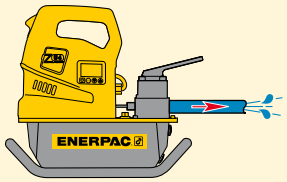
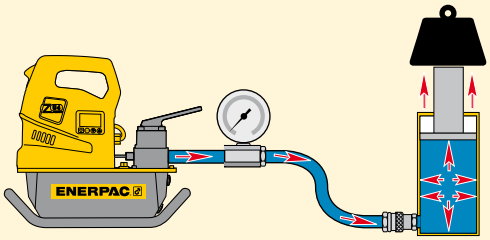
Flow

A hydraulic pump produces flow.



Pressure

Pressure occurs when there is resistance to flow.



Pascal's Law

Pressure applied at any point upon a confined liquid is transmitted undiminished in all directions (Fig.1). This means that when more than one hydraulic cylinder is being used, each cylinder will lift at its own rate, depending on the force required to move the load at that point (Fig. 2).

Cylinders with the lightest load will move first, and cylinders with the heaviest load will move last (Load A), as long as the cylinders have the same capacity.

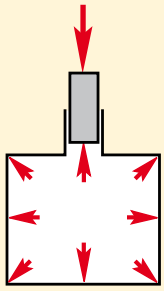


Figure 1

To have all cylinders operate uniformly so that the load is being lifted at the same rate at each point, either control valves (see Valve section) or Synchronous Lift System components (see Cylinder section) must be added to the system (Load B).

INCORRECT! **CORRECT!**

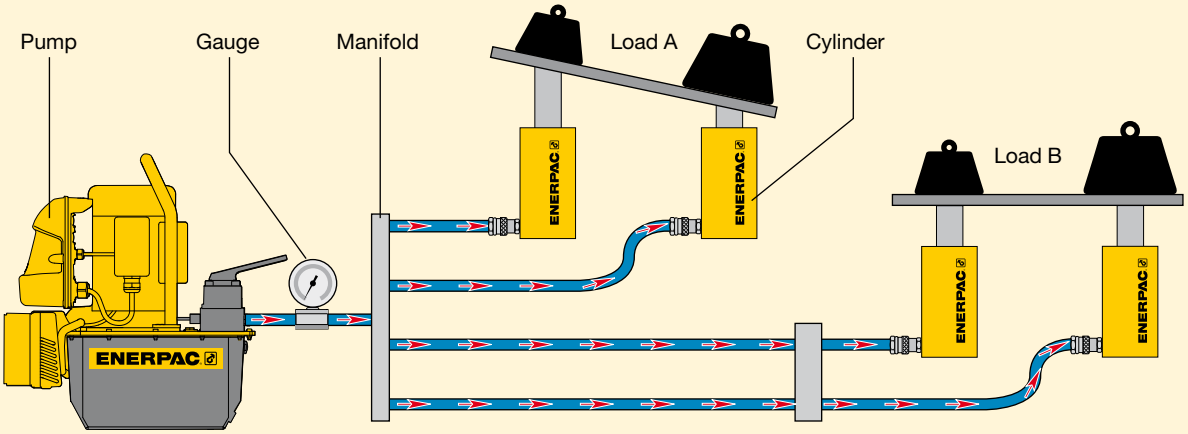


Figure 2

Synchronous Lift or Control Valves to provide uniform lifting of load.

CAUTION!
When lifting or pressing, always use a gauge.

A gauge is your 'window' to the system. It lets you see what's going on. You will find the gauges in the System Components section.

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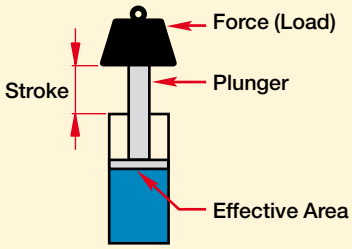
Learn more about hydraulics

Visit **www.enerpac.com** to learn more about hydraulics and system set-ups.

Force

The amount of force a hydraulic cylinder can generate is equal to the hydraulic pressure times the "effective area" of the cylinder (see cylinder selection charts).



Force	=	Hydraulic Working Pressure	x	Cylinder Effective Area
F	=	P	x	A

Use this formula to determine either force, pressure or effective area if two of the variables are known.

Example 1
An RC-106 cylinder with 14,5 cm^2 effective area operating at 700 bar will generate what force?
Force = 7000 N/cm^2 x 14,5 cm^2 = 101500 N = 101,5 kN

Example 2
An RC-106 cylinder lifting 7000 kg will require what pressure?
Pressure = 7000 x 9,8 N ÷ 14,5 cm^2 = 4731,0 N/cm^2 = 473 bar.

Example 3
An RC-256 cylinder is required to produce a force of 190.000 N. What pressure is required?
Pressure = 190.000 N ÷ 33,2 cm^2 = 5722,9 N/cm^2 = 572 bar.

Example 4
Four RC-308 cylinders are required to produce a force of 800.000 N. What pressure is required?
Pressure = 800.000 N ÷ (4 x 42,1 cm^2) = 4750,6 N/cm^2 = 476 bar.
Remember, since four cylinders are used together, the area for one cylinder must be multiplied by the number of cylinders used.

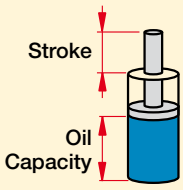
Example 5
A CLL-2506 cylinder is going to be used with a power source that is capable of 500 bar. What is the theoretical force available from that cylinder?
Force = 5000 N/cm^2 x 366,4 cm^2 = 1.832.000 N = 1832 kN.

Cylinder Oil Capacity

The volume of oil required for a cylinder (cylinder oil capacity) is equal to the effective area of the cylinder times the stroke*.

Cylinder Oil Capacity	=	Cylinder Effective Area	x	Cylinder Stroke

* Note: these are theoretical examples and do not take into account the compressibility of oil under high pressure.



Example 1:
An RC-158 cylinder with 20,3 cm^2 effective area and 200 mm stroke requires what volume of oil?
Oil Capacity = 20,3 cm^2 x 20 cm = 406 cm^3

Example 2:
An RC-5013 cylinder has an effective area of 71,2 cm^2 and a stroke of 320 mm. How much oil will be required?
Oil Capacity = 71,2 cm^2 x 32 cm = 2278,4 cm^3

Example 3:
An RC-10010 cylinder has an effective area of 133,3 cm^2 and a stroke of 260 mm. How much oil will it require?
Oil Capacity = 133,3 cm^2 x 26 cm = 3466 cm^3

Example 4:
Four RC-308 cylinders are being used, each with an effective area of 42,1 cm^2 and a stroke of 209 mm. How much oil will be required?
Oil Capacity = 42,1 cm^2 x 20,9 cm = 880 cm^3 for one cylinder
Multiply by four to obtain the required capacity: 3520 cm^3

CAUTION!
Enerpac oil will compress 2,28% at 350 bar and 4,1% at 700 bar.

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