SUBMERSIBLE WATER PUMPS

Submersible pumps are installed in either shallow or deep wells. They are efficient, can produce a high capacity water flow and high pressures, require very little maintenance, and generally are economical to use in sand free wells.

A submersible water pump is a small diameter, vertical, multi-stage centrifugal pump, close-coupled to a water cooled electric motor which is usually water lubricated (Figure 1). In operation the entire pump and motor assembly are submerged in the water. Thus it is self-priming. Power is supplied through waterproof cables which are spliced onto the motor leads with a waterproof splicing kit.

Two and three wire motors are used on submersible pumps. The capacitors and relays are located inside the motor on the two-wire models, while on three-wire models the capacitors and relays are located at the ground surface for easier maintenance. Submerged, the motor is very susceptible to power surges caused by lightning. To counter this, newer models have a built in lightning arrestor.

Figure 1 — A Submersible Pump

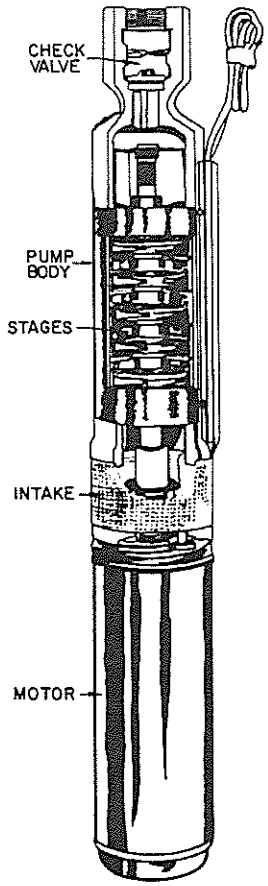

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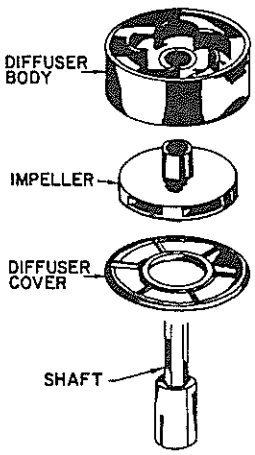
Figure 2 — the Components of each stage in a submersible pump



Operation

The pressure obtained from a submersible pump varies with the number of built in stages. Each stage consists of an impeller, diffuser body and diffuser cover (See Figure 2). The diffuser's stationary vanes convert the high velocity water coming from the impeller (which is spinning at 3450 rpm), to pressure, and directs the water to the eye of the next impeller. Each stage in a 100 millimetre (4 in.) pump adds about 60 kPA (10 psi) to the pressure generated by the entire unit. The capacity and pressure of the pump varies with the design and number of the impellers in the unit.

Like other centrifugal pumps, the capacity and power requirement of a submersible pump are reduced as the well depth or discharge pressure increases. When operating at low pressure the motor can be overworked.

Limitations

These types of pumps do not work efficiently in sandy wells. Since there is very little tolerance between the impellers and diffusers, any amount of sand or other abrasive can damage these working parts.

Submersible motors are water cooled and usually water lubricated. They should not be used in wells which may pump dry, unless protected by a pump down liquid level control, a low pressure cut-out switch, or devices which automatically slow down the pumping rate when the water level drops. A submersible pump may also lose its prime in wells containing a high concentration of dissolved gases.

The dissolved gas air-locks the impellers preventing them from pumping water.

Four factors to consider when choosing any pump are well yield, the pumping static water level, the capacity, and the pressure required. Be sure the pump cannot over-work the well (pumping capacity exceeds well yield) and the well head pressure does not exceed the pressure rating of the piping. Also, if the pump can produce more than 560 kPa (80 psi) at the pressure tank, a pressure relief valve should be installed.

Installation

A typical installation for a submersible pump, including the pressure tank and fittings, is shown in Figure 3. Before the pump is installed it should first be tested on the ground surface. To do this, hook up the electrical wires to the pump (use the control box on three-wire units), submerge the pump in a container of water, and run the unit for several minutes. If it appears to run smoothly, and at a constant speed, it can be installed in the well.

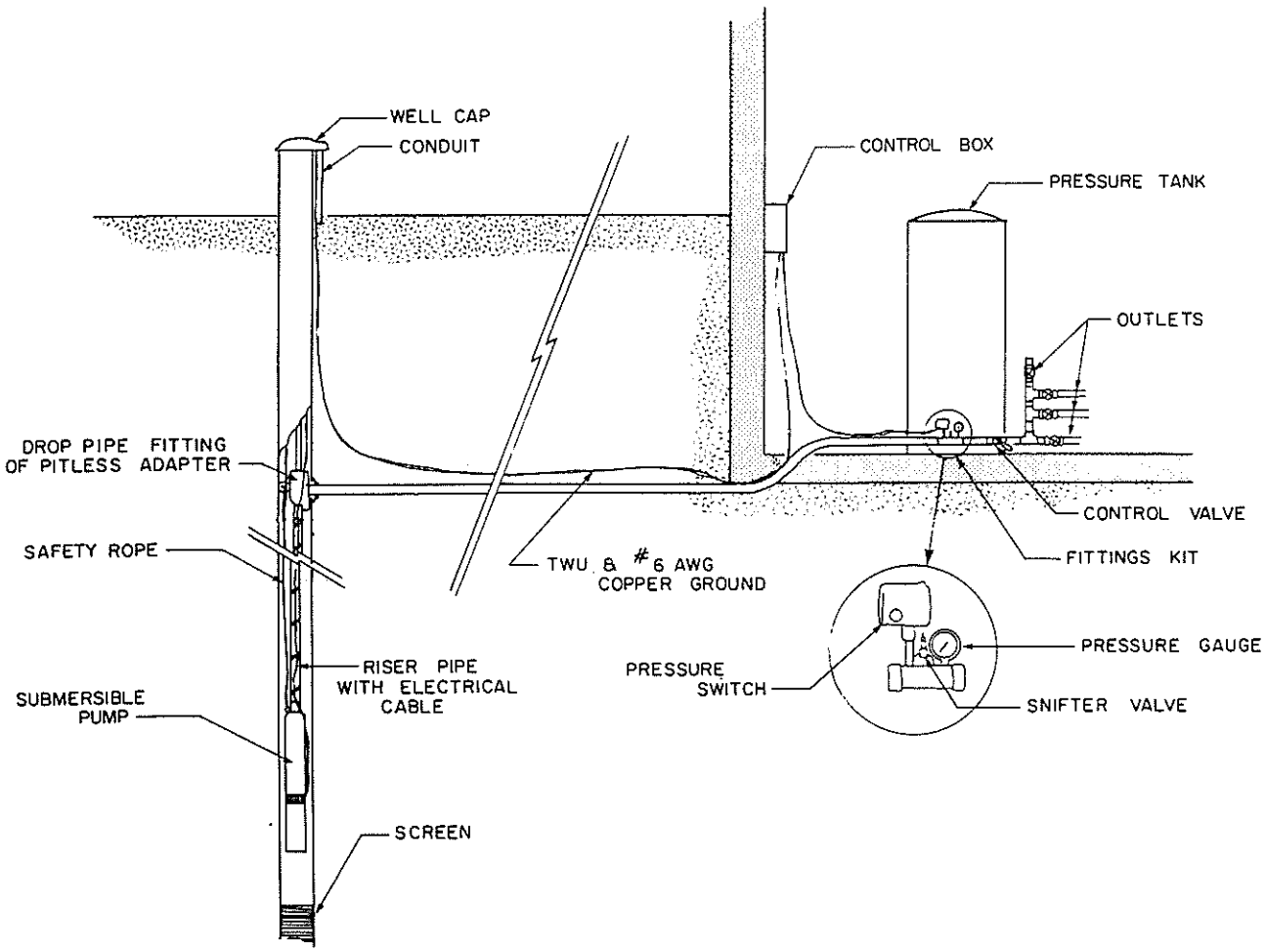
As a rule of thumb, submersible pumps can be used to a depth of 60 metres (200 ft) if fitted to series 100 C.S.A. certified polyethylene pipe, providing the working pump head pressure does not exceed 860 kPa (120 psi). For recommendations on drop pipes in wells deeper than 60 metres (200 ft.) contact a Manitoba Water Services Board technician.

For grounding protection use either #6 AWG ground or an insulated copper conductor (green only), which is equal to or larger than the electrical drop cable, to connect the submersible pump head to the ground in the electrical system. The cables from the pump head to the surface should be encased in a 20 millimetre (¾ in.) or 25 millimetre (1 in.) polyethylene pipe conduit, depending on the size of the wire.

A nylon safety rope at least 10 millimetres (⅜ in.) thick should be attached to the rope eye on the pump and secured to the well head on the surface. If the pipe fails you can use the rope to recover the pump.

In most cases a pitless adapter will facilitate the installation or removal of the pump and make the well safe from contamination.

Figure 3 — A Typical Submersible Pump Installation



Priming and Adjusting for Flowrate

Submersible pumps are self priming.

When pumping in sandy conditions, the restrictor valve on the discharge line should be closed almost completely before starting the pump and connecting the discharge line to the pressure tank. When the pump is turned on and reaches cut-in pressure the valve is gradually opened. At this point it will either pump clean water at full capacity or discolored, gritty water. If it is pumping grit, close the valve slightly and run the pump until the discharge water clears. Repeat this procedure until clear water is coming out at the desired rate. **Under no circumstances should a submersible pump be stopped when it is pumping gritty water.**

In low yield wells the discharge control valve should be adjusted when the pump reaches cut-in pressure to match the pump's output to the capacity of the well.

Precharging Pressure Tanks

In precharged pressure tanks it is necessary to have a cushion of air in the tank before the pump is turned on. A floating diaphragm separates the air and water in the tank reducing the rate at which this air cushion is dissipated by dissolving into the water. This air cushion maintains pressure in the system and increases the "drawdown" capacity of the tank.

In some tanks the diaphragm is installed by the manufacturer, in others it must be rolled and inserted through the air volume control hole on the side of the tank.

Once a new system is installed, primed, and the pump control valve set, the tank should be precharged as follows:

1. First open all taps, turn on the pump and run it for approximately 10-15 minutes to stabilize the pumping water level in the well.
2. Close down the discharge control valve until the pressure on the gauge registers about 20 kPa (3 psi) above the cut-in pressure setting which activates the pump. Remove the valve handle so the valve cannot be tampered with.
3. Close all the taps and switch off the pump.
4. Open one tap close by the tank and pump air into the tank with a compressor until air spurts from the tap.
5. Close the tap and precharge the tank with air to approximately 20 kPa (3 psi) **below** the cut-in pressure setting.
6. Switch the pump on.

The system is now ready for service. Precharged in this manner, the pump will operate at close to maximum capacity and the pressure tank will not lose its precharge. Pressure tanks should be precharged in this manner every six months.

Maintenance

Submersible pumps require no regular maintenance. When a three-wire submersible pump fails, the pump wires and capacitors at the control box should be tested with an electrical meter prior to removing the pump from the well. Operating and repair manuals which detail the correct procedure for testing these failures are available from authorized repair depots or your district Manitoba Water Services Board technician.

In two-wire pumps most of the electrical components are in the motor. Thus it is often necessary to remove these pumps from the well when they fail.

Metric Conversions

NOMINAL Pipe Dia.		FLOWS	WEIGHTS
mm	in	1 Imp. gal. = 4.546 L	1 oz = 28.35 g
		1 U.S. gal. = 3.785 L	1 lb = 0.4536 kg
3	1/8		2.2 lb = 1 kg
6	1/4		
10	3/8	**DIMENSIONS**	
12	1/2		**PRESSURE**
20	3/4	1 in = 25.4 cm	
25	1	1 in = 2.54 cm	1 psi = 6.895 kPa
32	1 1/4	1 ft = 0.3048 m	
40	1 1/2	3.26 ft = 1 m	
50	2		**POWER**
75	3		
100	4		1 hp = 0.7457 kW
150	6		1 kW = 1.34 hp
200	8		

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