Water for the World

Installing Mechanical Pumping

Technical Note No. RWS. 4.C.2

Installing mechanical pumps for community water systems involves several considerations including protecting the pump and motor from vandalism and the weather, ensuring accessibility for operation, maintenance and replacement, minimizing potential contamination of the water supply, proper sizing and protection of electrical components, and providing pump controls and metering.

Both pump and motor should be protected from weather extremes. In areas where freezing occurs, supplemental heat may be needed. Usually this means that a pump house is required. Even if the pump is in the well and an underground discharge is used, pump controls are needed and the water should be metered. This will usually require a pump house or meter vault. Pumps should not be placed in pits due to the risk of flooding. See Figure 1. Earth can be mounded around a pump house for insulation as long as the floor of the pump house can be drained to ground level by gravity flow.

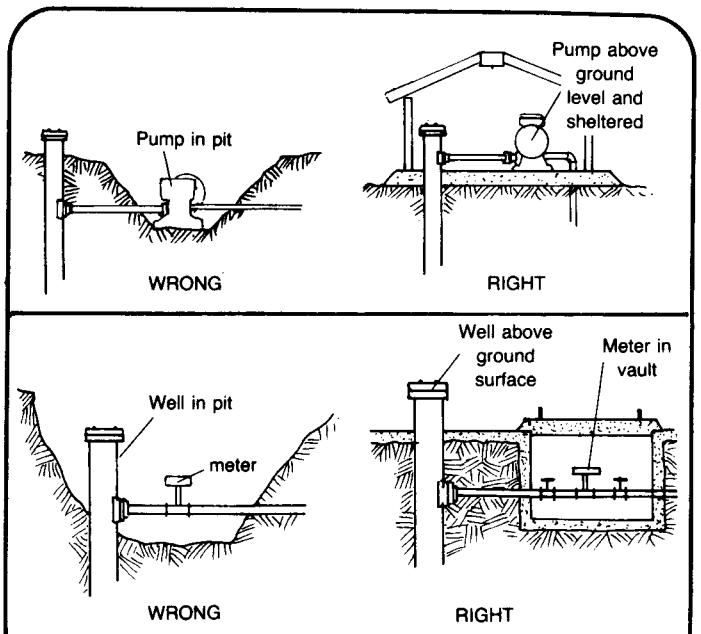


Figure 1. Locating Pumps and Wells

Useful Definitions

ALTERNATE OPERATION - In two-pump systems the pumps alternately operate except that when one pump cannot keep up with demand, both pumps operate at the same time.

CONTAMINATION - Introduction of harmful substances including organisms and chemicals to a water supply; these substances may cause illness or disability.

DROP PIPE - The pipe in the well connecting to the pump.

If the well is located inside the pump house, roof access will be needed so the drop pipe and/or the pump in the well can be removed. See Figure 2. For small units, the entire roof can be removed. Care must be taken to locate and size the doors so the pump and other equipment can be removed for repair or replacement. A vent is required to minimize excess moisture. For deep wells, a method to hoist the pipe and pump may have to be incorporated into the design.

Sizing and Protection of Electrical Components

The electric wire within the pump house should be enclosed in flexible cable or in a conduit. Care must be taken to use the correct size wire and fuses. Table 1 shows the correct sizes for motors of different horsepower. The electric meter should be as close to the pump as possible, preferably along with a main circuit breaker on the outside of the pump house.

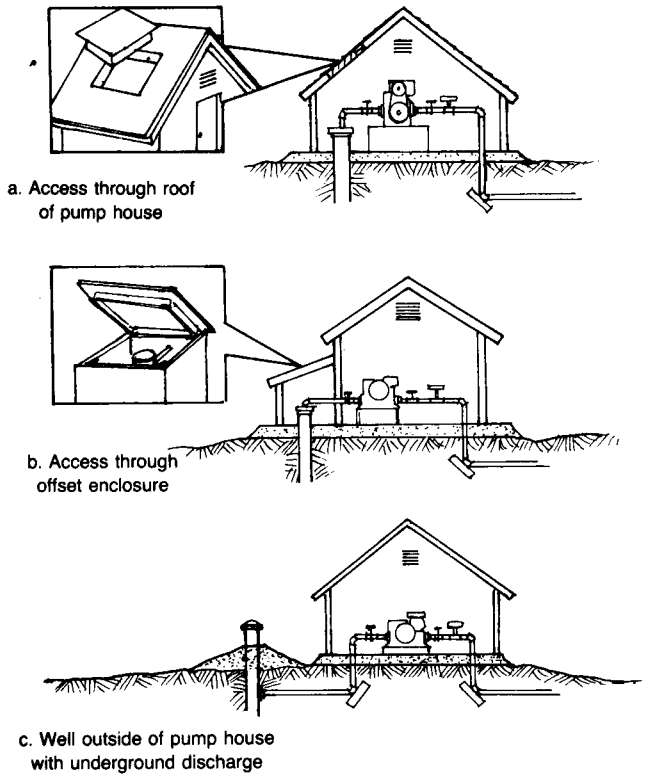


Figure 2. Providing Access to Well for Pump Removal

Although lightning surges are not common, they occasionally cause damage to a motor when thunderstorms are in an area. To protect against these surges, a lightning arrester should be installed either at the service entrance or at the switchbox. Care must be taken to install adequate grounding. This can be done by driving a ground rod into the earth with a copper wire connection at the entrance location.

Pump Controls

Pump motors must be turned on and off in accordance with water needs. This can be accomplished by a person controlling a switch, called manual operation; by a time clock; by pressure differences; or by high/low probes in the water. These controls are used to maintain the water level in a storage tank, the pressure in a system or to protect a pump from low water levels in a well or low flows which can cause a pump to burn out.

Table 1. Wire and Fuse Table
(From Service Entrance to Pump Motor or Control Box)

H.P.	Volts	Full Load Amps.	Max.* Fuse Size Amps.	**Minimum Wire Size of Rubber Insulated Copper Wire-A.W.G. Length Wire from Motor to Meter or Distribution Point-Meters									
				0-15	15-30	30-45	45-60	60-75	75-90	90-105	105-120	120-135	135-150
1/6	115	3.0	15	14	14	14	14	14	14	14	12	12	12
1/6	230	1.5	15	14	14	14	14	14	14	14	14	14	14
1/4	115	4.0	15	14	14	14	14	14	12	12	12	12	10
1/4	230	2.0	15	14	14	14	14	14	14	14	14	14	14
1/3	115	5.0	15	14	14	14	14	12	12	12	10	10	10
1/3	230	2.5	15	14	14	14	14	14	14	14	14	14	14
1/2	115	7.2	25	14	14	14	12	12	10	10	10	9	9
1/2	230	3.6	15	14	14	14	14	14	14	14	14	14	14
2/4	115	9.2	30	14	14	12	12	10	10	9	9	8	8
2/4	230	4.6	15	14	14	14	14	14	14	14	14	14	12
1	115	12.0	40	14	12	12	10	9	9	8	7	7	6
1	230	6.0	20	14	14	14	14	14	14	14	12	12	12
1½	115	16.0	50	14	12	10	9	8	7	7	6	5	5
1½	230	8.0	25	14	14	14	14	14	12	12	12	10	10
2	115	20.0	60	14	12	10	8	7	6	6	5	5	4
2	230	10.0	30	14	14	14	14	12	12	12	10	10	10
3	115	29.0	90	12	10	8	7	6	5	4	4	3	3
3	230	14.5	45	14	14	14	12	12	10	10	9	9	8
5	115	46.0	150	10	8	6	5	4	3	2	2	1	1
5	230	23.0	80	14	14	12	10	10	9	8	7	7	6

*These fuses are maximum for protection at wiring only and do not give motor overload protection.
**Wire sizes shown permit maximum voltage drop at 5 percent.

Metering

A water meter is a management tool that is desirable for more sophisticated systems. If the amount of water produced is known, excessive use can be identified. This often indicates leakages or unauthorized use. In addition, water use trends can be identified and system design adjusted to these trends.

Accessibility of Equipment

The pump and motor must be easily accessible for repair, replacement, operation and preventive maintenance. This means that the site should be accessible in all weather conditions.

Minimizing Contamination Potential

Water sources must be protected to prevent contamination. This is done by using well slabs set on mounds, well seals, draining wastewater away from the well, extending the casing at least 15cm above the well slab and by using materials that are clean and meant to be used in water systems. See Figure 3.

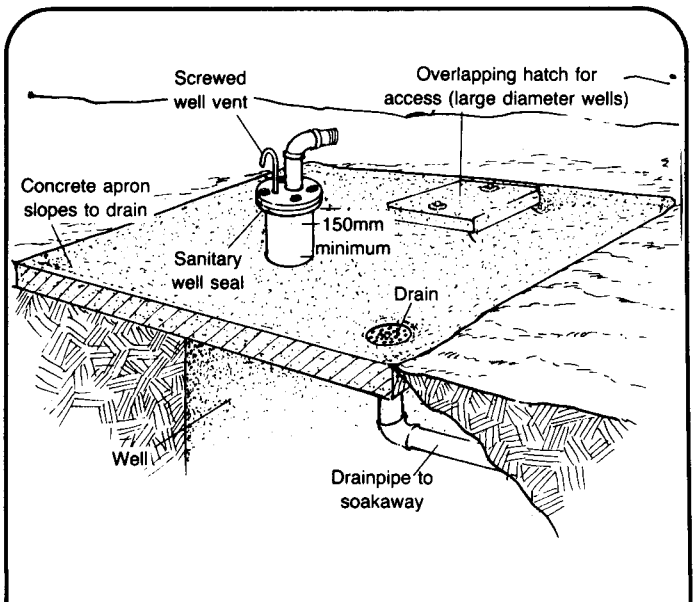


Figure 3. Minimizing Pollution Potential

Typical Pump Installation Techniques

Centrifugal pumps are installed as shown in Figures 4 and 5. They should preferably be installed in tandem with alternate operation. They are relatively simple to install and do not normally require hoists or A-frames.

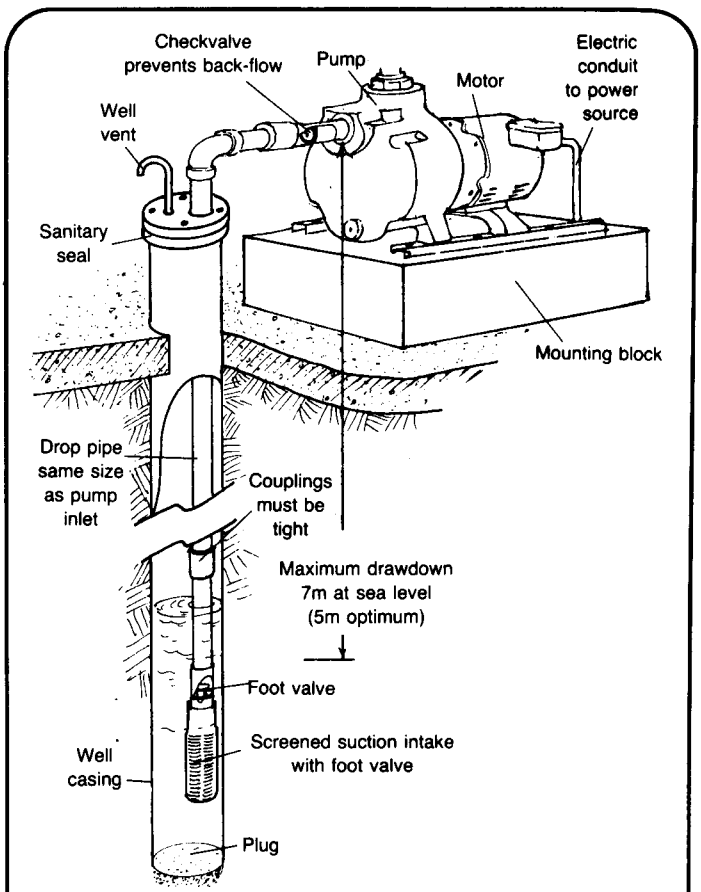


Figure 4. Typical Close-Coupled or Frame-Mounted Centrifugal Pump Installation

Submersible pumps are typically installed as shown in Figure 6. Pump controls are often located outside of the equipment house as shown in Figure 7. Special equipment is usually needed for installation including a tripod, block and tackle, pipe holder, pipe clamps and electric instruments to check for grounding once the pump is in water.

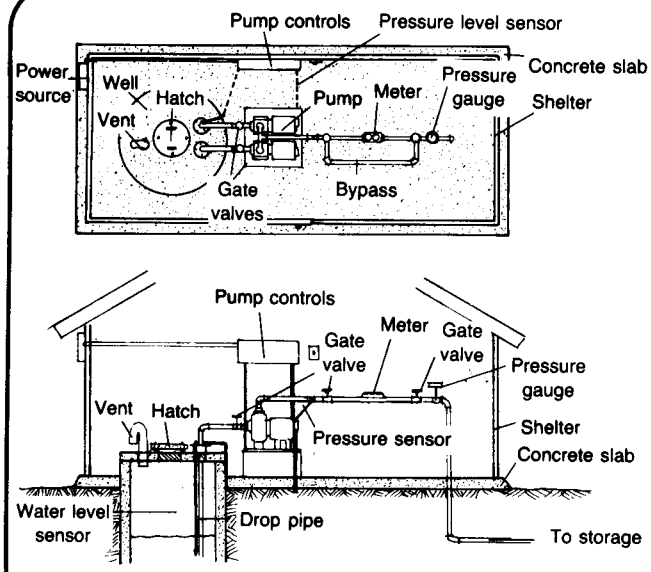


Figure 5. Dual Pump Suction Lift Installation (Well Less than 7m)

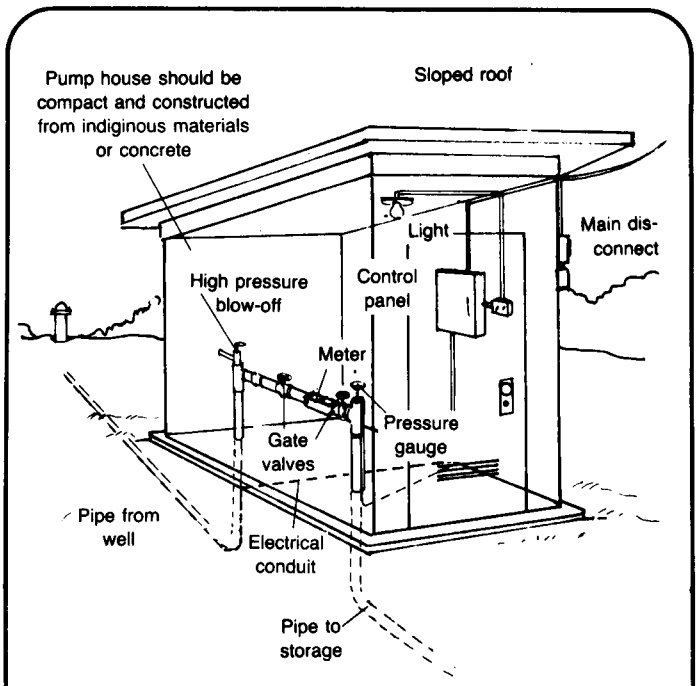


Figure 7. Pump House for Submerged Pump

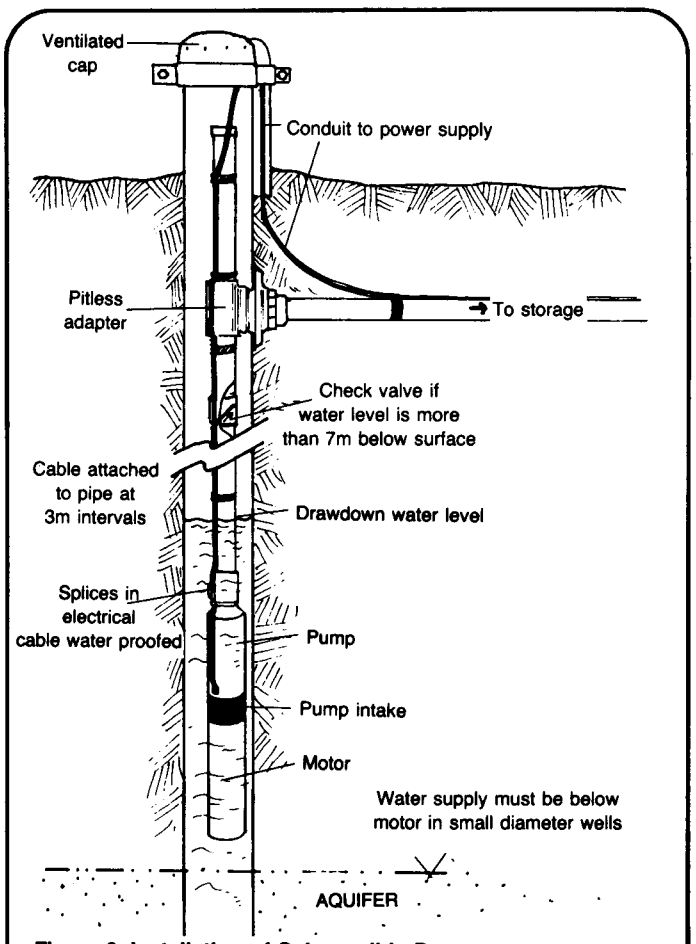


Figure 6. Installation of Submersible Pump with Underground Discharge

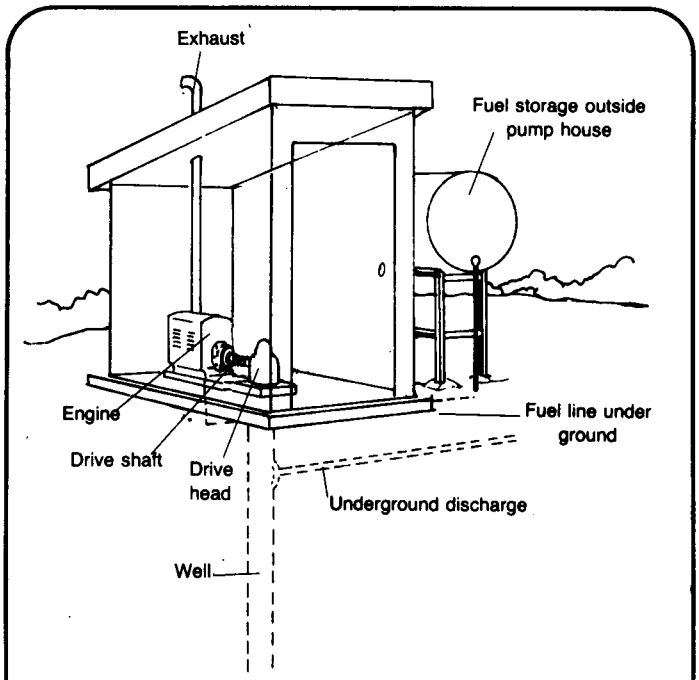


Figure 8. Pump House for Internal Combustion Engine and Vertical Turbine Pump

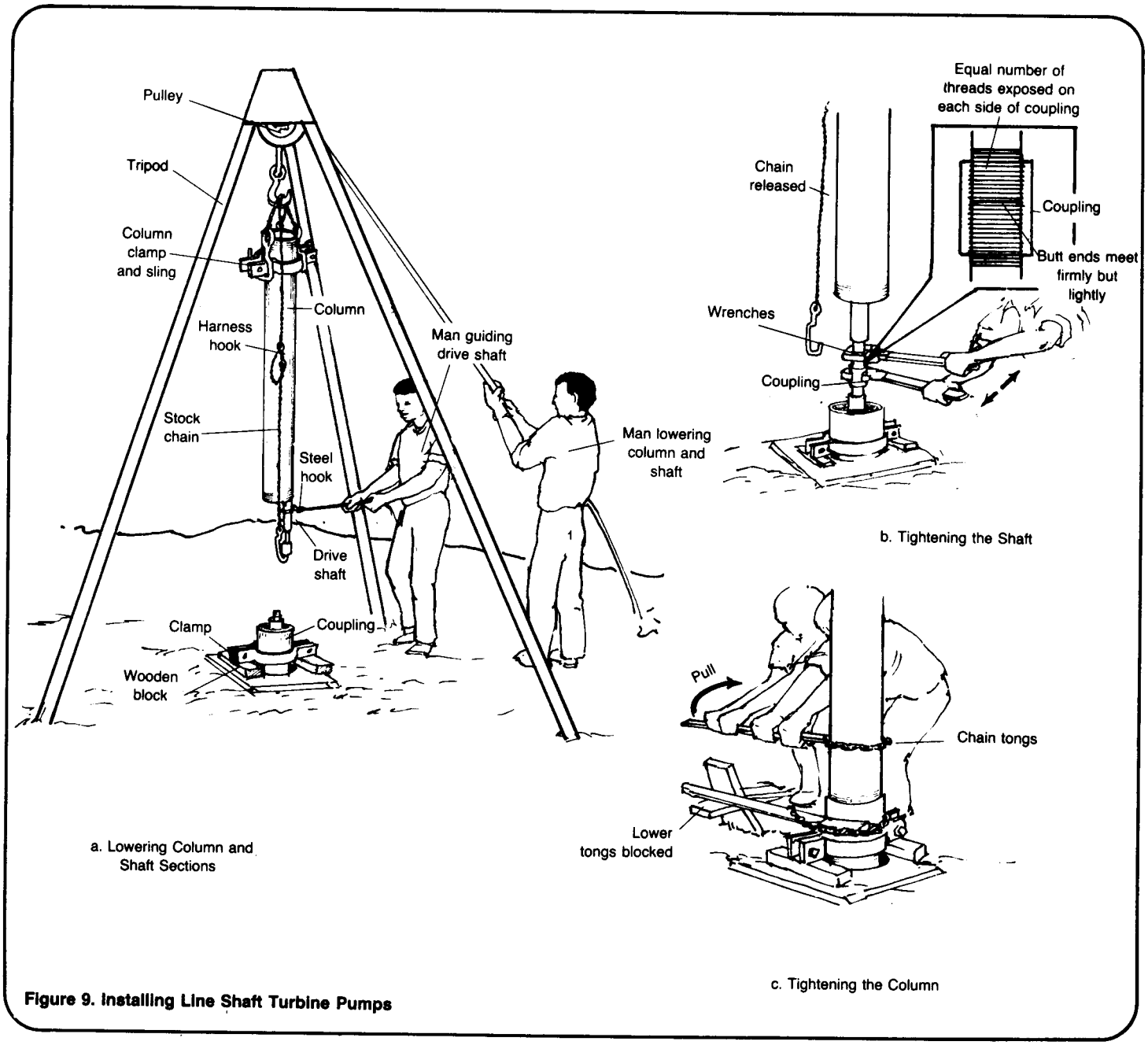
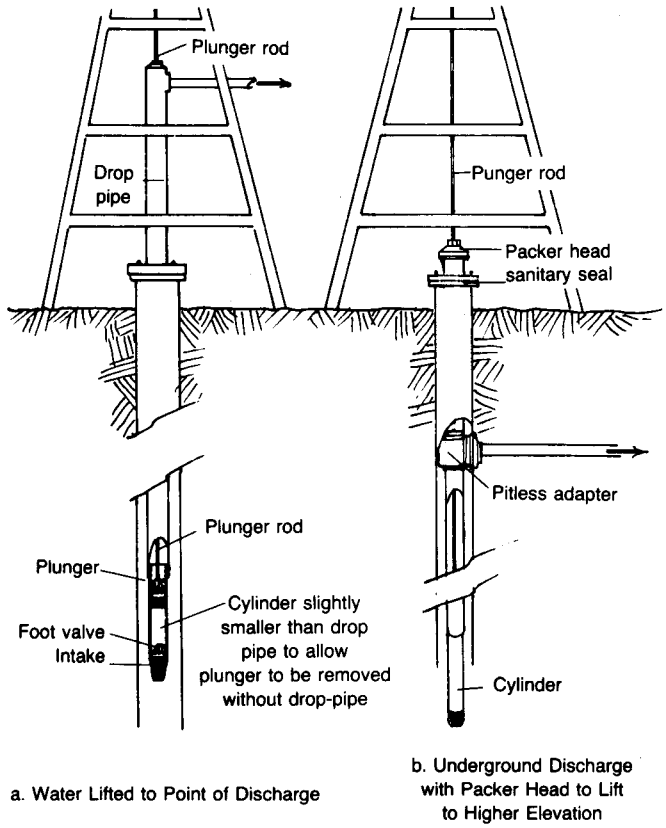


Figure 9. Installing Line Shaft Turbine Pumps

Line shaft turbines, also called deep well and vertical axis turbines, require a tripod, block and tackle, pipe holder and pipe clamps. Since the motor is not in water, shorting it out is not a problem. Because of the shaft which connects the motor to the pump, vertical alignment is much more critical than with a submersible pump.

Typical installations are shown in Figure 8. Figure 9 shows how line shaft turbine units are installed or removed.

Windmill installations are similar to vertical axis turbines. A typical installation is shown in Figure 10.



a. Water Lifted to Point of Discharge

b. Underground Discharge with Packer Head to Lift to Higher Elevation

Figure 10. Typical Windmill Installations