

Hydraulic Formulas

The following formulas can be helpful in designing and sizing hydraulic systems for specific applications.

$$\text{psi} = \frac{F}{A} \quad \begin{array}{l} \text{Fluid pressure (psi)} = \\ \text{Force (lbs.)} \div \text{Area (sq. in.)} \end{array}$$

$$A = \pi r^2 \quad \begin{array}{l} \text{Cylinder area (sq. in.)} = \\ 3.1416 \times \text{Radius}^2 \text{ (in.)} \end{array}$$

$$F = PA \quad \begin{array}{l} \text{Cylinder force (lbs.)} = \\ \text{Pressure (psi)} \times \text{Area (sq. in.)} \end{array}$$

$$V = \frac{.3208Q}{A} \quad \begin{array}{l} \text{Cylinder speed (ft./sec.)} = \\ (231 \times \text{GPM}) \div (12 \times 60 \times \text{Area}) \end{array}$$

$$\text{HP} = \frac{QP}{1714} \quad \begin{array}{l} \text{Hydraulic horsepower} = \\ \text{Pressure (psi)} \times \text{GPM} \div 1714 \end{array}$$

$$T = \frac{PD}{2\pi} \quad \begin{array}{l} \text{Fluid motor torque (in. -lbs.)} = \\ \text{Pressure (psi)} \times \text{displ. (cu. in.)} \div 62822 \end{array}$$

$$N = \frac{231 Q}{d} \quad \begin{array}{l} \text{Fluid motor speed (RPM)} = \\ 231 \times \text{GPM} \div \text{displ. (cu. in.)} \end{array}$$

$$\text{HP} = \frac{TN}{63025} \quad \begin{array}{l} \text{Fluid motor horsepower} = \\ \text{Torque (in. -lbs.)} \times \text{RPM} \div 63025 \end{array}$$

$$Q = \frac{ND}{231} \quad \begin{array}{l} \text{Pump output flow (GPM)} = \\ \text{Speed (RPM)} \times \text{displ. (cu. in.)} \div 231 \end{array}$$

$$1 \text{ Gallon} = 231 \text{ Cubic Inches}$$

$$\text{Input HP} = \text{psi} \times \text{GPM} \times .0007$$

$$\text{Hydraulic Motor HP} = \text{Torque} \times \text{RPM} \div 63025$$

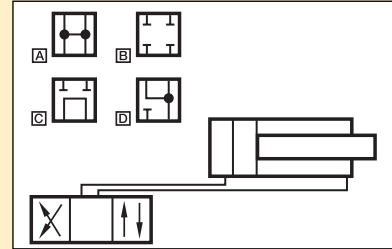
$$\text{Volume (in.}^3\text{)} = \text{Area (in.}^2\text{)} \times \text{Stroke (in.)}$$

$$\text{Area} = (\text{Piston Dia.})^2 \times .7854$$

$$\text{Flow (GPM)} = \frac{\text{Rod Speed (in./min.)} \times \text{Area (in.}^2\text{)}}{231}$$

$$\text{Force (lbs.)} = \frac{\text{Pressure Applied (psi)} \times \text{Piston Area (in.}^2\text{)}}{231}$$

Spool Schematic



A Open Center

Used when cylinder "drift" is necessary under pressure (i.e. snow plow blade)

B Closed Center

Used when cylinder must lock into place along travel path and fluid flow from supply is blocked completely (i.e. air-powered press)

C Tandem Center

Same as "B" but allows fluid to flow through valve, reducing created fluid heat and facilitating more functions downstream (i.e. multiple valves in series)

D Float Center

In the center position the cylinder can move free-wheeling in or out under no pressure (i.e. free-wheeling hydraulic motor)