

# Private Drinking Water Wells: Operation and Maintenance for Mechanical Components

Jan R. Hygnstrom, Extension Project Manager  
Wayne Woldt, Extension Water and Environment Specialist  
Sharon O. Skipton, Extension Water Quality Educator

This publication is one of six in a series designed to help rural families understand and manage their private drinking water wells.

The most common private water system is a drilled well with a submersible pump and pressure tank. The small amount of maintenance these systems require should be performed by a State of Nebraska licensed professional. This NebGuide explains the operation and maintenance services that a State of Nebraska licensed professional might offer.

The mechanical components of a water system consist of the pump, pressure tank, and pressure switch. Outdoor hydrants and the wellhead are other features that may require periodic checking or maintenance. Become familiar with your water system so that you will know how to respond if an emergency occurs, such as a water leak. In addition, being knowledgeable about your system will help when you need to work with a professional.

## Water Shutoff

In case of an emergency, such as a leak, that requires water to be shut off in the house, you can shut off the switch or circuit breaker to the well pump. Without power, the pump cannot supply more water into the water line. The pressure tank will still have some water in it, so you will need to shut off the water valve (*Figure 1*) located in the water line after the pressure tank. When the lever is parallel to the water line, the valve is open. The valve is closed when the lever is perpendicular to the water line. If the water valve is closed for an extended period of time and there is a leak in the hot water system, or you continue to use hot water, you may want to turn off your hot water heater, as the tank could drain and overheat.



Figure 1. Shut-off valve for water line in the open position.

## Pump

Most private water systems require a pump to move water from a private drinking water well to the building or yard where it will be used. Your licensed professional selected a pump based on the depth of the groundwater, the distribution system, the pressure required, and the number and flow rate of fixtures on the system. Most pumps are powered with electricity from a public utility. In remote areas, a wind turbine, solar collector, or fuel-powered generator may power a pump.

During a maintenance check, a State of Nebraska licensed professional will pull the pump from the well and inspect it for signs of corrosion or malfunction.

## Troubleshooting

If you turn on a faucet or flush the toilet and there is no water, first check that there is electrical power in the house by turning on electrical appliances on a different circuit. If those are working, check the electrical breaker box or fuse

box and flip the breaker switch or change the fuse for the well pump circuit if necessary. If this doesn't correct the problem, contact a State of Nebraska licensed professional.

If you turn on the faucet and have little or no water, the pump may be set too high in the well. As water is used, the level of water in the well drops, perhaps so low that the pump is no longer submerged. This is more likely during heavy water use. During drought years the groundwater level in the aquifer can drop so that the pump is no longer submerged. A State of Nebraska licensed professional will be able to determine the static water level and the water level when water is being pumped and set the pump at the appropriate height.

If your pump runs continuously, a check valve in the pump or in the riser pipe may be stuck open and need repair or replacement. Otherwise, there may be a break in the water line between the well and the building, or within the building plumbing system. A soggy area in your yard (not the septic system drainfield) could indicate a break in the water line.

You may not be able to tell if your pump is running continuously unless you have a small control light that goes on when the pump is running. Another way to check is to shut off water to the house and observe the water pressure gauge. If it holds steady, the check valves are working and there are no leaks in the lines. If the pressure drops, there is a leak in the line to the house, or there is a problem with a check valve. A State of Nebraska licensed professional should check this, and may have to replace the check valve or repair a leak.

If your pump runs only a few seconds and then shuts off, there is a problem with the system. Pressure is building up too fast, meaning there is not enough air in the pressure tank. The air acts as a buffer, slowing the pressure change so that the pump will not have to start and stop as often. A State of Nebraska licensed professional will be able to help.

### Variable Frequency Drive Pumps

Variable Frequency Drive (VFD) pumps represent newer technology to the water well industry. If you feel there is a problem with your water system, and the well pump is a possible source of the problem, it will be important to involve a State of Nebraska licensed professional in solving the problem. A VFD pump consists of a complicated combination of electric power components and sensitive electronic circuits. The controls are directed by precision, low-voltage, low-current digital or analog circuitry that can be quite sensitive to outside disturbances and voltage fluctuations. You might want to work with a licensed professional who applies a systematic commonsense thinking and troubleshooting technique as embodied in the SMARTS concept.

- S — Safety — Exercise safety when dealing with electrical components.
- M — Manual — Use the manual to troubleshoot; have yours available.
- A — Application — Make certain the correct VFD pump has been selected for your application.
- R — Readings — Gather data and information on the operation of your system.

- T — Talk — Talk to you to learn what has been happening, and to other professionals and the manufacturer to learn what may be the cause of the problem.
- S — Symptoms — Understand the symptoms, and which are the “cause” and which are the “effect.”

Since VFD pumps are a newer technology, make sure your professional is familiar with them and has been keeping up on professional training and development.

### Pressure Tank

Most homes have bladder or diaphragm pressure tanks. The pressure tank stores water and provides water under pressure when the pump is not running. It builds up a reserve supply of water so the pump starts and stops less often, prolonging the life of the pump. In addition, it provides a reserve supply of water for use during times of high demand.

A pressure tank has a pressure gauge (*Figure 2*) to show the pressure in the water line. When the pressure tank was installed, the pressure was checked and set at the appropriate level using the air valve at the top of the tank. A homeowner may be able to check if the tank is holding the right amount of pressure by checking the pressure when the tank is empty. **Some manufacturers void the tank warranty if anyone other than a licensed professional removes the valve cap.**



Figure 2. Pressure gauge on pressure tank.

Information about how much pressure the pressure tank should have when the tank is empty is located on the lid of the pressure switch or just inside the case. This amount is 2 pounds per square inch (psi) less than the start pressure for the pump. For example, if the system has a start pressure of 30 psi, the drained pressure tank should have a pressure of 28 psi.

A State of Nebraska licensed professional may perform this service for you. After determining the pressure the drained tank should have by reading information on your system, the professional will turn off the power to the pump and turn on faucets until the pressure gauge reads zero (0). The professional will tap the side of the tank to determine if the tank is actually empty. If water remains in the tank, the tank may need to be replaced. If the tank is empty, the professional will use

**Table I. Useable pressurized storage amount in gallons for various types of pressure tanks with common pressure switch settings**

Total tank volume (gallons)			Usable water storage or drawdown for pressure switch range (gallons)		
Galvanized steel tank	Pre-charged steel tank with wafer	Diaphragm or bladder tank	20 to 40 psi	30 to 50 psi	40 to 60 psi
15	4.5	4.5	1.7	1.4	1.2
30	14	14	5.1	4.3	3.7
42	20	20	6.5	5.5	5
82	32	32	12	10	8.5
120	45	45	18	15	12
160	62	62	21	19	17
225	90	90	30	26	23

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the valve at the top of the tank and an automobile tire gauge to measure the pressure in the tank. The pressure should be 2 pounds less than the start setting for the system. If it is lower, the professional will use an air compressor to add air until the tank has the desired pressure. The professional will replace the cap on the valve after the tank has the desired pressure.

Your licensed professional may ask you to check the pressure in a week to see if it is still at the desired pressure. If the pressure has dropped, the tank may need to be replaced. A pressure tank will last about 10 years, although some have performed properly for 30 years.

When replacing a pressure tank, the new tank should have a storage volume equal to or greater than the old pressure tank. This is the storage volume, not the total tank volume (*Table I*). Look at the total tank volume for the tank to be replaced, and note the usable water storage at the pressure switch range that is used. For example, if you were replacing a 30-gallon galvanized steel tank with a pressure range of 20 to 40 psi, the usable water storage would be 5.1 gallons. You could replace this with a 14-gallon diaphragm or bladder tank, or a 14-gallon pre-charge steel tank with wafer. Choose the next larger size if household demands for water have increased, or if the pressure switch setting needs to be increased to supply a higher flow rate.

### Pressure Switch

The pressure switch is the control unit for the system, dictating when the pump will start or stop. When pressure in the water system drops to a predetermined set point, often 30 or 40 pounds per square inch (psi), the pressure switch tells the pump to start working. The pump moves water from the well into the pressure tank, building pressure until the “stop” pressure is reached. This is usually about 20 psi higher than the start level, often 50 or 60 psi.

The pressure switch usually is located at the bottom of the tank. Systems with **variable frequency drive (VFD)** motor controllers will have the pressure switch located in a separate unit near the tank (*Figure 3*). The VFD system varies the speed of the pump in order to maintain a constant pressure. When water is used, the drop in pressure turns on the pump. If there is a heavy water demand, the pump speed will be higher; as the



**Figure 3. Control unit for a VFD system.**

demand decreases, pump speed will slow or stop. Typically, the pump will start more times with the traditional system, using more energy than with the VFD system.

Homeowners should not attempt to adjust the pressure switch, as it is connected to electric power and could cause a serious injury. A State of Nebraska licensed professional should perform any work done on the pressure switch.

### Water Treatment Units

A private water system may have additional treatment units to manage contaminants such as bacteria and nitrate, or nuisance problems such as hardness, iron, sediment, or odor. Your State of Nebraska licensed professional may look at these and take note of their condition, but often service will be performed by the homeowner or a service professional employed by the company from which the treatment unit was purchased.

### Outdoor Hydrants

For frost protection, outdoor hydrants typically are designed to drain water from the hydrant through a valve so water does not remain in the line and freeze. Often, a bed of pea gravel at the base of the valve absorbs water that drains. Some hydrants may have an additional underground shutoff valve in the water line to close the line for winter. The “key”



is a rod with a notch on the end that fits into the valve, which may be buried. A homeowner should shut the valve in the late fall before the ground freezes, and open it in the spring so it is ready for water use.

If the ground around an outdoor hydrant is soggy and you have not been using the hydrant, there could be a break in the line. This could have happened if a vehicle, piece of equipment, or even a large animal like a horse bumped into the hydrant. You, or preferably, a State of Nebraska licensed professional will have to dig up the line carefully to determine if there is a break. If ever you do any digging, be certain to call Diggers Hotline at 811. They require 48 hours advance notice, and will locate and flag underground utilities such as electric, telephone, and gas lines. If there is a break in the line, a splice may be needed, which a licensed professional can install.

### Well Operation and Maintenance

As part of the operation and maintenance process, the State of Nebraska licensed professional will check the well-head to see that there is a seal around the base of the pipe. The well casing should not be loose, nor should there be a space or gap between the casing and the surrounding soil. The soil should slope away from the well — it should not be in a depression where water might pond and flow along the pipe down to groundwater. The professional will check that the screen on the air vent of the well cap is in place and intact. This could serve as an entry point for animals such as snakes, mice, or ants. Any of these could introduce bacteria to your drinking water.

The life span of a well can vary greatly, but is usually about 50 years. It depends on water quality, as minerals may clog the screen in the well and the pump. A State of Nebraska licensed professional may rejuvenate or rehabilitate a well by using chemicals to open the screen in the well, or use a surge block to plunge water into and out of the well to clear the screen. Air pressure also may be used to reopen a screen.

In some cases, a professional may need to decommission the well and drill a new one. A State of Nebraska licensed professional cannot drill in the existing well, but can drill next to it. The old well must be decommissioned correctly by a State of Nebraska licensed professional.

### Summary

Although there is little maintenance that a homeowner can perform on the well system, it is valuable to understand what to look for if it is not working properly, and to know what a State of Nebraska licensed professional may do if operation and maintenance services are performed.

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