



# **Dash-Pot Mechanism Formulas**

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#### **List of 36 Dash-Pot Mechanism Formulas**

#### Dash-Pot Mechanism

1) Length of Piston for Pressure Drop over Piston

$$\mathbf{L}_{\mathrm{P}} = rac{\Delta \mathrm{Pf}}{\left(6 \cdot \mu_{\mathrm{viscosity}} \cdot rac{\mathrm{v}_{\mathrm{piston}}}{\mathrm{C_{\mathrm{R}}^3}}
ight) \cdot \left(0.5 \cdot \mathrm{D} + \mathrm{C_{\mathrm{R}}}
ight)}$$

 $= \frac{33 \text{Pa}}{\left(6 \cdot 10.2 \text{P} \cdot \frac{0.045 \text{m/s}}{\left(0.45 \text{m}\right)^3}\right) \cdot \left(0.5 \cdot 3.5 \text{m} + 0.45 \text{m}\right)}$ 

# 2) Length of Piston for Shear Force Resisting Motion of Piston

 $L_{\mathrm{P}} = rac{\mathrm{Fs}}{\pi \cdot \mu_{\mathrm{viscosity}} \cdot v_{\mathrm{piston}} \cdot \left(1.5 \cdot \left(rac{\mathrm{D}}{\mathrm{C_R}}
ight)^2 + 4 \cdot \left(rac{\mathrm{D}}{\mathrm{C_R}}
ight)
ight)}$ 

Open Calculator 🚰

Open Calculator

Open Calculator

$$= \frac{90 \text{N}}{\pi \cdot 10.2 \text{P} \cdot 0.045 \text{m/s} \cdot \left(1.5 \cdot \left(\frac{3.5 \text{m}}{0.45 \text{m}}\right)^2 + 4 \cdot \left(\frac{3.5 \text{m}}{0.45 \text{m}}\right)\right)}$$

# 3) Length of Piston for Vertical Upward Force on Piston

 $\mathbf{F}_{\mathbf{v}}$ 

$$= \frac{\mathrm{F_{v}}}{\mathrm{v_{piston}} \cdot \pi \cdot \mu_{\mathrm{viscosity}} \cdot \left(0.75 \cdot \left(\left(\frac{\mathrm{D}}{\mathrm{C_{R}}}\right)^{3}\right) + 1.5 \cdot \left(\left(\frac{\mathrm{D}}{\mathrm{C_{R}}}\right)^{2}\right)\right)}$$

$$= \frac{320 \text{N}}{0.045 \text{m/s} \cdot \pi \cdot 10.2 \text{P} \cdot \left(0.75 \cdot \left(\left(\frac{3.5 \text{m}}{0.45 \text{m}}\right)^3\right) + 1.5 \cdot \left(\left(\frac{3.5 \text{m}}{0.45 \text{m}}\right)^2\right)\right)}$$



#### 4) Pressure Drop over Length of Piston given Vertical Upward Force on Piston

 $\Delta ext{Pf} = rac{ ext{F}_{ ext{v}}}{0.25 \cdot \pi \cdot ext{D} \cdot ext{D}}$ 

Open Calculator 🗗

ex 
$$33.26014 ext{Pa} = rac{320 ext{N}}{0.25 \cdot \pi \cdot 3.5 ext{m} \cdot 3.5 ext{m}}$$

### 5) Pressure Drop over Piston

 $\Delta \mathrm{Pf} = \left(6 \cdot \mu_{\mathrm{viscosity}} \cdot v_{\mathrm{piston}} \cdot rac{L_{\mathrm{P}}}{C_{\mathrm{P}}^{3}}
ight) \cdot (0.5 \cdot \mathrm{D} + C_{\mathrm{R}})$ 

Open Calculator

## 6) Pressure Gradient given Rate of Flow

fx

Open Calculator

$$\mathrm{dp} | \mathrm{dr} = \left( 12 \cdot rac{\mu_{\mathrm{viscosity}}}{\mathrm{C_R^3}} 
ight) \cdot \left( \left( rac{\mathrm{Q}}{\pi} \cdot \mathrm{D} 
ight) + \mathrm{v_{piston}} \cdot 0.5 \cdot \mathrm{C_R} 
ight) |$$

$$8231.832 \text{N/m}^{_3} = \left(12 \cdot \frac{10.2 \text{P}}{\left(0.45 \text{m}\right)^3}\right) \cdot \left(\left(\frac{55 \text{m}^3/\text{s}}{\pi} \cdot 3.5 \text{m}\right) + 0.045 \text{m/s} \cdot 0.5 \cdot 0.45 \text{m}\right)$$

#### 7) Pressure Gradient given Velocity of Flow in Oil Tank

$$\mathrm{d} p | \mathrm{d} r = rac{\mu_{\mathrm{viscosity}} \cdot 2 \cdot \left( u_{\mathrm{Oiltank}} - \left( v_{\mathrm{piston}} \cdot rac{\mathrm{R}}{\mathrm{C_H}} 
ight) 
ight)}{\mathrm{R} \cdot \mathrm{R} - \mathrm{C_H} \cdot \mathrm{R}}$$

$$\boxed{ \text{ex} \ \, 50.97758 \text{N/m}^{_3} = \frac{10.2 \text{P} \cdot 2 \cdot \left(12 \text{m/s} - \left(0.045 \text{m/s} \cdot \frac{0.7 \text{m}}{50 \text{mm}}\right)\right)}{0.7 \text{m} \cdot 0.7 \text{m} - 50 \text{mm} \cdot 0.7 \text{m}} } }$$





#### 8) Shear Force Resisting Motion of Piston

fx

Open Calculator 🗗

$$ext{Fs} = \pi \cdot ext{L}_ ext{P} \cdot \mu_{ ext{viscosity}} \cdot ext{v}_{ ext{piston}} \cdot \left( 1.5 \cdot \left( rac{ ext{D}}{ ext{C}_ ext{R}} 
ight)^2 + 4 \cdot \left( rac{ ext{D}}{ ext{C}_ ext{R}} 
ight) 
ight)$$

9) Total Forces

fx  $T_{
m f}=F_{
m v}+F_{
m S}$ 

Open Calculator 🖸

= 410 N = 320 N + 90 N

#### 10) Velocity of Flow in Oil Tank

fx

Open Calculator

$$\boxed{ u_{Oiltank} = \left( dp \middle| dr \cdot 0.5 \cdot \frac{R \cdot R - C_H \cdot R}{\mu_{viscosity}} \right) - \left( v_{piston} \cdot \frac{R}{C_H} \right) }$$

ex

$$\boxed{12.75235 \text{m/s} = \left(60 \text{N/m}^3 \cdot 0.5 \cdot \frac{0.7 \text{m} \cdot 0.7 \text{m} - 50 \text{mm} \cdot 0.7 \text{m}}{10.2 \text{P}}\right) - \left(0.045 \text{m/s} \cdot \frac{0.7 \text{m}}{50 \text{mm}}\right)}$$

#### 11) Vertical Force given Total Force

fx  $\mathrm{F_v} = \mathrm{Fs} - \mathrm{F}_{\mathrm{Total}}$ 

$$87.5N = 90N - 2.5N$$



Open Calculator

#### 12) Vertical Upward Force on Piston given Piston Velocity

$$\boxed{ F_v = L_P \cdot \pi \cdot \mu_{viscosity} \cdot v_{piston} \cdot \left( 0.75 \cdot \left( \left( \frac{D}{C_R} \right)^3 \right) + 1.5 \cdot \left( \left( \frac{D}{C_R} \right)^2 \right) \right) }$$

$$\boxed{319.849 \text{N} = 5 \text{m} \cdot \pi \cdot 10.2 \text{P} \cdot 0.045 \text{m/s} \cdot \left(0.75 \cdot \left(\left(\frac{3.5 \text{m}}{0.45 \text{m}}\right)^3\right) + 1.5 \cdot \left(\left(\frac{3.5 \text{m}}{0.45 \text{m}}\right)^2\right)\right)}$$

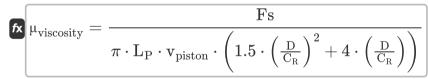
## Dynamic Viscosity

# 13) Dynamic Viscosity for Pressure Reduction over Length of Piston 🗗

 $\overline{\left(6 \cdot \mathrm{v}_{\mathrm{piston}} \cdot \frac{\mathrm{L}_{\mathrm{P}}}{\mathrm{C}_{\mathrm{o}}^{\mathrm{o}}}\right) \cdot \left(0.5 \cdot \mathrm{D} + \mathrm{C}_{\mathrm{R}}\right)}$ 

Open Calculator

## 14) Dynamic Viscosity for Shear Force Resisting Motion of Piston



ex 
$$10.44908P = \frac{90N}{\pi \cdot 5m \cdot 0.045m/s \cdot \left(1.5 \cdot \left(\frac{3.5m}{0.45m}\right)^2 + 4 \cdot \left(\frac{3.5m}{0.45m}\right)\right)}$$



### 15) Dynamic Viscosity given Rate of Flow

 $\mu_{
m viscosity} = rac{{
m d}p |{
m d}r \cdot rac{C_{
m R}^3}{12}}{\left(rac{{
m Q}}{\pi} \cdot {
m D}
ight) + v_{
m piston} \cdot 0.5 \cdot C_{
m R}}$ 

Open Calculator 🗗

#### 16) Dynamic Viscosity given Velocity of Flow in Oil Tank

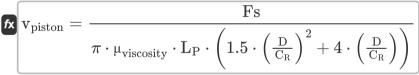
 $\mu_{viscosity} = 0.5 \cdot dp | dr \cdot \frac{R \cdot R - C_H \cdot R}{u_{Oiltank} + \left(v_{piston} \cdot \frac{R}{C_H}\right)}$ 

Open Calculator

$$ag{10.8076P} = 0.5 \cdot 60 ext{N/m}^3 \cdot rac{0.7 ext{m} \cdot 0.7 ext{m} - 50 ext{mm} \cdot 0.7 ext{m}}{12 ext{m/s} + \left(0.045 ext{m/s} \cdot rac{0.7 ext{m}}{50 ext{mm}}
ight)}$$

# Velocity of Piston 🗗

#### 17) Velocity of Piston for Shear Force Resisting Motion of Piston







#### 18) Velocity of Piston for Vertical Upward Force on Piston

fx

$$= \frac{F_{\mathrm{v}}}{L_{\mathrm{P}} \cdot \pi \cdot \mu_{\mathrm{viscosity}} \cdot \left(0.75 \cdot \left(\left(\frac{\mathrm{D}}{\mathrm{C_{\mathrm{R}}}}\right)^{3}\right) + 1.5 \cdot \left(\left(\frac{\mathrm{D}}{\mathrm{C_{\mathrm{R}}}}\right)^{2}\right)\right)}$$

#### 19) Velocity of Piston given Velocity of Flow in Oil Tank

$$v_{piston} = \left( \left( 0.5 \cdot dp | dr \cdot \frac{R \cdot R - C_H \cdot R}{\mu_{viscosity}} \right) - u_{Oiltank} \right) \cdot \left( \frac{C_H}{R} \right)$$

ex

$$0.098739 ext{m/s} = \left( \left( 0.5 \cdot 60 ext{N/m}^{_3} \cdot rac{0.7 ext{m} \cdot 0.7 ext{m} - 50 ext{mm} \cdot 0.7 ext{m}}{10.2 ext{P}} 
ight) - 12 ext{m/s} 
ight) \cdot \left( rac{50 ext{mm}}{0.7 ext{m}} 
ight) 
ight)$$

#### 20) Velocity of Pistons for Pressure Drop over Length of Piston

$$\mathbf{v}_{ ext{piston}} = rac{\Delta ext{Pf}}{\left(6 \cdot \mu_{ ext{viscosity}} \cdot rac{ ext{L}_{ ext{P}}}{ ext{C}_{ ext{R}}^3}
ight) \cdot (0.5 \cdot ext{D} + ext{C}_{ ext{R}})}$$





# When Piston Velocity is Negligible to Average Velocity of Oil in Clearance Space ☑

## 21) Clearance given Pressure Drop over Length of Piston

 $\mathbf{C}_{\mathrm{R}} = \left(3 \cdot \mathrm{D} \cdot \mu_{\mathrm{viscosity}} \cdot v_{\mathrm{piston}} \cdot rac{\mathrm{L}_{\mathrm{P}}}{\Delta \mathrm{Pf}}
ight)^{rac{1}{3}}$ 

Open Calculator 🗗

 $\boxed{ \text{ex} } \ 0.417977 \text{m} = \left( 3 \cdot 3.5 \text{m} \cdot 10.2 \text{P} \cdot 0.045 \text{m/s} \cdot \frac{5 \text{m}}{33 \text{Pa}} \right)^{\frac{1}{3}}$ 

# 22) Clearance given Shear Stress

 $m C_H = \sqrt{1.5 \cdot D \cdot \mu_{viscosity} \cdot rac{V_{piston}}{ au}}$ 

Open Calculator

ex 50.87579mm =  $\sqrt{1.5 \cdot 3.5$ m  $\cdot 10.2$ P  $\cdot \frac{0.045$ m/s}{93.1Pa

# 23) Diameter of Piston for Pressure Drop over Length

 $D = \left(rac{\Delta Pf}{6 \cdot \mu_{
m viscosity} \cdot v_{
m piston} \cdot rac{L_P}{C_{
m R}^3}}
ight) \cdot 2$ 

Open Calculator 🗗

# 24) Diameter of Piston given Shear Stress

 $ag{D} = rac{ au}{1.5 \cdot \mu_{
m viscosity} \cdot rac{
m v_{
m piston}}{
m C_H \cdot C_H}}$ 

Open Calculator

 $= \frac{93.1 Pa}{1.5 \cdot 10.2 P \cdot \frac{0.045 m/s}{50 mm \cdot 50 mm}}$ 





#### 25) Dynamic Viscosity for Pressure Drop over Length

 $\left| \mu_{
m viscosity} = rac{\Delta P f}{\left( 6 \cdot {
m v}_{
m piston} \cdot rac{L_{
m P}}{C_{
m R}^3} 
ight) \cdot (0.5 \cdot {
m D})} 
ight|$ 

Open Calculator 🗗

## 26) Dynamic Viscosity given Shear Stress in Piston

 $\mu_{
m viscosity} = rac{ au}{1.5 \cdot {
m D} \cdot rac{{
m v}_{
m piston}}{{
m C}_{
m H} \cdot {
m C}_{
m H}}}$ 

Open Calculator

#### 27) Dynamic Viscosity given Velocity of Fluid 🚰

 $\mu_{
m viscosity} = {
m d}p |{
m d}r \cdot 0.5 \cdot \left(rac{{
m R}^2 - {
m C_H} \cdot {
m R}}{{
m u_{
m Fluid}}}
ight)$ 

Open Calculator

$$\boxed{ 0.455 \mathrm{P} = 60 \mathrm{N/m^3 \cdot 0.5 \cdot \left( \frac{(0.7 \mathrm{m})^2 - 50 \mathrm{mm \cdot 0.7 m}}{300 \mathrm{m/s}} \right) }$$

### 28) Dynamic Viscosity given velocity of piston 🖒

fx

$$\mu_{ ext{viscosity}} = rac{ ext{F}_{ ext{Total}}}{\pi \cdot ext{v}_{ ext{piston}} \cdot ext{L}_{ ext{P}} \cdot \left(0.75 \cdot \left(\left(rac{ ext{D}}{ ext{C}_{ ext{R}}}
ight)^3
ight) + 1.5 \cdot \left(\left(rac{ ext{D}}{ ext{C}_{ ext{R}}}
ight)^2
ight)}$$

$$7.972511P = \frac{2.5N}{\pi \cdot 0.045 \text{m/s} \cdot 5 \text{m} \cdot \left(0.75 \cdot \left(\left(\frac{3.5 \text{m}}{0.45 \text{m}}\right)^3\right) + 1.5 \cdot \left(\left(\frac{3.5 \text{m}}{0.45 \text{m}}\right)^2\right)\right)}$$





#### 29) Length of Piston for Pressure Reduction over Length of Piston 🗗

 $\mathbf{x} = rac{\Delta \mathrm{Pf}}{\left(6 \cdot \mu_{\mathrm{viscosity}} \cdot rac{\mathrm{v}_{\mathrm{piston}}}{\mathrm{C_R^3}}
ight) \cdot (0.5 \cdot \mathrm{D})}$ 

Open Calculator

 $= \frac{33 \mathrm{Pa}}{\left(6 \cdot 10.2 \mathrm{P} \cdot \frac{0.045 \mathrm{m/s}}{\left(0.45 \mathrm{m}\right)^3}\right) \cdot \left(0.5 \cdot 3.5 \mathrm{m}\right)}$ 

## 30) Pressure Drop over Lengths of Piston

 $\Delta Pf = \left(6 \cdot \mu_{viscosity} \cdot v_{piston} \cdot rac{L_P}{C_R^3}
ight) \cdot (0.5 \cdot D)$ 

Open Calculator

 $26.44444 \text{Pa} = \left( 6 \cdot 10.2 \text{P} \cdot 0.045 \text{m/s} \cdot \frac{5 \text{m}}{\left( 0.45 \text{m} \right)^3} \right) \cdot \left( 0.5 \cdot 3.5 \text{m} \right)$ 

### 31) Pressure Gradient given Velocity of Fluid

 $d\mathbf{p}|d\mathbf{r} = rac{\mathbf{u}_{\mathrm{Oiltank}}}{0.5 \cdot rac{\mathrm{R}\cdot\mathrm{R} - \mathrm{C}_{\mathrm{H}}\cdot\mathrm{R}}{\mu_{\mathrm{viscosity}}}}$ 

Open Calculator

 $= \frac{12 \text{m/s}}{0.5 \cdot \frac{0.7 \text{m} \cdot 0.7 \text{m} - 50 \text{mm} \cdot 0.7 \text{m}}{10.2 \text{P}}}$ 

# 32) Velocity of Fluid

 $u_{\mathrm{Oiltank}} = \mathrm{d} p | \mathrm{d} r \cdot 0.5 \cdot rac{R \cdot R - C_{\mathrm{H}} \cdot R}{\mu_{\mathrm{viscosity}}}$ 

Open Calculator



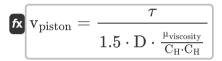
#### 33) Velocity of Piston for Pressure reduction over Length of Piston 🗗

 $extbf{v}_{ ext{piston}} = rac{\Delta ext{Pf}}{\left(3 \cdot \mu_{ ext{viscosity}} \cdot rac{ ext{L}_{ ext{P}}}{ ext{C}_{ ext{R}}^3}
ight) \cdot ( ext{D})}$ 

Open Calculator

$$\boxed{ 0.056155 \text{m/s} = \frac{33 \text{Pa}}{\left(3 \cdot 10.2 \text{P} \cdot \frac{5 \text{m}}{\left(0.45 \text{m}\right)^3}\right) \cdot \left(3.5 \text{m}\right) } }$$

#### 34) Velocity of Piston given Shear Stress

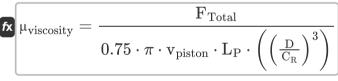


Open Calculator

$$= \frac{93.1 Pa}{1.5 \cdot 3.5 m \cdot \frac{10.2 P}{50 mm \cdot 50 mm}}$$

## When Shear Force is Negligible

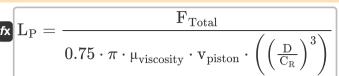
# 35) Dynamic Viscosity for Total Force in piston



$$0.100226 \mathrm{P} = \frac{2.5 \mathrm{N}}{0.75 \cdot \pi \cdot 0.045 \mathrm{m/s} \cdot 5 \mathrm{m} \cdot \left(\left(\frac{3.5 \mathrm{m}}{0.45 \mathrm{m}}\right)^3\right)}$$



## 36) Length of Piston for Total Force in Piston



ex 
$$4.913032 \mathrm{m} = rac{2.5 \mathrm{N}}{0.75 \cdot \pi \cdot 10.2 \mathrm{P} \cdot 0.045 \mathrm{m/s} \cdot \left(\left(rac{3.5 \mathrm{m}}{0.45 \mathrm{m}}\right)^3\right)}$$



#### Variables Used

- **C**<sub>H</sub> Hydraulic Clearance (Millimeter)
- C<sub>R</sub> Radial Clearance (Meter)
- **D** Diameter of Piston (*Meter*)
- dp|dr Pressure Gradient (Newton per Cubic Meter)
- F<sub>Total</sub> Total Force in Piston (Newton)
- **F**<sub>v</sub> Vertical Component of Force (Newton)
- **Fs** Shear Force (Newton)
- Lp Piston Length (Meter)
- Q Discharge in Laminar Flow (Cubic Meter per Second)
- R Horizontal Distance (Meter)
- Tf Total Force (Newton)
- u<sub>Fluid</sub> Fluid Velocity in Pipe (Meter per Second)
- UOiltank Fluid Velocity in Oil Tank (Meter per Second)
- V<sub>piston</sub> Velocity of Piston (Meter per Second)
- **APf** Pressure Drop due to Friction (Pascal)
- **µ**viscosity Dynamic Viscosity (Poise)
- τ Shear Stress (Pascal)





## Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
   Archimedes' constant
- Function: sqrt, sqrt(Number) Square root function
- Measurement: Length in Meter (m), Millimeter (mm)

  Length Unit Conversion
- Measurement: Pressure in Pascal (Pa)
   Pressure Unit Conversion
- Measurement: Speed in Meter per Second (m/s)

  Speed Unit Conversion
- Measurement: Force in Newton (N)
  Force Unit Conversion
- Measurement: Volumetric Flow Rate in Cubic Meter per Second (m³/s)

  Volumetric Flow Rate Unit Conversion
- Measurement: Dynamic Viscosity in Poise (P)

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





#### Check other formula lists

- Dash-Pot Mechanism Formulas
- 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
- Measurement of Viscosity Viscometers Formulas
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