m^3} \right)$$

12) Length of Pipe given Pressure Difference 

$$fx \quad L_p = \frac{\Delta P \cdot w \cdot w}{\mu \cdot 12 \cdot V_{mean}}$$

Open Calculator 

$$ex \quad 0.301834m = \frac{13.3N/m^2 \cdot 3m \cdot 3m}{10.2P \cdot 12 \cdot 32.4m/s}$$



### 13) Length of Pipe given Pressure Head Drop

$$fx \quad L_p = \frac{\gamma_f \cdot w \cdot w \cdot h_{location}}{12 \cdot \mu \cdot V_{mean}}$$

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

$$ex \quad 0.422998m = \frac{9.81kN/m^3 \cdot 3m \cdot 3m \cdot 1.9m}{12 \cdot 10.2P \cdot 32.4m/s}$$

### 14) Maximum Shear Stress in fluid

$$fx \quad \tau_{smax} = 0.5 \cdot dp|dr \cdot w$$

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

$$ex \quad 25.5N/mm^2 = 0.5 \cdot 17N/m^3 \cdot 3m$$

### 15) Maximum Velocity between Plates

$$fx \quad V_{max} = \frac{(w^2) \cdot dp|dr}{8 \cdot \mu}$$

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

$$ex \quad 18.75m/s = \frac{((3m)^2) \cdot 17N/m^3}{8 \cdot 10.2P}$$

### 16) Maximum Velocity given Mean Velocity of Flow

$$fx \quad V_{max} = 1.5 \cdot V_{mean}$$

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487\_img.jpg\)](#)

$$ex \quad 48.6m/s = 1.5 \cdot 32.4m/s$$



17) Pressure Difference 

$$\text{fx } \Delta P = 12 \cdot \mu \cdot V_{\text{mean}} \cdot \frac{L_p}{w^2}$$

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

$$\text{ex } 4.4064 \text{N/m}^2 = 12 \cdot 10.2 \text{P} \cdot 32.4 \text{m/s} \cdot \frac{0.10 \text{m}}{(3 \text{m})^2}$$

18) Pressure Head Drop 

$$\text{fx } h_{\text{location}} = \frac{12 \cdot \mu \cdot L_p \cdot V_{\text{mean}}}{\gamma_f}$$

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

$$\text{ex } 4.042569 \text{m} = \frac{12 \cdot 10.2 \text{P} \cdot 0.10 \text{m} \cdot 32.4 \text{m/s}}{9.81 \text{kN/m}^3}$$

19) Shear Stress Distribution Profile 

$$\text{fx } \tau = -dp|dr \cdot \left( \frac{w}{2} - R \right)$$

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

$$\text{ex } 91.8 \text{Pa} = -17 \text{N/m}^3 \cdot \left( \frac{3 \text{m}}{2} - 6.9 \text{m} \right)$$

20) Velocity Distribution Profile 

$$\text{fx } v = - \left( \frac{1}{2 \cdot \mu} \right) \cdot dp|dr \cdot (w \cdot R - (R^2))$$

[Open Calculator !\[\]\(06a315363e7801bba8c7489a6694af19\_img.jpg\)](#)

$$\text{ex } 224.25 \text{m/s} = - \left( \frac{1}{2 \cdot 10.2 \text{P}} \right) \cdot 17 \text{N/m}^3 \cdot \left( 3 \text{m} \cdot 6.9 \text{m} - ((6.9 \text{m})^2) \right)$$



## Mean Velocity of Flow

### 21) Mean Velocity of Flow given Maximum Velocity

$$\text{fx } V_{\text{mean}} = \left( \frac{2}{3} \right) \cdot V_{\text{max}}$$

[Open Calculator !\[\]\(96cc62f861fdd6e50510c0224a756dff\_img.jpg\)](#)

$$\text{ex } 12.4\text{m/s} = \left( \frac{2}{3} \right) \cdot 18.6\text{m/s}$$

### 22) Mean Velocity of Flow given Pressure Difference

$$\text{fx } V_{\text{mean}} = \frac{\Delta P \cdot w}{12 \cdot \mu \cdot L_p}$$

[Open Calculator !\[\]\(f95dab70c751fda7d824b8b03650f7aa\_img.jpg\)](#)

$$\text{ex } 32.59804\text{m/s} = \frac{13.3\text{N/m}^2 \cdot 3\text{m}}{12 \cdot 10.2\text{P} \cdot 0.10\text{m}}$$

### 23) Mean Velocity of Flow given Pressure Gradient


$$\text{fx } V_{\text{mean}} = \left( \frac{w^2}{12 \cdot \mu} \right) \cdot dp|dr$$

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

$$\text{ex } 12.5\text{m/s} = \left( \frac{(3\text{m})^2}{12 \cdot 10.2\text{P}} \right) \cdot 17\text{N/m}^3$$





24) Mean Velocity of Flow given Pressure Head Drop 

$$fx \quad V_{\text{mean}} = \frac{\Delta P \cdot S \cdot (D_{\text{pipe}}^2)}{12 \cdot \mu \cdot L_p}$$

Open Calculator 


$$ex \quad 8.313315\text{m/s} = \frac{13.3\text{N/m}^2 \cdot 0.75\text{kN/m}^3 \cdot ((1.01\text{m})^2)}{12 \cdot 10.2\text{P} \cdot 0.10\text{m}}$$

Pressure Gradient 25) Pressure Gradient given Maximum Velocity between Plates 

$$fx \quad dp|dr = \frac{V_{\text{max}} \cdot 8 \cdot \mu}{w^2}$$

Open Calculator 

$$ex \quad 16.864\text{N/m}^3 = \frac{18.6\text{m/s} \cdot 8 \cdot 10.2\text{P}}{(3\text{m})^2}$$

26) Pressure Gradient given Shear Stress Distribution Profile 

$$fx \quad dp|dr = -\frac{\tau}{\frac{w}{2} - R}$$

Open Calculator 

$$ex \quad 17.24074\text{N/m}^3 = -\frac{93.1\text{Pa}}{\frac{3\text{m}}{2} - 6.9\text{m}}$$



## Dynamic Viscosity

### 27) Dynamic Viscosity given Maximum Velocity between Plates

$$\text{fx } \mu = \frac{(w^2) \cdot dp|dr}{8 \cdot V_{\max}}$$

[Open Calculator !\[\]\(339a16584d5da0f0a3ca4e9ec17bf6a1\_img.jpg\)](#)

$$\text{ex } 10.28226\text{P} = \frac{((3\text{m})^2) \cdot 17\text{N/m}^3}{8 \cdot 18.6\text{m/s}}$$

### 28) Dynamic Viscosity given Mean Velocity of Flow with Pressure Gradient

$$\text{fx } \mu = \left( \frac{w^2}{12 \cdot V_{\text{mean}}} \right) \cdot dp|dr$$

[Open Calculator !\[\]\(6059a5aa8b4ca7bb793408023d6c6e42\_img.jpg\)](#)

$$\text{ex } 3.935185\text{P} = \left( \frac{(3\text{m})^2}{12 \cdot 32.4\text{m/s}} \right) \cdot 17\text{N/m}^3$$

### 29) Dynamic Viscosity given Pressure Difference

$$\text{fx } \mu = \frac{\Delta P \cdot w}{12 \cdot V_{\text{mean}} \cdot L_p}$$

[Open Calculator !\[\]\(e3275251d0893157c3584e20c81dc3ba\_img.jpg\)](#)

$$\text{ex } 10.26235\text{P} = \frac{13.3\text{N/m}^2 \cdot 3\text{m}}{12 \cdot 32.4\text{m/s} \cdot 0.10\text{m}}$$



### 30) Dynamic Viscosity using Velocity Distribution Profile

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb\_img.jpg\)](#)

$$\text{fx } \mu = \left( \frac{1}{2 \cdot v} \right) \cdot dp|dr \cdot (w \cdot R^2)$$

$$\text{ex } 197.1829\text{P} = \left( \frac{1}{2 \cdot 61.57\text{m/s}} \right) \cdot 17\text{N/m}^3 \cdot (3\text{m} \cdot (6.9\text{m})^2)$$











## Variables Used

- $D_{\text{pipe}}$  Diameter of Pipe (Meter)
- $dp|dr$  Pressure Gradient (Newton per Cubic Meter)
- $h_{\text{location}}$  Head Loss due to Friction (Meter)
- $L_p$  Length of Pipe (Meter)
- $Q$  Discharge in Laminar Flow (Cubic Meter per Second)
- $R$  Horizontal Distance (Meter)
- $S$  Specific Weight of Liquid in Piezometer (Kilonewton per Cubic Meter)
- $v$  Velocity of Liquid (Meter per Second)
- $V_{\text{max}}$  Maximum Velocity (Meter per Second)
- $V_{\text{mean}}$  Mean Velocity (Meter per Second)
- $w$  Width (Meter)
- $\gamma_f$  Specific Weight of Liquid (Kilonewton per Cubic Meter)
- $\Delta P$  Pressure Difference (Newton per Square Meter)
- $\mu$  Dynamic Viscosity (Poise)
- $T_{\text{smax}}$  Maximum Shear Stress in Shaft (Newton per Square Millimeter)
- $\tau$  Shear Stress (Pascal)










## Constants, Functions, Measurements used

- **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:** **Pressure** in Newton per Square Meter (N/m<sup>2</sup>)  
*Pressure Unit Conversion* 
- **Measurement:** **Speed** in Meter per Second (m/s)  
*Speed Unit Conversion* 
- **Measurement:** **Volumetric Flow Rate** in Cubic Meter per Second (m<sup>3</sup>/s)  
*Volumetric Flow Rate Unit Conversion* 
- **Measurement:** **Dynamic Viscosity** in Poise (P)  
*Dynamic Viscosity Unit Conversion* 
- **Measurement:** **Specific Weight** in Kilonewton per Cubic Meter (kN/m<sup>3</sup>)  
*Specific Weight Unit Conversion* 
- **Measurement:** **Pressure Gradient** in Newton per Cubic Meter (N/m<sup>3</sup>)  
*Pressure Gradient Unit Conversion* 
- **Measurement:** **Stress** in Pascal (Pa), Newton per Square Millimeter (N/mm<sup>2</sup>)  
*Stress Unit Conversion* 



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