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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

Open Calculator

fx $$L_P = \frac{\Delta Pf}{\left(6 \cdot \mu_{viscosity} \cdot \frac{v_{piston}}{C_R^3}\right) \cdot (0.5 \cdot D + C_R)}$$

ex $$4.963235m = \frac{33Pa}{\left(6 \cdot 10.2P \cdot \frac{0.045m/s}{(0.45m)^3}\right) \cdot (0.5 \cdot 3.5m + 0.45m)}$$

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

Open Calculator

fx $$L_P = \frac{Fs}{\pi \cdot \mu_{viscosity} \cdot v_{piston} \cdot \left(1.5 \cdot \left(\frac{D}{C_R}\right)^2 + 4 \cdot \left(\frac{D}{C_R}\right)\right)}$$

ex $$5.122097m = \frac{90N}{\pi \cdot 10.2P \cdot 0.045m/s \cdot \left(1.5 \cdot \left(\frac{3.5m}{0.45m}\right)^2 + 4 \cdot \left(\frac{3.5m}{0.45m}\right)\right)}$$

3) Length of Piston for Vertical Upward Force on Piston

Open Calculator

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

ex $$5.00236m = \frac{320N}{0.045m/s \cdot \pi \cdot 10.2P \cdot \left(0.75 \cdot \left(\left(\frac{3.5m}{0.45m}\right)^3\right) + 1.5 \cdot \left(\left(\frac{3.5m}{0.45m}\right)^2\right)\right)}$$

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

Open Calculator

fx $$\Delta Pf = \frac{F_v}{0.25 \cdot \pi \cdot D \cdot D}$$

ex $$33.26014\text{Pa} = \frac{320\text{N}}{0.25 \cdot \pi \cdot 3.5\text{m} \cdot 3.5\text{m}}$$

5) Pressure Drop over Piston

Open Calculator

fx $$\Delta Pf = \left(6 \cdot \mu_{viscosity} \cdot v_{piston} \cdot \frac{L_P}{C_R^3}\right) \cdot (0.5 \cdot D + C_R)$$

ex $$33.24444\text{Pa} = \left(6 \cdot 10.2\text{P} \cdot 0.045\text{m/s} \cdot \frac{5\text{m}}{(0.45\text{m})^3}\right) \cdot (0.5 \cdot 3.5\text{m} + 0.45\text{m})$$

6) Pressure Gradient given Rate of Flow

Open Calculator

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

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

7) Pressure Gradient given Velocity of Flow in Oil Tank

Open Calculator

fx $$dp|dr = \frac{\mu_{viscosity} \cdot 2 \cdot \left(u_{Oiltank} - \left(v_{piston} \cdot \frac{R}{C_H}\right)\right)}{R \cdot R - C_H \cdot R}$$

ex $$50.97758\text{N/m}^3 = \frac{10.2\text{P} \cdot 2 \cdot \left(12\text{m/s} - \left(0.045\text{m/s} \cdot \frac{0.7\text{m}}{50\text{mm}}\right)\right)}{0.7\text{m} \cdot 0.7\text{m} - 50\text{mm} \cdot 0.7\text{m}}$$

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8) Shear Force Resisting Motion of Piston

fx Open Calculator

$$Fs = \pi \cdot L_P \cdot \mu_{viscosity} \cdot v_{piston} \cdot \left(1.5 \cdot \left(\frac{D}{C_R}\right)^2 + 4 \cdot \left(\frac{D}{C_R}\right)\right)$$

ex $$87.85464N = \pi \cdot 5m \cdot 10.2P \cdot 0.045m/s \cdot \left(1.5 \cdot \left(\frac{3.5m}{0.45m}\right)^2 + 4 \cdot \left(\frac{3.5m}{0.45m}\right)\right)$$

9) Total Forces

fx $$T_f = F_v + Fs$$ Open Calculator

ex $$410N = 320N + 90N$$

10) Velocity of Flow in Oil Tank

fx Open Calculator

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

ex

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

11) Vertical Force given Total Force

fx $$F_v = Fs - F_{Total}$$ Open Calculator

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

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12) Vertical Upward Force on Piston given Piston Velocity

Open Calculator

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

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

Dynamic Viscosity

13) Dynamic Viscosity for Pressure Reduction over Length of Piston

Open Calculator

fx
$$\mu_{viscosity} = \frac{\Delta Pf}{\left(6 \cdot v_{piston} \cdot \frac{L_P}{C_R^3}\right) \cdot (0.5 \cdot D + C_R)}$$

ex
$$10.125\text{P} = \frac{33\text{Pa}}{\left(6 \cdot 0.045\text{m/s} \cdot \frac{5\text{m}}{(0.45\text{m})^3}\right) \cdot (0.5 \cdot 3.5\text{m} + 0.45\text{m})}$$

14) Dynamic Viscosity for Shear Force Resisting Motion of Piston

Open Calculator

fx
$$\mu_{viscosity} = \frac{Fs}{\pi \cdot L_P \cdot v_{piston} \cdot \left(1.5 \cdot \left(\frac{D}{C_R}\right)^2 + 4 \cdot \left(\frac{D}{C_R}\right)\right)}$$

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

15) Dynamic Viscosity given Rate of Flow

Open Calculator

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

ex $$0.074346P = \frac{60N/m^3 \cdot \frac{(0.45m)^3}{12}}{\left(\frac{55m^3/s}{\pi} \cdot 3.5m\right) + 0.045m/s \cdot 0.5 \cdot 0.45m}$$

16) Dynamic Viscosity given Velocity of Flow in Oil Tank

Open Calculator

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

ex $$10.8076P = 0.5 \cdot 60N/m^3 \cdot \frac{0.7m \cdot 0.7m - 50mm \cdot 0.7m}{12m/s + \left(0.045m/s \cdot \frac{0.7m}{50mm}\right)}$$

Velocity of Piston

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

Open Calculator

fx $$v_{piston} = \frac{Fs}{\pi \cdot \mu_{viscosity} \cdot L_P \cdot \left(1.5 \cdot \left(\frac{D}{C_R}\right)^2 + 4 \cdot \left(\frac{D}{C_R}\right)\right)}$$

ex $$0.046099m/s = \frac{90N}{\pi \cdot 10.2P \cdot 5m \cdot \left(1.5 \cdot \left(\frac{3.5m}{0.45m}\right)^2 + 4 \cdot \left(\frac{3.5m}{0.45m}\right)\right)}$$

18) Velocity of Piston for Vertical Upward Force on Piston

Open Calculator

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

ex
$$0.045021\text{m/s} = \frac{320\text{N}}{5\text{m} \cdot \pi \cdot 10.2\text{P} \cdot \left(0.75 \cdot \left(\left(\frac{3.5\text{m}}{0.45\text{m}}\right)^3\right) + 1.5 \cdot \left(\left(\frac{3.5\text{m}}{0.45\text{m}}\right)^2\right)\right)}$$

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

Open Calculator

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

ex
$$0.098739\text{m/s} = \left(\left(0.5 \cdot 60\text{N/m}^3 \cdot \frac{0.7\text{m} \cdot 0.7\text{m} - 50\text{mm} \cdot 0.7\text{m}}{10.2\text{P}}\right) - 12\text{m/s}\right) \cdot \left(\frac{50\text{mm}}{0.7\text{m}}\right)$$

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

Open Calculator

fx
$$v_{piston} = \frac{\Delta Pf}{\left(6 \cdot \mu_{viscosity} \cdot \frac{L_P}{C_R^3}\right) \cdot (0.5 \cdot D + C_R)}$$

ex
$$0.044669\text{m/s} = \frac{33\text{Pa}}{\left(6 \cdot 10.2\text{P} \cdot \frac{5\text{m}}{(0.45\text{m})^3}\right) \cdot (0.5 \cdot 3.5\text{m} + 0.45\text{m})}$$

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

21) Clearance given Pressure Drop over Length of Piston

Open Calculator

fx $$C_R = \left(3 \cdot D \cdot \mu_{viscosity} \cdot v_{piston} \cdot \frac{L_P}{\Delta Pf}\right)^{\frac{1}{3}}$$

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

Open Calculator

fx $$C_H = \sqrt{1.5 \cdot D \cdot \mu_{viscosity} \cdot \frac{v_{piston}}{\tau}}$$

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

23) Diameter of Piston for Pressure Drop over Length

Open Calculator

fx $$D = \left(\frac{\Delta Pf}{6 \cdot \mu_{viscosity} \cdot v_{piston} \cdot \frac{L_P}{C_R^3}}\right) \cdot 2$$

ex $$4.367647\text{m} = \left(\frac{33\text{Pa}}{6 \cdot 10.2\text{P} \cdot 0.045\text{m/s} \cdot \frac{5\text{m}}{(0.45\text{m})^3}}\right) \cdot 2$$

24) Diameter of Piston given Shear Stress

Open Calculator

fx $$D = \frac{\tau}{1.5 \cdot \mu_{viscosity} \cdot \frac{v_{piston}}{C_H \cdot C_H}}$$

ex $$3.380537\text{m} = \frac{93.1\text{Pa}}{1.5 \cdot 10.2\text{P} \cdot \frac{0.045\text{m/s}}{50\text{mm} \cdot 50\text{mm}}}$$

25) Dynamic Viscosity for Pressure Drop over Length

Open Calculator

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

ex $$12.72857P = \frac{33Pa}{\left(6 \cdot 0.045m/s \cdot \frac{5m}{(0.45m)^3}\right) \cdot (0.5 \cdot 3.5m)}$$

26) Dynamic Viscosity given Shear Stress in Piston

Open Calculator

fx $$\mu_{viscosity} = \frac{\tau}{1.5 \cdot D \cdot \frac{v_{piston}}{C_H \cdot C_H}}$$

ex $$9.851852P = \frac{93.1Pa}{1.5 \cdot 3.5m \cdot \frac{0.045m/s}{50mm \cdot 50mm}}$$

27) Dynamic Viscosity given Velocity of Fluid

Open Calculator

fx $$\mu_{viscosity} = dp|dr \cdot 0.5 \cdot \left(\frac{R^2 - C_H \cdot R}{u_{Fluid}}\right)$$

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

28) Dynamic Viscosity given velocity of piston

Open Calculator

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

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

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

Open Calculator

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

ex $$6.239496\text{m} = \frac{33\text{Pa}}{\left(6 \cdot 10.2\text{P} \cdot \frac{0.045\text{m/s}}{(0.45\text{m})^3}\right) \cdot (0.5 \cdot 3.5\text{m})}$$

30) Pressure Drop over Lengths of Piston

Open Calculator

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

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

31) Pressure Gradient given Velocity of Fluid

Open Calculator

fx $$dp|dr = \frac{u_{Oiltank}}{0.5 \cdot \frac{R \cdot R - C_H \cdot R}{\mu_{viscosity}}}$$

ex $$53.8022\text{N/m}^3 = \frac{12\text{m/s}}{0.5 \cdot \frac{0.7\text{m} \cdot 0.7\text{m} - 50\text{mm} \cdot 0.7\text{m}}{10.2\text{P}}}$$

32) Velocity of Fluid

Open Calculator

fx $$u_{Oiltank} = dp|dr \cdot 0.5 \cdot \frac{R \cdot R - C_H \cdot R}{\mu_{viscosity}}$$

ex $$13.38235\text{m/s} = 60\text{N/m}^3 \cdot 0.5 \cdot \frac{0.7\text{m} \cdot 0.7\text{m} - 50\text{mm} \cdot 0.7\text{m}}{10.2\text{P}}$$

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

Open Calculator

fx $$v_{piston} = \frac{\Delta Pf}{\left(3 \cdot \mu_{viscosity} \cdot \frac{L_P}{C_R^3}\right) \cdot (D)}$$

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

34) Velocity of Piston given Shear Stress

Open Calculator

fx $$v_{piston} = \frac{\tau}{1.5 \cdot D \cdot \frac{\mu_{viscosity}}{C_H \cdot C_H}}$$

ex $$0.043464\text{m/s} = \frac{93.1\text{Pa}}{1.5 \cdot 3.5\text{m} \cdot \frac{10.2\text{P}}{50\text{mm} \cdot 50\text{mm}}}$$

When Shear Force is Negligible

35) Dynamic Viscosity for Total Force in piston

Open Calculator

fx $$\mu_{viscosity} = \frac{F_{Total}}{0.75 \cdot \pi \cdot v_{piston} \cdot L_P \cdot \left(\left(\frac{D}{C_R}\right)^3\right)}$$

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

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36) Length of Piston for Total Force in Piston

Open Calculator

fx $$L_P = \frac{F_{Total}}{0.75 \cdot \pi \cdot \mu_{viscosity} \cdot v_{piston} \cdot \left(\left(\frac{D}{C_R}\right)^3\right)}$$

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

Variables Used

- C_H Hydraulic Clearance *(Millimeter)*
- C_R Radial Clearance *(Meter)*
- **D** Diameter of Piston *(Meter)*
- **dp|dr** Pressure Gradient *(Newton per Cubic Meter)*
- F_{Total} Total Force in Piston *(Newton)*
- F_v Vertical Component of Force *(Newton)*
- **Fs** Shear Force *(Newton)*
- L_P Piston Length *(Meter)*
- **Q** Discharge in Laminar Flow *(Cubic Meter per Second)*
- **R** Horizontal Distance *(Meter)*
- T_f Total Force *(Newton)*
- u_{Fluid} Fluid Velocity in Pipe *(Meter per Second)*
- $u_{Oiltank}$ Fluid Velocity in Oil Tank *(Meter per Second)*
- v_{piston} Velocity of Piston *(Meter per Second)*
- **ΔPf** Pressure Drop due to Friction *(Pascal)*
- $\mu_{viscosity}$ Dynamic Viscosity *(Poise)*
- τ Shear Stress *(Pascal)*

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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 (m^3/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/m^3)
  Pressure Gradient Unit Conversion
- Measurement: **Stress** in Pascal (Pa)
  Stress Unit Conversion

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