

STUDY GUIDE – PUMPS

Each molecule of air has weight. At sea level the mass of air molecules above any square inch of ground exerts a downward force of 14.7 pounds per square inch.

Atmospheric pressure at sea level is 14.7 psi. At higher elevations atmospheric pressure is less because there are fewer molecules piled above the ground.

Each molecule of water has weight. This weight pushes down with a force of .43 psi for each foot of water depth. At the bottom of a well with 100 feet of standing water the downward pressure of the water is 43 psi plus the weight of the air above the water.

A vacuum at sea level can lift water about 33.9 feet and no further. At Nebraska elevations a vacuum will lift water less because there is less atmospheric pressure pushing the water into the suction pipe.

At sea level atmospheric pressure of 14.7 psi will push water upward 33.9 feet.

Omaha has about 14 psi which will push water upward 32 feet.

North Platte has about 13 psi which will push water upward 30 feet.

Kimball has about 12 psi which will push water upward only 28 feet.

Shallow well jet pumps will only operate where the pumping water level in the well is less than 33 feet below the pump because the pump is utilizing atmospheric pressure to force the water into the pump drop pipe. Generally the closer the pump is to the static water level the more efficient the system is.

If a well has ten feet of draw down, will a shallow well jet pump work when the pump is twenty four feet above static water level? How deep below the pump does the suction pipe need to extend? Why?

What is the physical difference between a shallow well jet pump and a deep well pump? Can line check and foot valves be used interchangeably of all jet pumps? Why?

Some deep well jet pumps utilize an inch or an inch and a quarter pipe inside a two inch pipe and others utilize an inch and an inch and a quarter pipe side by side down the well. Explain why and what well construction designs are appropriate for each.

What is a packer type jet pump system?

Shallow well jet pumps, deep well jet pumps, and even submersible and turbin pumps utilize centrifugal force by directing water into the center of a rotating impeller which throws the water out radially away from the axis of rotation.

What factors must be considered when sizing a pump to a well?

Should water from a new well be tested for bacterial contamination? Why?

What is friction loss? How is it calculated?

Are stroke pumps capable of producing head pressure? How do they work?

What does "waterlogged" mean? What symptoms suggest this problem? How is it corrected?

What symptoms suggest an "air bound" pressure tank? Can standard galvanized hydro-pneumatic pressure tanks get "air bound"? Explain.

How can you correct each of the above conditions?

What does a submersible control box do?

What factors determine the head potential of a centrifugal pump?

If a pressure gauge on a pump indicates 28 psi, how high will this pressure be able to push a column of water? How far will the same pressure push water horizontally?

How much pressure per square inch does a column of water 130 feet high produce at the base of the column?

Total dynamic head pressure on a submersible pump is composed of friction loss (at specified flow rate), elevation above the well's pumping level, and desired discharge pressure.

Explain what it means when a well has a weak recovery rate. How can you design a pumping system around such a condition?

How would you electrically ground a pump? Why? Is an ungrounded pump safe? Will an ungrounded pump still run normally? Explain.

How do you check current draw? With what instrument? How do you best protect a pump from lightning surges?

If a three-wire single phase submersible pump won't run, what checks should you run? In what sequence?

If you pull a pump from a buried tank-pitless adapter, what happens to the water stored in the system? (Answer, system including whatever might be attached via garden hose etc. Should such a system be equipped with discharge plumbing shutoffs or checks?

Should you disinfect a well before using it for human consumption? Why?

What factors determine the type and size of wiring to a pump? (Answers, voltage, amperage required by motor and distance from power source).

If you know a pumps needed voltage and current draw, how do you determine wire size?

What purpose does a pressure regulating valve serve on a deep well jet pump?

Are most three phase pump motors wired for 120 volts, 220 volt, 460 volts, or 208 volts?

Three phase motors will run backward. How could you tell if a three phase submersible is running backward? If one is found to be running backward, can the direction of rotation be corrected? If so how?

Do three phase motors use control boxes the same as single phase submersibles?

Why are magnetic contractors a normal part of three phase submersible pump wiring?

Can a high volume-low pressure centrifugal pump operate on 1750 rpm? What would its impeller look like?

If you know a well's static water level varies greatly seasonally, at what level would you set a pump?

Does atmospheric pressure vary from day to day? If so, does it affect pumping levels?

If a newly drilled well produces mud and sand when first pumped, what precautions should the pump installer take? Explain why?

Most jet and submersible pumps rotate at 3450 rpm. The pump's head potential depends upon the feet per second at the outside edge of the impeller. The larger diameter of the impeller the more feet per second and the greater the head potential.

Some jet pumps (2 and 3 stage) and submersible pumps stack the impellers so each one feeds the intake of the next to increase the total head potential.

Small diameter submersible pumps produce head potential equal to larger diameter pumps by rotating faster making the feet per second at the outer edge of the impeller about the same as the slower larger diameter pumps.

Can you estimate the capacity of a closed impeller pump by looking at the thickness of the impeller ports? Explain.

If a water system has undersized piping what can the pump installer do to partially overcome the inadequacy? Does this affect the overall efficiency of the system?

On a centrifugal pump the water entering the center of the impeller equals the amount of water discharged from the pump. Is this true of jet pumps? Why?

If a pump under three hp is found with the pressure switch points closed but the pump is not running, what should you check first? Where would you check? Why? What instrument would you use? (Answers, power to pressure switch, power from the pressure switch if accessible. If not, closet power disconnect to the system. Volt meter)

How would you detect a faulty submersible pump cable? Where would you check? What instrument would you use? Why?

What happens when you have a voltage imbalance on a three phase pump? How can you check for voltage imbalance? What instrument(s) would you use?

Does the electrical power for a three phase pump normally run through a pressure switch? Explain.

What problems might you suspect if the breakers, fuses, or overload protectors on a pump motor shut the motor down on a recurring basis at the same time every day?

What test instrument can you use to make a liquid level indicator? Explain how.

If the check valve on a pumping system sticks open, what symptoms are presented? How can you check for sure that the symptoms observed are not some other problem?