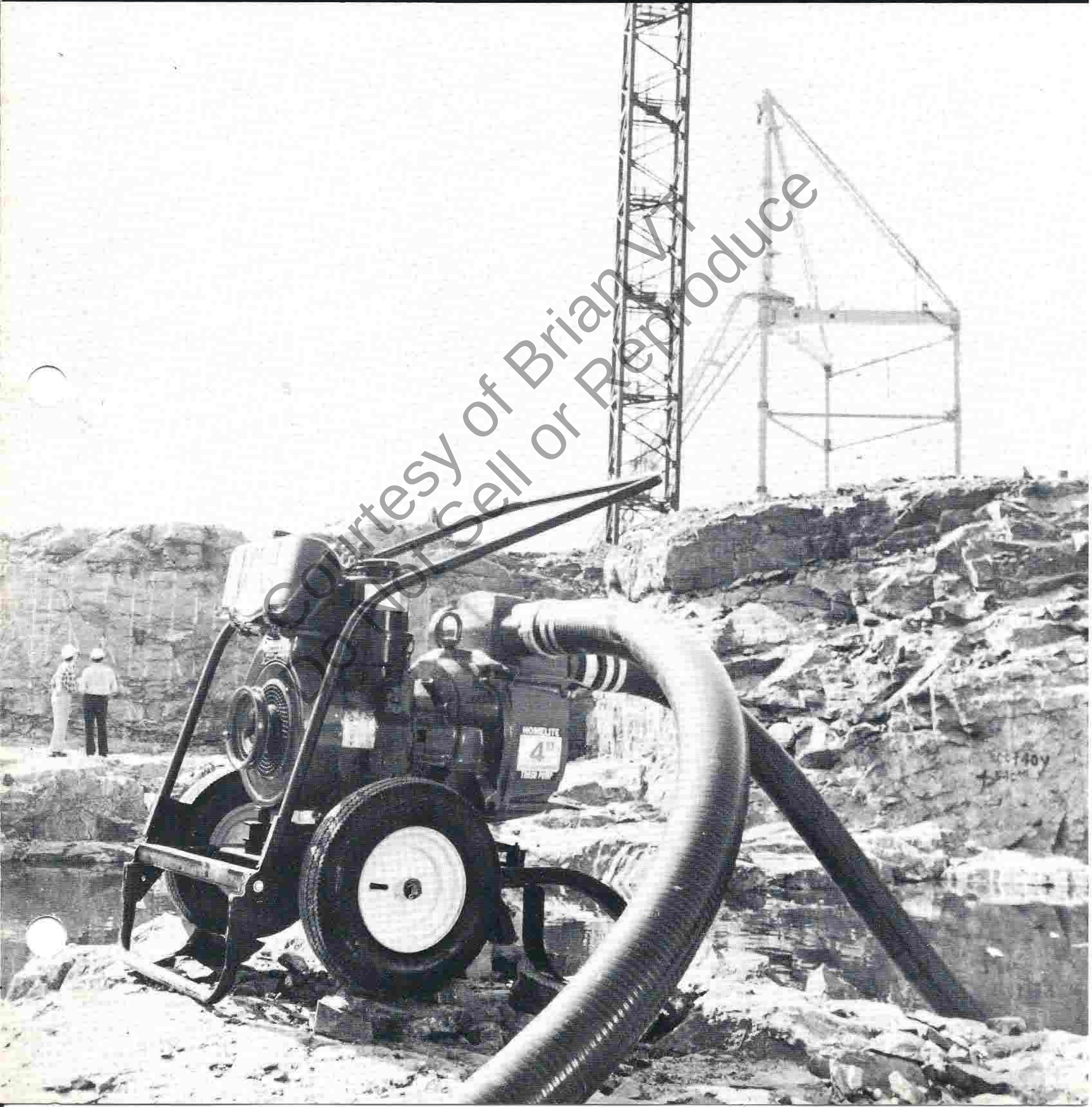
HOMELITE®

PUMP BASICS



The Evolution of Pumps

The first economical method of lifting water by mechanical means dates back to the Egyptian and Chinese dynasties around 1500 B. C. These early devices called "sweeps" were movable wooden troughs supported on the end of a lever. They scooped up water at one elevation and transported it a short distance to an irrigation ditch at another level. The mechanical energy used to accomplish this was provided by man; later domesticated animals provided the power source. Although simple in design, these machines are still used to irrigate crops throughout the Far East, as well as in Mexico and South America.

Later pump designs used a wheel with a series of buckets arranged to drop water into long wooden troughs. Not until the late 18th century was the steam engine developed to a point where a steam cylinder could power a pump plunger causing a column of water to be lifted equal in weight to the plunger itself. This early pump was powered by the "Cornish" engine, and effectively used in dewatering the mines of Cornwall, England.

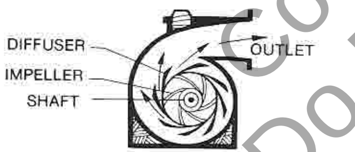
Later development of the 2-cycle and 4-cycle air-cooled gasoline engine in the early 20th century provided a source of efficient power for running small portable pumps.

Today Homelite, a leader in the design and manufacture of portable pumps, markets a variety of gasoline engine and electric motor driven pumps for many applications, including construction, farming, mining, firefighting, and marine use.

How they work

There are basically four types of self-priming pump designs: centrifugal, diaphragm, piston and gear. The two most popular are the centrifugal and diaphragm types. The self-priming centrifugal type includes trash, pressure, and submersible pumps.

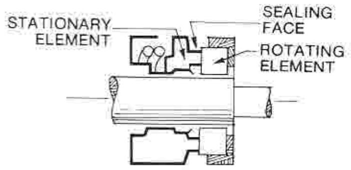
The centrifugal group uses an impeller mounted in a housing called the volute. The impeller is driven by the engine drive shaft



creating a vacuum within the pump. Atmospheric pressure then pushes the pumped medium (e.g., water) up the suction pipe. While technically atmospheric pressure has forced the water into the pump, we refer to the pump as having "pulled a vacuum."

The water fills the pump body where the action of the rotating impeller forces the water against the internal surface of the volute through centrifugal force. The impeller always reduces the pressure at the impeller eye to a level well below suction pressure. The impeller design is what creates the vacuum; the volute channels the water to the discharge outlet.

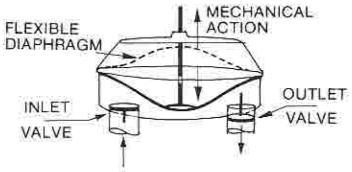
Air is kept from entering the pump body by use of a seal permanently affixed to the impeller where it is mounted to the drive shaft. Another shaft seal ring is attached to the inside of the pump body. The two seals are pressed together forming an air tight chamber. By design these seals can be



either self-lubricating with water acting as the lubricating agent, or packed with grease for lubrication as the shaft turns.

Diaphragm pumps also are a self-priming design, but they incorporate a heavy rubber elastomer diaphragm to form a water chamber, instead of the impeller and volute as used in centrifugal designs. The diaphragm is a large disc, sealed and attached with bolts to the pump body.

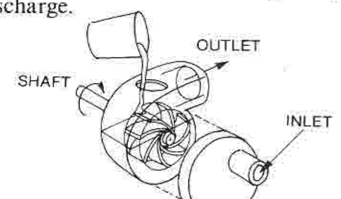
A rod driven by the engine crankshaft



moves the center of the flexible diaphragm in and out creating a vacuum. As the rod pulls on the diaphragm, water is pulled into the pump. The pressure forces a flapper valve to close the suction side at the full stroke of the rod. With the valve shut, the rod pushes the diaphragm in the opposite direction and the pressure opens a discharge valve, forcing the water out of the pump and completing one full cycle. This cycle occurs about 50-70 times a minute.

What is a Self-Priming Pump and how does it work?

A true "self-priming pump" is one that will clear its passages of air if it becomes airbound and resume delivery of the pumped liquid without outside attention. Therefore, its basic requirement is that the pumped liquid retain air (in the form of bubbles) so that the air will be removed from its suction side. The air must be allowed to separate from the liquid once the mixture of the two has been discharged by the impeller, and the separated air must be allowed to escape or to be swept out through the pump discharge.



The self-priming feature of many pumps permits the pump to continue to run even when the minimum pumping capacity is greater than the seepage of water. Under these conditions the pump will pull in amounts of water mixed with air, which is separated in a specially designed reservoir. The air is pushed into the discharge line, while the water is returned to the recirculating port to help remove more air from the suction line.

For self-priming to occur, the pump body must be filled with water when first starting the pump. This initial prime remains in the pump and manual re-priming is not needed later.

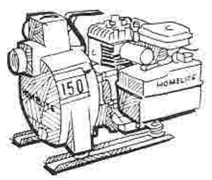
There is the danger, however, that a self-priming pump left running too long on seepage without actually pumping will eventually evacuate all the water in the pump. The seals can burn out and the pump will no longer self-prime. The manufacturer's specifications should be checked for maximum operating time on seepage. It should be remembered that the pump's ability to operate on seepage is a result of and not the reason for the self-priming feature.

As air is removed from the suction line a partial vacuum is created which permits water to flow directly into the impeller housing, and the impeller forces the water out the discharge side of the pump. Because of the self-priming feature, water will always remain in the pump body permitting the pump to automatically reprime when air is no longer present with the water in the suction line, or when the pump must be restarted.

Types of Pumps and the work they do

Portable pumps generally refer to those sold with discharge sizes ranging from 1½" to 4", and powered by either 2 or 4-cycle gasoline air-cooled engines or electric motors. Pumps of this type are easily carried and transported by one or two men, and many are designed with a center balanced eye for crane lifting.

The Homelite line of gasoline engine powered models include centrifugals, trash, pressure, and diaphragm pumps. The submersible pumps and some diaphragm models are driven by electric motors up to 3¾ horsepower.



Centrifugal Pumps

The self-priming centrifugal is an all-purpose general dewatering pump, with the ability to handle large volumes of water mixed with small spherical solids (approximately ¼ the diameter of the suction hose). A strainer at the end of the suction hose is matched to the size of the pump, and the size of the strainer holes determine the diameter of the solids allowed to enter the pump.

Small solids can be passed through the suction hose and into the pump body, and the sharp impeller will chop up small fiberous materials such as roots. But larger solids will clog the strainer causing pump inefficiency until cleaned and removed.

Centrifugal pumps are easy to operate and maintain because of simple construction with a minimum of moving parts. Periodic maintenance is all that's required.

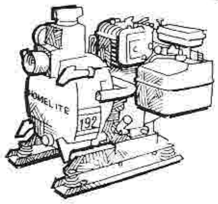
APPLICATION. The primary use of centrifugal pumps is for handling clear water which is principally void of debris, where combinations of volume and pressure are needed. The main advantages of using this type of pump is a relatively high head and high volume of water, which can be pumped with a fast priming time.

While in use the pump should be on a solid footing and located not higher than 28 feet above the water at sea level. Some pumps will lift water as much as 28 feet at sea level, but it is more efficient if the distance of the suction lift is as short as possible. This allows the pumping capacity to increase.

These pumps are ideal for construction site use to control flooding in trenches . . . excavations . . . pipelines . . . manholes . . . and coffer dams. Other applications include utility and municipal use for pipe and sewer installations, and emergency service.

Trash Pumps

Self-priming trash pumps are similar in design as the standard centrifugal pump, but the impeller is an open type constructed with fewer vanes and larger passages in the volute. This difference in design permits



trash pumps to move water mixed with a large amount of solids up to 25% of volume, although the greater the incidence of solids, the higher the horsepower requirements for the pump.

Dewatering jobs which might normally clog a standard centrifugal pump can be tackled with a trash pump which will handle solids like mud, sticks, sand, gravel, leaves, tank sludge, and industrial waste water.

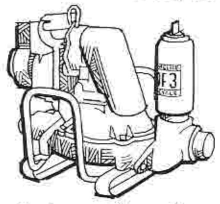
Hand tightened wing nuts on the pump end allow quick cleanout of the pump body to remove larger solids which do not pass through the discharge. The strainer on the end of the suction hose has large holes through which the water and solids enter. The size of the holes are matched to the pump and suction hose diameter.

APPLICATION. These pumps are used for clean water conditions in place of a standard centrifugal pump, or for removing water mixed with solids. Trash pumps are basically dual purpose, and suitable for construction site dewatering where fast priming time and relatively high heads are needed. They are excellent for high volume seepage control and high output pumping of excavations, drainage ditches, foundations, and catch basins.

Diaphragm Pumps

Homelite portable diaphragm pumps range in output size up to 3" and are powered by either gasoline air-cooled engines or electric motors. Built with straight-through self-priming design, this positive displacement type of pump will handle liquids mixed with abrasive solids such as mud, sand, silt, and sludge. Diaphragm pumps will move water mixed with high percentages of air and solids, making them ideal for controlling slow variable seepage for trench and foundation work.

Dry pumping will not damage a diaphragm pump and, due to their slower pumping action, smaller engines are used giving high fuel economy. The elastomer diaphragm and flapper valves are easily replaced, and maintenance is minimal because of few moving parts. These pumps deliver total head of about 50 feet with rela-



tively low discharge flow. Care should be taken, for positive displacement pumps must be operated with obstruction free discharge.

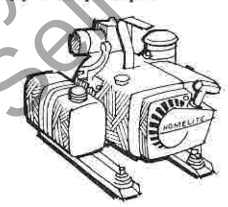
APPLICATION. Diaphragm pumps are suitable for controlling seepage in trenches and small excavations where water level is low and the pump runs for many hours. They are excellent for pumping out septic tanks and well point systems, and are equally useful under other conditions where large amounts of air and abrasive solids are pulled into the pump.

When a high suction lift is needed for controlling variable seepage, a foot valve and strainer can be attached to the suction hose to speed priming time and keep a drier foundation.

Diaphragm pumps are used by contractors, municipalities, and industrial maintenance crews for draining ditches and ponds, and around structural footings.

Pressure Pumps

Pressure pumps are intended primarily for handling clean water without solids and debris. They are used to deliver high pressure at relatively high output capacities, under conditions where hose lines are long or discharge heights are exceptional in elevation. Homelite pressure pumps deliver a high total head up to 510 feet and, although they are furnished with an exhaust priming feature, the priming time is slow compared to other types of pumps.



A pressure gauge is built into the discharge fitting of the pump to give an accurate measurement in pounds per square inch (P.S.I.). Increasing the throttle speed will create greater pressure at the discharge side of the pump.

APPLICATION. For fire and emergency use, pressure pumps provide reliable performance and easy portability. They can also be used for powering sprinkling systems, and for jetting, irrigation, high pressure equipment washing, and water supply pumping.

Submersible Pumps

Driven by an electric motor in a common housing with the pump, submersibles are completely watertight and require no priming. They are submerged below the water surface and power is supplied from a control box on dry ground through a waterproof electric cable. The discharge hose is connected at the top of the pump and the hose line is run out of the water to an area where the liquid is to be pumped.

Submersible pumps overcome the disadvantage of other pumps by being able to pump water at low depths without the restriction of a 28 foot suction lift. They also run quietly without fumes and do not require a suction hose. This type of pump has the strainer built into the bottom, and it will move water mixed with small solids. Priming time is immediate and a total head up to 80 feet can be attained.

Features include a thermal cutout and overcurrent circuit breaker to prevent motor burnout and overheating . . . and a level control which automatically controls pump operation at predetermined water levels.

APPLICATION. Submersible pumps are used to control variable seepage around structural footings, coffer dams, ditches, deep pilings, and manholes. They are also excellent for pumping relatively clear water and require little maintenance.

Pumps of this type are used by contractors, mining operations, utilities and municipalities, and industrial crews.

The effects of altitude on pump performance

The height to which water can be lifted at sea level is effectively limited to 28 feet, and the lift capability of any pump is reduced with any increase in flow requirement.

This is due to the effects of atmospheric pressure or the weight of air exerted on the water within the suction line. More water can be pumped if the suction lift is kept as short as possible. As lifts approach 28 feet, output capacity will drop accordingly.

Pumping water at elevations above sea level will decrease the amount of suction lift capability and lower the horsepower output of gasoline engines, which will cause less pump output capacity and head. At higher elevations suction lift must be reduced so the pump can take in the same amount of water it could at sea level and keep from overloading the engine.

Diesel vs. Gasoline

Trash pumps are available with both diesel and gasoline fuel engines. There are distinct advantages for both. Gasoline engines are lower in initial cost and are easily maintained and serviced by thousands of competent servicing dealers. Diesel engines have a higher initial cost than gasoline engines but diesel fuel is normally lower than gasoline. The diesel engine is more efficient and therefore uses less fuel than gasoline engines. The fuel consumption per horsepower of a diesel engine at full load is up to 43% lower than an equivalent gasoline engine. Since spark-type ignition systems are not used on diesel engines, maintenance is less because spark plugs, points, condensers, magnetos and distributors are eliminated.

Operational Tips

Suction Lift — The centrifugal types of pumps will give a suction lift up to 28 feet, but it is best to keep the length of the suction hose as short as possible for greater pump efficiency.

Placing the Pump — The pump should be set on solid ground and not in soft dirt. When the pump is running, some vibration is present and an improperly placed pump may shift position and fall into the excavation.

Suction Hose and Pipe Connections — Hose connections should be made tight against the threaded pump fittings, and a hose washer used to create an air tight connection. Hoses should be periodically inspected for excessive wear, holes, cuts, and collapsed liners. Pipe compound can be used to prevent air leaks at the fitting. Leaks will affect both pump output capacity and the ability of the pump to prime.

If pipe is used a minimum amount of elbows and right angle bends should be taken into consideration, for all this will affect output performance. The pipe should not be supported by the pump, but have its own supports which can be made of wood.

Strainers — A strainer matched for the suction hose diameter should be used to prevent stalling and possible damage to the pump impeller. It should be periodically checked for clogging.

Discharge Hose and Pipe Connections — Washers should be placed in the hose fittings and connections made tight. Either collapsible or rigid hose may be used, but when using long runs of pipe the diameter should be one size larger than the discharge fitting. This will prevent a loss in pump performance caused by internal friction of the pipe. Discharge hose lengths should be kept to a minimum for greatest pump capacity.

A check valve should be installed in the discharge line for jobs where high heads are required, and where vertical discharge line runs exceed 30 feet. The valve will limit the amount of water back pressure from a discharge line placed in a vertical position.

Priming — It is advisable to place a pump not higher than 15 feet above the water source for best performance. Self-priming pumps must be manually primed the first time by removing the priming plug at the top of the pump body, filling the casing with water, and replacing the plug. Fast priming can be achieved by limiting the length of the suction lift. Back pressure must be eliminated from the discharge line for priming to occur.

Shaft Seals — Most pumps use a self-lubricating type of seal which requires no maintenance. Other types require grease or oil for lubrication and these should be checked about every six months. Refer to the pump owner's manual for proper care.

Maintenance Schedule

Conscientious periodic maintenance will insure long service life from your equipment. Pumps should not be run dry. Run the engine at reasonable speed to prevent damage and excessive wear. In cold weather drain the pump of water to prevent freezing, and store in a dry place. Other maintenance should be performed as follows:

Every Month — Check for noise or excessive vibration. Check for air or water leakage around shaft seals and hose fittings. Determine if any adjustment to the carburetor is needed, and in the case of four-cycle engines, replace crankcase oil every 50 hours of operation with high grade engine oil, or in accordance with the manufacturer's specifications.

Every Six Months — Check impeller for broken vanes and nicks. Replace shaft seals. Check engine parts for wear and replace as needed. Perform engine tuneup and replace spark plug. Change crankcase oil and lubricate bearings as needed.

Every Year — If a pump has had heavy use, open pump body and clean all interior parts. Clean out engine crankcase and refill with clean oil of high quality. Remove engine head and clean off all carbon deposits.

ALWAYS REFER TO THE OWNER'S MANUAL FOR PROPER SERVICING INSTRUCTIONS.

Glossary

Air Bound — A condition which occurs when a pump body is filled with air and a vacuum can no longer be formed to pull water into the pump. This condition does not occur with positive displacement.

Capacity — The total volume of liquid a pump can move in a given amount of time. Usually measured in gallons per minute or gallons per hour.

Dewatering — The function whereby water is moved from one area to another by use of a pump.

Discharge Hose — A hose or tube used to carry water from the discharge side of the pump.

Dynamic Suction Head — The same as total suction head. The static suction lift plus suction line friction.

Dynamic Discharge Head — The same as total discharge head. The static discharge head, plus the friction in the discharge line.

Fittings — Couplings connected to the suction and discharge hose. They are threaded on the inside for tight connection to the pump.

G.P.M./G.P.H. — A unit of measurement used to determine the water handling capability of a pump. Pump capacity can be expressed in either gallons per minute or gallons per hour.

Hazardous Material — Any poisonous, volatile, explosive or flammable fluid which should not be moved with a pump designed for dewatering with gasoline or diesel driven engines.

Impeller — A set of rotating vanes connected to the drive shaft within the pump body. When they are rotated, they create a partial vacuum, drawing fluid through the pump in an apparent suction.

Self-Priming — The ability of a pump to separate air from water and create a partial vacuum or low-pressue area in the pump body. This causes water to flow to the impeller and on through the pump. The pump evacuates the air and the resultant vacuum produces what is commonly referred to as suction. After all air is removed from the suction line, atmospheric pressure forces water in and discharges it through the opposite side of the pump.

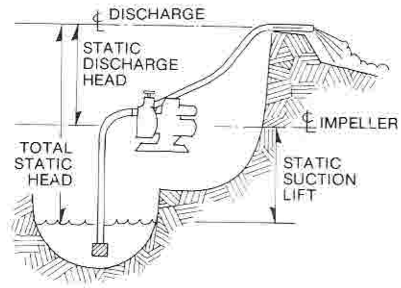
Shaft Seal — A device mounted on the drive shaft between the impeller and the inside pump housing, which creates an air tight chamber within the housing.

Spherical Solids — Particles of mud, sand, leaves, gravel and roots which are mixed with water and pass through the pump.

Spanner Wrench — An open end wrench designed for tightening hose couplings to the suction or discharge fittings on the pump body.

Strainer — A round fitting at the end of the suction hose which is matched to the size of the pump and permits solids of only a certain size to enter the pump body. The strainer eliminates potential damage to the impeller.

Static Suction Lift — The vertical distance from the center of the pump impeller connection to the surface of the liquid to be pumped.



Static Discharge Head — The vertical distance from the center line of the impeller on the pump to the point of discharge or liquid level when discharging into a tank where the pipe is immersed in the liquid.

Suction Hose — A flexible hose connected to the suction side of the pump and made of heavy rubber or plastic tubing with a reinforced inner wall to prevent collapsing.

Total Dynamic Head — The same as total head. The dynamic suction head plus the dynamic discharge head. (If this head is measured by gauges, it is necessary either to add or subtract the vertical distance between the suction and discharge gauge to the dynamic suction head and dynamic discharge head indicated by the gauges.)

Variable Seepage — The slow entering of water from either a water table or runoff with a continuous flow into an excavation or ditch.

Volute — The housing in which the impeller rotates, with channels cast into the metal to direct the flow of water in a given direction.

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