A Complete Guide of All Submersible Pump Components
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SUBMERSIBLE PUMPS EFFICIENTLY PUSH WATER TO THE SURFACE

Submersible pumps are installed in wells and the pump pushes water to the surface so it can be used for a household. The submersible pump is only one component of many that are required to get water from the ground up.

This book will walk you through all the components that are required in a submersible pump installation as well as go over how they work together and why each component is essential.

To make it easier to understand we are going to split the products into four groups or chapters.
Submersible Pump Components

The below diagram shows all of the components in a submersible pump application and where they can be found within the system.
WHERE THE WATER TRAVELS

In this chapter, we are going to look at the components of a submersible pump that water travels through to get it from the well to the house. These include:

- Submersible Pump
- Check Valves
- Pitless Adapters
- Insert and Easy-Tie Adapters
- Gear Clamps
Submersible Pumps

Submersible pumps are run by controls in the house to pump water from the well to the surface.

What they do:

They push water from the well to the surface. Submersible pumps are completely submerged in the water within the well and are very efficient.

What they look like:

Submersible Pumps in Submersible Pump Applications:

Submersible pumps are the first component in a submersible pump application. They are lowered into the well and used to pump water to the surface. The submersible pump is turned on and off from the surface. It is important that the water level in the well does not fall below the submersible pump.

Installation Considerations:

- Pumping requirements
- Flow required
- Depth of water in the well

Submersible pumps not sold at Boshart Industries.
Check Valves

Check valves allow water to only travel in one direction. When the flow reverses, the check valve prevents it from flowing the other way.

What they do:

They carry the weight of the submersible pump, pipe and the water in the riser pipe, and prevent water from reversing direction and draining back down the well when the pump stops.

Check Valves in Submersible Pump Applications:

Multiple check valves are required in a submersible pump application. For every application a check valve should be installed just after the pump and one at the surface. In cases where there is a check valve built into the pump, another one should be added less than 21’ above the pump or 25’ above the bottom of the pump.

When the well is more than 200’ deep a check valve should be installed at 200’ intervals, plus the one at the surface and just after the pump. These check valves ensure that once the pump has stopped, no water will flow back into the pump.

Installation Considerations:

- Weight of piping water and submersible pump
- Head loss of the valves
- Friction loss of the piping
- Velocity of water
- Water hammer
Pitless Adapters

Pitless adapters consist of two components that slide together. The pitless slide is attached to the well casing and the pitless elbow is attached to the riser pipe supporting the submersible pump.

What they do:
They provide an easy transition between water being pumped vertically up the well to the discharge pipe that leads to the house. The two pieces that slide together making the required 90° turn.

What they look like:

Pitless Adapters in Submersible Pump Applications:
The elbow that connects to the pump is threaded at both ends but water makes a 90° turn after entering the bottom. The threading on the top allows a piece of pipe to be installed that extends to the top of the well. A crane truck can then lift the pitless elbow, riser pipe and the submersible pump assembly up out of the well. Lifting the assembly disconnects the elbow from the slide, which is permanently installed in the well casing. The two components can slide freely together and apart as the assembly is lowered for installation or raised for pump removal. A water tight seal between the pitless slide and elbow is made by compressing an O-ring.

Installation Considerations:
- Weight of piping water and submersible pump
- Material
Insert & Easy-Tie Adapters

Insert adapters have a threaded end and an insert (barbed) end. Easy-tie adapters are simply insert adapters with the addition of a eye hole.

What they do:
They provide a connection between a thread and a poly pipe. There are two styles of insert adapters, hex and swaged. Clamps are used to secure the adapter to the poly pipe.

What they look like:

Insert & Easy-Tie Adapters in Submersible Pump Applications:
Insert adapters are used to join threaded connections to poly pipe where the water travels vertically up the well and horizontally as it travels to the house.

Easy-tie insert adapters thread into the discharge on the check valve at the submersible pump and inserts into poly riser pipe, a second adapter is threaded into the pitless adapter at the well head to connect to the poly riser pipe. The lug with a eye hole (rope eye) provides an easy means to securely fasten the safety rope or cable, to secure the submersible pump to the well head.

Installation Considerations:

- The number of barbs on the insert adapter
- Number of gear clamps used to secure the poly pipe
Gear Clamps

Gear clamps consist of a housing, band and screw. The screw lives in the housing and tightens the band when turned.

**What they do:**

They are used to secure hose or tubing around a fitting. Tightened around the tubing and fitting, they create a secure and watertight seal with their high torque capabilities.

**What they look like:**

![Image of gear clamps]

**Gear Clamps in Submersible Pump Applications:**

Gear clamps are used for securing the insert and easy-tie adapters to the pipe. They seal the poly pipe to the barbed end of the fittings, to make both a positive watertight seal and pull-off proof connection. In a water well installation or for direct burial of water lines, where maximum corrosion resistance is required, all 300 grade stainless steel clamp are to be used to ensure that the clamp will last the lifetime of the system.

**Installation Considerations:**

- Double clamping on each fitting
- Use all stainless steel clamps for maximum corrosion resistance
RUNNING & PROTECTING WHAT'S IN THE WELL

There are a number of products that support the pipe and pump in submersible pump applications. In this chapter we are going to look at what they are. These include:

- Pump Cable
- Splice Kits
- Rope
- Rope Hanger
- Torque Arrestor
- Cable Guards
- Cable Ties
- Well Caps
Pump Cable

Multiple wires make up a cable, they can be twisted or laid flat and are wrapped by another layer of insulation.

What it does:
Wire is threaded through the submersible pump, providing wire from the equipment located at the water wellhead to the motor of the submersible pump that is installed in deep well applications.

What it looks like:

Pump Cable in Submersible Pump Applications:
Pump cable is typically found in stranded or solid-core wire. Stranded wire is extremely flexible and is able to withstand large amounts of flexing and is normally found in applications where the pump cable needs to be routed through tight spaces. Depending on the motor installed on the submersible pump, it will determine the amount of wires required. Two wire pump motors will have three wires, two conductors (black and red) and a third wire which is the green ground.

Installation Considerations:
- Stranded or solid wire
- Advantages of flat jacket cable
- Number of wire pump motors in the submersible pump
- Location of the motor components
Splice Kit

Splice kits are also known as heat shrink or shrink tubing as they require a heat source in order to form the secure connection.

What it does:
Splice kits electrically insulate and protect wires, the electrical component and other objects. They also provide a seal that prevents liquid and solid contaminants from reaching any sensitive components.

What it looks like:

Splice kits in Submersible Pump Applications:

Splice kits are not only used in electrical applications, they can be used to bundle loose items, provide a cushion from impact, prevent fraying and protect from chemicals, corrosion or UV light.

For proper installation in a submersible pump application, you must strip 1/4" of insulation from the wire. The heat shrink tube is then slid over one end, the wires insert into the stakon connector. The heat shrink is then crimped to attach the stakon to the wire. Before you shrink the tube, ensure the tube is centred over the stakon connector.

Installation Considerations:

- Black splice kits to be used in outdoor applications
- Common shrink ratio is 2:1 but also available in 3:1
**Safety Rope**

Rope is made of strands of yarn that are braided and twisted together to form a strong cord.

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**What it does:**

The safety ropes main function is to prevent the pipe from separating which would result in the pump being lost at the bottom of the well.

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**What it looks like:**

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**Safety Rope in Submersible Pump Applications:**

Safety rope connects directly to the submersible pump, securing to the well head. If the riser pipe were to ever fail, the safety rope allows the installer to pull the pump up if the connection separates. The rope can be tied to the easy-tie adapters installed within the application.

It is highly recommended that every submersible pump has a safety rope installed to the well head before you hang it from the well.

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**Installation Considerations:**

- Weight of the pump
- Weight of the piping
- Weight of the wire
- Material of pipe being used
Rope Hangers

Rope hangers were invented by Mel Boshart and are only available at Boshart Industries.

**What it does:**
Rope hangers provide a simple method of attaching the safe rope securely to the well casing.

**What it looks like:**

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**Rope Hangers in Submersible Pump Applications:**

The rope hanger gets installed at the top of the well casing, it does not rely on the structural strengths of any of the other well components. The well cap is not obstructed from being installed properly by the rope hanger, the well cap is still able to fit right over the rope hanger and goes onto the well casing.

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**Installation Considerations:**

- Easily removed to service or repair pump
- Does not obstruct the well cap from being installed onto the well casing
Torque Arrestor

Torque Arrestors are formed from two rubber moulded pieces and two stainless steel gear clamps to prevent wear and tear caused by start up torque.

What it does:
Torque arrestors are designed to protect the three main components of the pipe column assembly which is the submersible pump, the pump cable and the drop pipe.

What it looks like:

Torque Arrestor in Submersible Pump Applications:
The first torque arrestor is typically installed 18" to 24" above the submersible pump. They not only protect the pump from start up torque but they keep the pump centred in the well. They also keep the pump snug in the well casing to protect from right hand threads loosening. The submersible pump could cause the drop pipe to unscrew when it rotates.

Polyethylene and rigid threaded PVC pipe are the usual drop pipe materials that require a torque arrestor. Galvanized pipe may not require a torque arrestor but one is sometimes installed to centralize the pump to ensure proper motor cooling.

Installation Considerations:
- # of torque arrestors determined by pipe, depth and pump horsepower
- 3-4 can be spaced out at 75-100 ft intervals
Cable Guards

Cable guards are created to fit in 6" well casing but the outside tabs can be cut off to fit in 4" and 5" well casings.

What they do:
Cable guards are solid or self clamping and can be installed over the end of the riser pipe. They prevent damage to the pump cable while keeping the riser pipe centred in the well.

What they look like:

Cable Guards in Submersible Pump Applications:
If the pump cable is not properly protected, the insulation on the wire will get worn due to the rubbing against the inside of the well casing. Every time the pump stops and starts, the entire installation moves in response. After years of this action, the wire insulation will thin resulting in a possible short circuit. Cable guards do not require any tape or hose clamps to stay in place.

Installation Considerations:
- Placed every 15 feet
- Two designs; solid and self clamping
Cable Ties

The serrated teeth on one end of the cable tie, locks inside the head creating a very tight connection.

What they do:
Cable ties are multipurpose and extremely easy to use. They are used to efficiently secure the pump cable to the riser pipe between the cable guards.

What they look like:

Cable Ties in Submersible Pump Applications:
In a good submersible pump installation, the pump cable will be against the riser pipe from the bottom to the top, free of loose wire. The cable ties guarantee the riser pipe is connected to the pump cable. It is recommended that the cable ties are fastened to the riser pipe and pump cable at intervals of no greater than 10 ft apart.

Installation Considerations:
- Size of length of cable ties depends on the diameter of the load
- Black cable ties designed for outdoor applications
Well Cap

Well caps protect the top of the well casing by providing a watertight, vermin proof connection.

What it does:

Well caps prevent debris from getting into the well. They also allow the well to properly breathe while still protecting the well from anything entering the well from the outside.

What it looks like:


Well Caps in Submersible Pump Applications:

A typical well cap used in a submersible pump application would be a watertight and vermin proof cap. The cap is installed on the well head. This style of well cap has a connection on the side used to attach the electrical conduit that supplies the power to the pump. The well cap is sealed using an o-ring to ensure nothing can enter the well. The well caps are equipped with screens to still allow the well to breath but also still keeping a watertight connection. More codes are making watertight well caps mandatory.

Installation Considerations:

- Locking well caps allow for a pad lock to be added
- Determine the outside diameter of the well casing
- Be aware of well casing material to ensure not to join dissimilar metals
WHAT'S INSIDE THE HOUSE

Submersible pump applications include products inside the house that deal with the water once it has arrived. In this chapter we will dive deeper into what they are and more about them. These include:

- Flow Controls
- Pressure Tanks
- Tank Tees
- Ball Valves
- Filtration Products
Flow Controls

The internal mechanism has no moving parts, it only has a flexible orifice that varies with applied pressure keeping a constant flow rate.

What they do:
They restrict the output flow to a specific flow rate. Flow controls can be used in many locations in plumbing to maintain a constant flow rate within variations of 15%, up to 125 PSI. They provide a means to conserve water and save energy & money.

What they look like:

Flow Controls in Submersible Pump Applications:

Flow controls are used to provide protection to the submersible pump in low producing wells. They throttle the pumps capacity back to a level at which the aquifer can sustain a static water level in the well which will not fall below the submersible pump preventing the pump from running dry. The flow control can be installed anywhere between the submersible pump and the tank tee at the pressure tank connection. Normally, they will be installed by the tank tee just before the check valve where they are easily accessible for service or change out if required.

Installation Considerations:

- Amount of water that needs to be conserved
- Location of installation for maintenance
- Desired flow rate
Pressure Tanks

Pressure tanks are a holding area for water and are under pressure to help indicate when the pump need to be turned on and off.

What they do:

They store water that has been pumped from the well. The air bladder inside indicates the pressure within the tank. The pressure is used to indicate when the pump should be turned on to refill the tank.

What they look like:

Pressure Tanks in Submersible Pump Applications:

Pressure tanks are installed in the house and are a holding area for water before it goes to the household plumbing system. This helps prevent the pump from short cycling (running for a short period of time) more often. The air pressure in the top chamber of the tank, should be set to 2 PSI below the pressure switch cut-in pressure before any water is added. The water being pumped into the pressure tank will press against the air bladder moving it to compress the air, causing the water to be pressurized making the pressure switch turn off the pump when the desired pressure has been attained. Likewise, as the water pressure drops the compressed air forces the diaphragm downwards to empty the tank until the pressure switch cut-in setting is reached.

Installation Considerations:

- Size of the pressure tank
- Desired pressure settings

Pressure tanks not sold at Boshart Industries.
Tank Tees

Tank Tees are a multi port fitting that connects a tank to the water system. The ports allow for the installation of different accessories.

**What they do:**
They provide a compact and neat looking means of connecting multiple accessories to the water system without extra connections. Tank tees reduce the number of connections that have the potential to leak in a system.

**What they look like:**

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**Tank Tees in Submersible Pump Applications:**

Tank tees are threaded to the discharge of the pressure tank. There is a total of three main connections and four additional accessory ports. The connection on the leg goes to the tank, one of the lateral connections goes to the pump, and the other goes to the household plumbing system. Water from the pump can go either into the tank or directly into the household plumbing. When the pump is not running, the water comes out of the tank into the household plumbing. The accessory ports allow for installation of a drain valve, relief valve, pressure switch and pressure gauge.

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**Installation Considerations:**

- Union or non-union tank connection
- Material
- Inlet & port sizes
Ball Valves

Ball valves are used in a wide range of plumbing and water well applications to stop the flow of water at a particular point.

What they do:

They use a handle to turn a ball in the valve, with a hole or port through it. The ball is used to allow or prevent flow through the valve depending on its position. If the hole is aligned with the pipe, flow continues; if the hole is perpendicular to the pipe, flow will stop at the valve.

What they look like:

Ball Valves in Submersible Pump Applications:

A ball valve should be installed on the discharge side of the pressure tank, to provide a means of isolation to the plumbing system from the water well pressure system. This provides a means to shut off the water supply to the house in the event of a component failure in the in-house plumbing system and also enables the installer to isolate the water system and prevent the entire in-house plumbing system to drain back when the water system requires repairs.

Installation Considerations:

- Accessible location
- Material
Sediment Filters

Sediment filters are available in two types, spin out and whole house cartridges. The amount of sediment will indicate which one to use.

What they do:
Sediment filters remove sediment from the water supply. Spin out filters are for heavy sediment and work using centripetal force. Whole house cartridges use fibers to trap the sediment within the cartridge.

What they look like:

Sediment Filters in Submersible Pump Applications:
Sediment filters are installed after the tank tee before any water treatment equipment. It is a good practice to install a sediment filter to remove any sediment from the water prior to it entering the treatment equipment such as a softener, iron filter or hot water heater. Ensuring that the water is free of sediment will greatly increase the efficiency and longevity of these higher cost components.

Installation Considerations:
- Amount of sediment
- Lifespan of the filter
TANK TEE ACCESSORIES

Tank Tees, covered in the previous chapter, provide ports for different accessories. In this chapter we will have a look at what those accessories are and learn more about them. These include:

- Pressure Switches
- Pressure Gauges
- Relief Valves
- Drain Valves

These accessories are available in a kit to make purchasing easier but we will go over each individual component. This will help ensure the kit comes with all required products and give you a better understanding of what each of the components are and their use.
Pressure Switches

Pressure switches come in a variety of cut-in and cut-out pressure ranges. They can be used to automatically control different devices.

What they do:

They control a pump by using preset pressure settings. The cut-in pressure dictates what pressure the pump will start at and the cut-out pressure indicates what pressure the pump will stop at.

What they look like:

Pressure Switches in Submersible Pump Applications:

A pressure switch is installed on one of the top ports in the tank tee. It controls the submersible pumps operation using a built in diaphragm that moves back and forth reacting to the water system pressure. On pressure decrease, the diaphragm retracts and the spring loaded contacts will trip causing the contact to snap to the closed position, this is referred to as the cut-in and starts the pump. As the submersible pump builds the system pressure, the diaphragm is forced forward, forcing the contact mechanism to trip again and the contacts snap to the open position, referred to as the cut-out and stops the pump.

Installation Considerations:

- Cut-in & cut-out settings
- Standard / medium or heavy duty
Pressure Gauges

Pressure gauges are used in a wide variety of applications. They are available in different dial sizes, pressure ranges and materials.

What they do:
They monitor system pressure. The pointer indicates what the pressure is so at a glance the system pressure is visible.

What they look like:

Pressure Gauges in Submersible Pump Applications:

A pressure gauge is installed on one of the top ports of the tank tee. It allows the installer / homeowner to easily monitor what the pressure in the system is, and verify the cut-in and cut-out pressure settings of the pressure switch. When ordering a pressure gauge, the pressure range should be selected to ensure that the gauge will operate in the middle 1/3 of the dial face pressure range, pressure system gauges are most accurate and will last significantly longer when they operate in the mid-range of the pressure range.

Installation Considerations:

- Operate in the middle 1/3 of the dial face pressure range
- Liquid vs dry
- Stainless steel should be used in corrosive applications
Relief Valves

Relief valves generally come with pre-set pressure cut of 75 PSI or 100 PSI. Adjusting a pre-set relief valve is not recommended.

What they do:
They provide a pressurized system with protection from excessive pressure by opening to release some of the pressure. This will bring the pressure back below the pre-set pressure.

What they look like:

Relief Valves in Submersible Pump Applications:
A relief valve is installed on one of the front ports of the tank tee, ensuring the drain is facing down. The relief valve is spring loaded and will open only if the system pressure exceeds the pre-set blow-off setting of the relief valve. This eliminates the possibility of the system building pressures beyond that setting ensuring that the plumbing system is not subjected to extreme pressures. It is important that a relief valve be properly plumbed to a suitable drain that can handle the discharged water flow.

Installation Considerations:
- Pressure setting required
- Ensure the valve drains to a proper location
Drain Valves

Drain valves are also known as sediment faucets and boiler drain valves. They thread into the system and have a threaded outlet to attach a garden hose.

What they do:

They are a valve that allows water to be drained from a system or tank. By turning the handle water is released from the system to be drained.

What they look like:

Drain Valves in Submersible Pump Applications:

Drain valves are installed in one of the front ports in the tank tee, with the drain pointed down. This drain valve has multiple functions including, a means to take water samples, acquire water from the system, and to provide a means to drain the tank and water system in the event that a pressure tank must be replaced. Some areas plumbing code do not allow a threaded outlet so a sampling faucet must be used. A sampling faucet is basically identical but does not have the garden hose connection.

Installation Considerations:

- Where the water will be drained to
- Is a sampling faucet required
Wrap up

There are many products that go into a submersible pump installation. Each component works together to provide a seamless transition for the water coming from the well to the house. Whether it's a big component like the submersible pump itself or a smaller component like a cable tie, each one helps to create a submersible pump application with the longest life possible.
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