Understanding Pump Stations

Many times I feel overwhelmed by the information and terms of a new product or area unfamiliar to me. This is not uncommon! Technical and sales people tend to bring terms into their presentations that are foreign to the average layman. The more pump information I acquire, the more I tend to take for granted my customer will know.

I no longer want to know the technical jargon of the industry because it reduces my ability to explain to my customer what our product is all about and how it will suit their needs. One thing I do know is that my customers are the smartest people in the world. But if you don't know the language, how can you know the product.

So the easiest way for me to tell you about my product is to give you some background information. Hence, my glossary of terms.

Glossary – In order of most commonly used words

Pump Station – a combination of pumps and electrical control equipment prefabricated on a mounting plate (skid), with piping, valves and sensors to transfer fluid (generally water) from one point to another.

A. Methods of Operation

Variable Speed Electric
Constant Speed Electric
Engine Drive

B. Pump Styles

Turbine
Submersible
Centrifugal

Any combination of "A" and "B" except "engine drive" – "submersible", can become a pump station.

Pump – since this is a common generic word I will describe the most common types of pumps in the golf course industry. All four of these pump types can be used to build a pump station.

One of the problems I have with the English language is that words are not precise or concise, see what I mean – two different words, same meaning. I think Mr. Thesaurus invented the English Language. If the word is a noun, it doesn't mean the same thing as a verb. Example, submersible pump - the turbine pump is a submersible pump too, because it is also submerged. So why not use the term submersible turbine and submersible submersible. Because my spell check doesn't like it - that's why! It's like the term you park on the driveway and drive on the parkway. Anyway, I'm not trying to confuse you - I'm just letting you know that you are in for more of the same in the pump business.

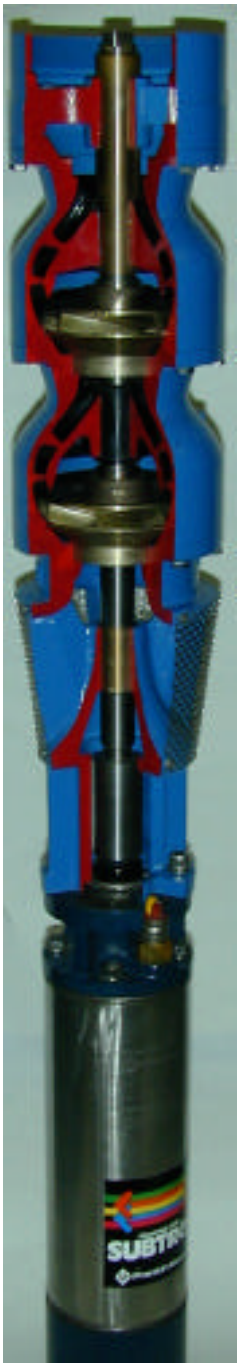
Turbine Pump – also known as lineshaft turbine, generally pumps from a vertical well. The main components are bowl assembly and impellers (actual pump), the discharge head (turns the water from a vertical direction to a horizontal direction and holds the motor), the motor, the column (connects the bowl assembly to the discharge head) and the shaft (connects the impellers inside the bowl assembly to the motor).

⇐ Motor

⇐ Discharge head

⇐ Shaft & Column

⇐ Bowl Assembly and impellers

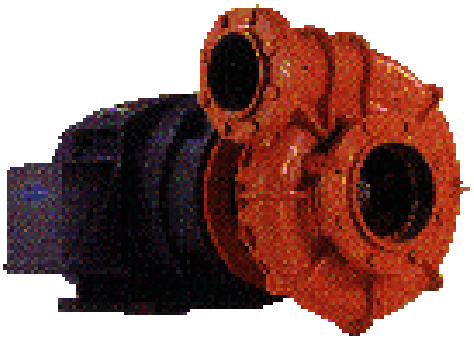


Submersible Pump – also known as submersible turbine, pumps from a vertical well also. The main components are bowl assembly and impellers (same as above) and the motor. The submersible motor is connected directly to the impellers at the bottom of the bowl assembly, unlike the turbine pump that uses shafts, bearings and discharge head. The submersible pump does not have to be installed vertically like the lineshaft turbine does. This pump can be installed at any angle between 5 degrees and 90 degrees.

⇐ Bowl Assembly and impellers

⇐ Motor

Centrifugal Pump – can pump from pond, stream or anywhere a suction line can be installed, including a vertical well like the previous pumps. The main components are the impeller (including pump casting) and the motor.



⇐ Pump Casting and impeller

Motor ⇑

Diesel Pump – can be a turbine pump or a centrifugal pump since the term diesel only describes the engine and not the style of pump (one of those word things again – it gets worse, just read on). The most common is a centrifugal pump (without the electric motor).

⇐ Diesel Engine

A right angle drive and lineshaft turbine can also be installed on the diesel at a greatly increased cost.

⇑ Pump Casting and impeller

⇑ Automated Control Panel used to run diesel engines similar to variable speed pump stations.

Drive ⇓

Drive – this is an abbreviated term to describe a main component on the variable speed pump station. The drive changes the speed of the motor and thus gives us the term “variable speed”. Other common terms in the technical field are inverter, frequency drive, and frequency modulator (I think someone dreamed this one up to confuse me). The drive is a big box of capacitors, rectifiers, diodes, transistors, fuses and circuit boards. The combination of these items modifies a 60-hertz electrical signal, and by doing so allows us to change the hertz, voltage and current going to the motor. As a result the motor speed changes. When you change the motor speed, you change the flow and pressure generated by the pump.

Pressure Regulating Valve – (Picture Not Available at this time) The PRV serves the same purpose on a constant speed pump station as a drive serves on a variable speed pump station. Both are intended to keep a constant pressure in the irrigation system. Other common terms (but not accurate) are Clayton Valve or Singer Valve. In my area, these are the major manufacturers of the valves but they also make many other types, such as, relief valves, reducing valves, combinations of reducing, regulating, sustaining and check valves.

Other Types of Valves on a Pump Station are:

Butterfly Valves – This valve is used to stop the flow of water through the pipe system. A butterfly valve generally is positioned between two flanges. It has a flat disc inside that seals like the gate in a gate valve. The only difference is that the butterfly turns 90 degrees to stop the flow of water instead of going up and down.

Ball Valves – These valves have a ball inside with a hole in the middle. When the handle is turned the ball turns. There is a double seal on each side of the ball for a positive seal. Many times ball valves are used as an alternative to the gate valve.

Check Valves – are used to stop the back flow of water. There are many types such as swing gate check valves, double door valves and plunger type check valves. The best valves are spring loaded.

PLC – in technical terms is a **P**rogrammable **L**ogic **C**ontroller. I call it the brains of the pump station. Whether you have a constant speed or variable speed pump station, the PLC determines what is to happen when you turn a switch on based on the software information in the controller. The PLC receives information from sensors and switches on the pump station, compares values from these sensors and sends signals to other devices (such as telling the drive to speed up or slow down depending on the pressure reading it receives).

Other parts of the electrical panel will include:

Fuses – Used to protect the electrical system should a short occur between wires.

Disconnect – Just a fancy word for switch, the disconnect shuts power off to the panel.

Transformers – Changes power from one voltage to another.

Contactors – Close to send power to the motors or other electrical apparatus and open to stop power from continuing down the wires.

Overloads – Sense the current going to the motor and will disconnect the contactors if the current to the motor is above the overload setting.

These are the basic terms you will hear most often when talking about pump stations.

What Pump Station Best Suits My Needs

There are a number of pump stations that might fit your requirements. When you are in the market to buy a pump station, a combination of these factors will determine a lot of your decisions:

- ✓ Electrical power available – 600 volt, 3 phase, 100 or 200 amp services
  - 230 volt, 3 phase, 100, 200 or 400 amp services
  - 230 volt, Single phase, 200, 400 or 600 amp
  - little or no source of power

- ✓ Water capacity and Pressure required – The electrical power might restrict the amount of water the pump station can give you!

- ✓ Location of the water source – Is the water coming directly from a well? Is the water source from a lake or river in which a wet well installation will be impossible or too expensive?

- ✓ Is there an elevation condition that will cause problems getting the water to the top of the course without over pressurizing the lower part of the golf course irrigation system?

- ✓ Your budget!

Generally, the availability of electrical power is the number one factor in determining the type and location of the pump station. It is almost always less expensive to move water than to install electrical lines.

If you have other conditions that exist on your golf you can contact me toll free at 1-888-222-6676 anywhere in Canada and I would be pleased to assist you.

Lets look at different types of pump stations based on hydro?

For purposes of understanding how much water a pump station will give you based on the electrical power available, I am going to assume that you have no extreme elevations on your golf course. Your irrigation system will operate at no higher than125 psi. If you do need higher pressure you will have to increase the size of the pump station to the next model to get the same amount of water.

600 Volt (formerly known as 575 or 550 volts)

A **100**-amp service (wire size feeding the building) will operate the following pump station sizes:

These flows will change depending on pump efficiency. These figures are for estimating **roughly** what you can expect from a pump station based on voltage available. As pressure requirements increase, flow decreases for the same horsepower.

Variable Speed

Vertical turbine - 2 – 40 hp pumps which is 800 usgpm
Submersible – 2 – 30 hp pumps which is 700 usgpm
Centrifugal – 2 – 40 hp pumps which is 600 usgpm

Constant Speed

Vertical turbine – 2 – 30 hp pumps which is 600 usgpm
Submersible – 2 – 30 hp pumps which is 600 usgpm
Centrifugal - 2 – 30 hp pumps which is 500 usgpm

600 Volt - 200-amp service

These flows will change depending on pump efficiency.

Variable Speed

Vertical turbine - 3 – 50 or 2 - 75 hp pumps which is 1700 usgpm
Submersible – 3 – 40 or 2 - 75 hp pumps which is 1400 to1600 usgpm
Centrifugal – 3 – 50 or 2 – 75 hp pumps which is 1200 to1400 usgpm

Constant Speed – I don't recommend constant speed above 600 usgpm. The hydro savings and reduced surges on the irrigation piping will easily pay for the difference in price.

230 Volt – 3 phase – This is not a common voltage in my area, but if you have an application, call me.

230 Volt – Single Phase – 100 Amp Service

An automated diesel package is the only station you will run on a service this size. One hundred amps will operate 2 – 7.5 hp pumps, which is equivalent to 120 usgpm.

230 Volt – Single Phase – 200 Amp Service

These flows will change depending on pump efficiency.

Variable Speed

Single Phase Variable Speed pump stations convert the 230-volt, single-phase signal to a 230-volt, 3-phase signal. As a result there has to be a drive for each pump since all pump motors will be 3-phase motors.

Vertical turbine - 2 – 15 hp pumps which is 300 usgpm
Submersible – 2 – 15 hp pumps which is 300 usgpm
Centrifugal – 2 – 15 hp pumps which is 250 usgpm

Constant Speed

Vertical turbine – not available
Submersible – 3 – 10 hp pumps which is 300 usgpm
Centrifugal - 3 – 10 hp pumps which is 250 usgpm

230 Volt – Single Phase – 400 Amp Service

Variable Speed

Vertical turbine - 2 – 30 hp pumps which is 600 usgpm
Submersible – 2 – 30 hp pumps which is 600 usgpm
Centrifugal – 2 – 30 hp pumps which is 250 usgpm

Constant Speed

Vertical turbine – not available
Submersible – 6 – 10 hp pumps which is 600 usgpm
Centrifugal - 7 – 10 hp pumps which is 600 usgpm

A 600-amp service will increase the above numbers by another third.

Choosing a Pump

From the exercises above you can see what is available depending on your power source. If you are starting from scratch then you can decide on the pump station and build around it. Based on this scenario lets look at the advantages and disadvantages of each type of pump.

Lineshaft Turbine

Advantages:

1. Motors are available in 1800 rpm versus the submersible pumps that are only available in 3600 rpm.
2. Motors are more efficient. This means the motor takes less current per horsepower.
3. Pumps turning at 1800 rpm are more efficient. The result is more water per horsepower.
4. Motors are accessible for repairs. (this one I don't really agree with since a submersible motor can be removed and replaced in about 3 hours – when you compare all the cost of rebuilding a motor, especially the down time, as compared to just installing a new one, I would go with the new one)

Disadvantages:

1. Expensive to rebuild
2. Lineshaft wear & packing leakage especially in dirty water applications

Submersible Turbine

Advantages:

1. Motors are coupled directly to the pump so there is no shaft bearings or packing to wear or replace.
2. Quiet operation.
3. Pumps are not as efficient as 1800-rpm pumps but are more efficient than centrifugal pumps.
4. Pumps do not have to be installed level. They can be installed on any angle above 15 degrees.
5. The pumps and motors are less expensive and are more readily available.

Disadvantages:

1. More susceptible to attracting lightning
2. Water depth has to be 6' in wet well for pumps to operate

Centrifugal

Advantages:

1. Very basic – It's a motor with an impeller on it – simple!

Disadvantages:

1. Less efficient than turbine pumps
2. Suction lines have to be primed or pressurized to guarantee against loss of prime
3. Less pump selection for higher pressure applications

Choosing a Pump Station - Variable Speed versus Constant Speed

Variable Speed

Advantages:

1. By varying the speed of the pumps you only get the amount of water required by the irrigation system. There is no relief valve discharging excess water back into the pond. Therefore the horsepower to move the water is reduced, as is the hydro.

2. There is no sudden impact (water hammer) on the irrigation system from a pump starting. This translates into longer irrigation system life and lower maintenance costs to keep the system running.

3. The pump station has a lot of features not available with a constant speed pump station such as irrigation system slow fill, automatic pressure ramp to compensate for friction loss in pipes and gentle pressure adjustments.

Disadvantages:

1. Higher capital cost

2. More susceptible to electrical surges

Constant Speed

Advantages:

1. Lower capital cost.

2. Easier to service.

Disadvantages:

1. Requires more service

2. Creates water hammer during pump cycling.

3. Higher operating costs