

Hand pumps

Economical and portable hand pumps have many uses, including jacking, clamping, applications where electrical power is not available, or as an emergency power source.

Within the body of a hand pump are a vented reservoir, some check valves, and a reciprocating piston powered by a lever. When the lever is cycled up and down manually, the piston strokes to generate fluid flow and eventually move a load. The built-in check valves prevent loss of pressure during the process. If a hand pump discharges fluid during one direction of lever motion and has a free return, it is a single-acting pump. If its configuration allows discharge flow during both directions of lever motion, it is double acting, Figure 1.

The length of the lever arm provides a mechanical advantage to increase the operator's input force, Figure 2. If the lever handle is 10 in. from the fulcrum and the piston is 1 in. from the fulcrum, and the operator applies a 100-lb force

to the handle, the force applied to the piston will be 2000 lb. If the piston has a 1.5-in. diameter (1.96-in.² area), the pressure that could be generated by that force would be (2000/0.0196) or slightly more than 10,000 psi. Of course the piston stroke would be short compared to the lever stroke, and flow would be modest, so hand pumps are best suited for applications requiring low flow at high pressure.

In a single-acting pump, raising the handle creates a vacuum beneath the pump piston the inlet stroke. Atmospheric pressure on the fluid in the pump's reservoir now can override the spring force holding the inlet check valve seated and fluid enters the pumping cavity. At the top of the handle stroke, the spring reseats the inlet check.

As the handle begins its downward stroke, pressure builds in the trapped fluid under the piston and the discharge check valve unseats. The piston now forces fluid into the system. At the end of the downward stroke, the discharge check reseats and the pump is ready to repeat its manual cycle. Double-acting hand pumps follow the same principle of operation, but deliver fluid with each stroke of the handle, rather than only with the downward stroke.

Two-speed hand pumps use two pumping pistons to provide a high volume of fluid at low pressure in the first stage of operation, and less volume at higher pressures in the second stage.

How many strokes are needed on the handle of a hand pump to move a load? To answer that question, determine the volume of fluid required, and divide that figure by the displacement per stroke of the hand pump.

For example: to stroke the piston of a 4-in. bore cylinder a distance of 3 in., the volume of oil needed is (piston area times distance) or 37.71 in.³. If the pump displaces 0.5 in.³/stroke, you will need 76 strokes to do the job.

Because of their greater displacements per lever cycle, both double-acting and two-speed hand pumps reduce the time for a manual pump to complete a job. One manufacturer, when comparing the capabilities of a two-speed pump, determined that to stroke a particular cylinder 10 in., a single-acting pump required 140 strokes, while a two-speed pump needed only 74 strokes.

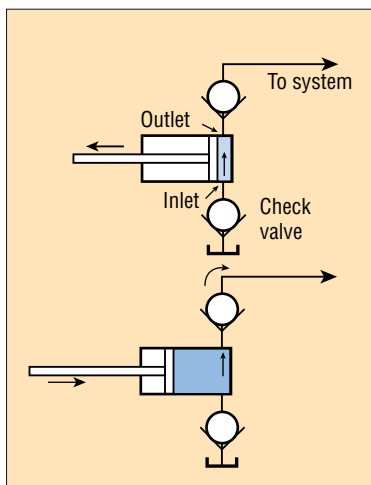


Fig. 1. Diagram of reciprocating hand pump. Liquid is drawn in during extension, discharged during retraction.



Fig. 2. Pump's lever arm has 3-position, quick-change fulcrum which provides three different mechanical advantages for three output flows and pressures.