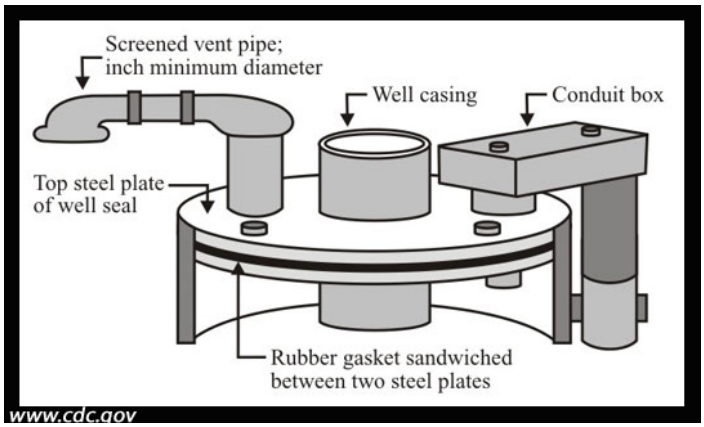
Seals and Liners

Surface Seals – Introduction

Soil acts as a filter, helping to keep groundwater clean. When wells are drilled, soil is removed, so we need to keep potentially contaminated water from entering wells from the surface. Sealing the well is one of the most cost effective ways to protect the water supply, properly sealing the small space between the well casing and the outside hole.



A well seal should include a screened vent pipe that passes through the gasket to allow pressure equilibration. A screen serves to reduce contaminant entry. The vent should be high enough not to be flooded.

What is a surface seal and why it is needed on a well?

Wellhead covers or seals at the top of the casing or pipe sleeve connections prevent contaminated water and other material from entering the well. Well drillers use casings, typically steel, to keep drilled holes from collapsing. Several types of covers and seals are available to meet the variety of conditions encountered, but

the principles and objectives of allowing free movement of air while excluding contamination are the same.

When the well is drilled, the upper part of the hole-diameter must be four inches wider than the casing. Filling that space with proper materials is called “sealing.” Sealing the top 18 feet of a well is the typical standard. This is measured from ground level. Sometimes a deeper seal is necessary to protect a well from contamination.

If only native soils are allowed to fill in around the casing, a path for dirty water can form on the outside of the casing and into the well. Surface runoff can migrate down the annular space along the outside of the well casing and contaminate the aquifer. Therefore, all sources of leakage should be plugged to prevent contamination. To keep this from happening, a surface seal is used. The sealing material is either bentonite clay or a special cement (grout) mixture.

The most visible point of leakage is the encasement at the surface. The construction of the well above the surface should prevent leakage down the outside of the well casing as well as through the casing cap, which is located on top of the

casing. A concrete slab extending 2 to 4 feet around and sloping away from the well casing provides an effective seal of the casing. By extending the casing at least 18 inches above the well slab, surface runoff should not be able to enter the casing. The well casing cap has to be a watertight sanitary seal to prevent water from entering through it. In addition, the casing vent through the cap should extend above flood level to preclude surface runoff from entering the well directly and the end of the vent should be terminated with a down turned gooseneck and screen to prevent rain and bugs from entering.

Bentonite Clay

Sodium bentonite (used as a sealing material) expands when wet, possibly absorbing several times its dry mass in water. Because of its excellent colloidal properties it is often used in drilling mud for oil and gas wells and for geotechnical and environmental investigations.

The property of swelling also makes sodium bentonite useful as a sealant, especially for quarantining metal pollutants of groundwater. Similar uses include making slurry walls, waterproofing of below-grade walls and forming other

impermeable barriers: e.g., to seal off the annulus of a water well, to plug old wells, or as a liner in the base of landfills to prevent migration of leachate.

Sodium bentonite can also be sandwiched between synthetic materials to create geo-synthetic clay liners (GCL) for the aforementioned purposes. This technique allows for more convenient transport and installation and it greatly reduces the volume of sodium bentonite required.

Well Caps

The cap that covers the well is a very important piece of the well water system. A well seal differs from a well cap in that a seal has a **gasket** and a cap does not.

A well cap is a sanitary seal cap if it has a:

- Two-piece cap

  Rubber seal between the two pieces of well cap Securing mechanisms (screws, bolts, etc.)

- Vented screen

  Electrical wiring outlet (conduit)

A sanitary well cap can be made of cast metal or plastic. However, metal is preferred because of the reduced risk for cracking and other damage, and metal is not subject to deterioration from sunlight.

The two pieces of a sanitary well cap are held together by securing mechanisms, usually nuts and bolts around the outer edges. This can also reduce the risk of unwanted tampering with your well cap.

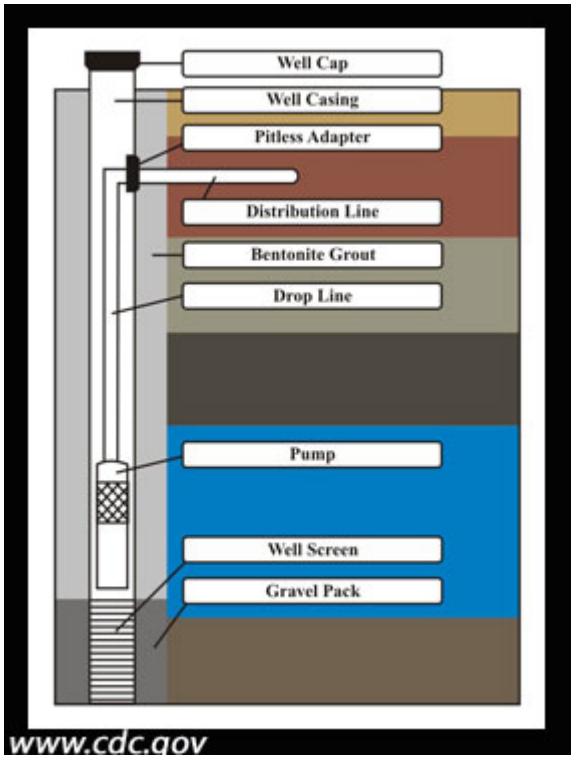
The rubber seal is the key component of a sanitary well cap. It is important for reducing the chances of the well becoming contaminated from surface pollutants mentioned earlier.

Periodically inspect the seal. Look for signs of aging and cracking and have it replaced if these characteristics are observed.

A vented screen is necessary to equalize the pressure difference between the inside and the outside of the well casing as water is pumped out of the well. Without a vent, a vacuum will be created within the well casing when the water level falls

(during pumping or seasonal variations in water level). This may draw unwanted contaminants and debris into the well. The screen also eliminates another point of entry for insects into the well.

A properly sealed well cap prevents the well from becoming contaminated from surface pollutants**.** If a well cover is not sealed properly, insects (such as earwigs) can crawl through gaps around the casing or through unscreened vents and form nests inside the well. Bacteria can reach unhealthy levels when enough cumulative dead bodies and droppings from the residing insects fall into the well water.

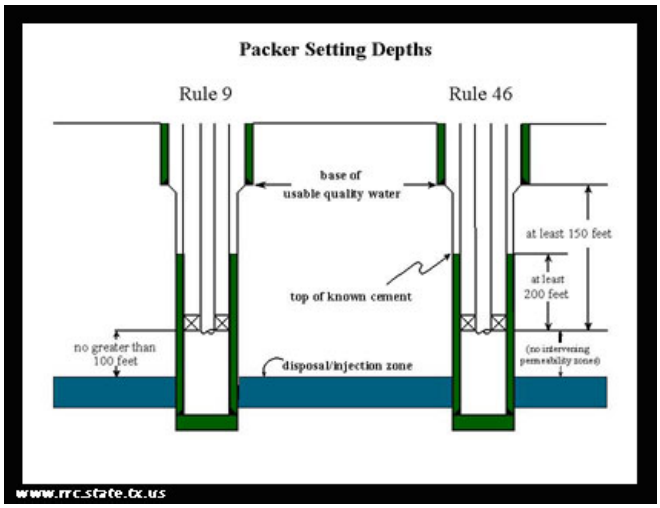


Water is the universal solvent. During spring runoff and storm events, surface water can encounter many different kinds of pollutants such as lawn pesticides and animal feces and easily transport them to the well. Because these and many other contaminants are not easily detected by taste or smell, laboratory testing is the best method of determining if any unsafe levels are present. Tests for coliform bacteria

and nitrates should be taken annually regardless of whether your well cap is properly sealed because well water can become contaminated from many different sources.

Secondary Well Seals and Liners

Secondary well seals, also known as seal packers, well packers, Jaswell-type seals, or Jaswell seals, are flexible rubber cylindrical shaped inserts with circular rings designed to provide a water tight seal between an attached smaller diameter well casing and the larger diameter well bore.



Shale packers or shale traps are flexible rubber cone shaped inserts designed to fit between an attached smaller diameter well casing and the larger diameter well bore and is designed to prevent material placed above it, such as a grout seal, from passing by it and into the well. These devices are well construction peripherals that are designed to create a seal that prohibits surface water, poor quality groundwater, sediment, or broken rock from entering the well.

Secondary well seals are most commonly used as a tool to remedy poor water quality conditions in a well by sealing off unwanted water bearing or sediment producing zones, however, they are sometimes used as a primary seal used in cable tool well construction. Shale packers are most commonly used as a tool to provide a secondary bridge to prevent sediments or rocks from entering the well by sealing off intervals of weathered or unstable bedrock formations.

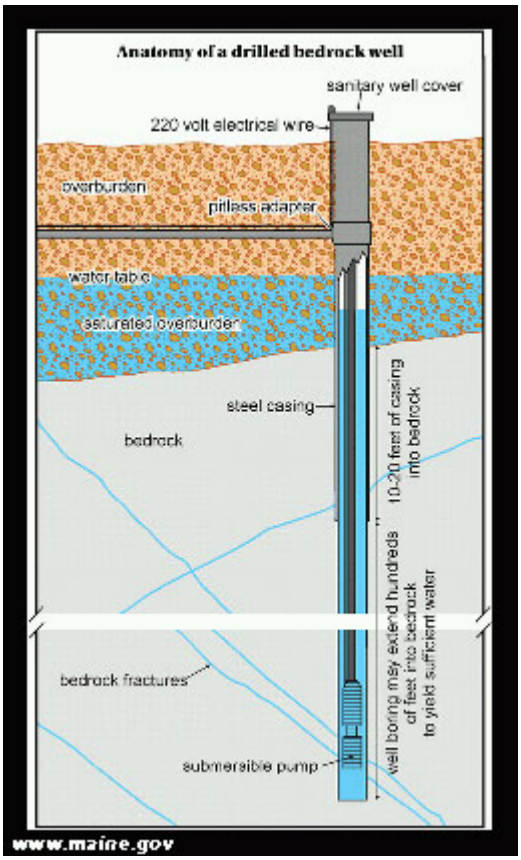
Applications

- Sealing of poor water quality zones
- Sealing of weathered rock fractures contributing sediment to a well
- Sealing of salt contaminated zones from the application of road de-icing chemicals
- Sealing off intervals of weathered or unstable bedrock formations (caving conditions)
- Sealing of existing wells with failed primary seals (Not applicable for new construction)
- Repairing wells damaged by earth movement (frost action, earthquake, blasting, etc.)
- To create a primary seal in cable tool construction

- To create a plug for accepting a grout seal

Installation

The seal is threaded onto a smaller diameter well casing, usually 4" or 5", for domestic applications, and installed into the well, seal end first. The assembly is pushed into position approximately 10 or more feet below the suspected problem area. Once installed, water or sediment entering above the seal is trapped within the annulus between the inner casing and the larger well bore. Some contractors install the seal on both ends of the inner casing, to avoid the entrance of unwanted water spilling over the top of the casing and back into the well.

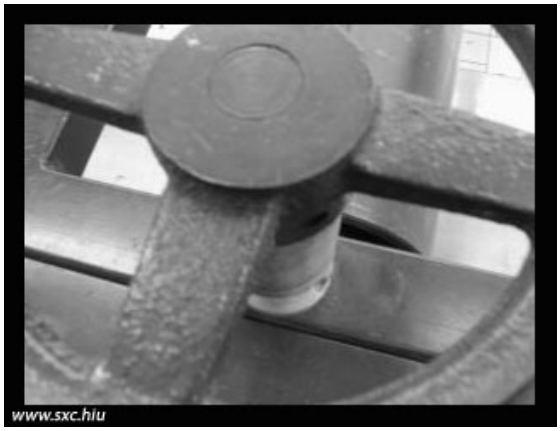


For permanent installations, it is recommended that the annular space created between the 6" diameter well and the smaller inner casing is sealed by filling the area with cement or bentonite grout or chips.

Primary Seals Required

A primary seal used in bedrock well construction is required by rule. Well casings shall prevent intrusion of contaminants from the ground surface or from unconsolidated surficial deposits into the well. In order to perform this function, a hardened steel drive shoe is required to be installed on the end of the casing. A larger diameter hole must be drilled into bedrock, to an appropriate depth, to accept the casing and provide a seat, or socket, for the drive shoe. The only exceptions to the use of a drive shoe seal are for cable tool construction and when plastic well casing is used. In these applications, a Jaswell seal or aswell type seal may be used for the primary seal.

Secondary well seals are not considered an appropriate repair or substitute for a properly installed primary seal in new well construction.



Disadvantages

1) **Not always reliable**

   Secondary well seals are designed to be installed in a smooth round hole. Unfortunately, well bores are not always round and are rarely smooth. Sometimes it is difficult to seat the seal properly so it doesn't leak.

2) **May shut off water**

When seals are installed to seal off unwanted poor quality water or to repair a sediment problem, the well owner always runs the risk of shutting off all of the water supply. Then this option is not a practical solution to the problem.

3) **Pump retrieval may be difficult**

Submersible pumps are usually slightly less than 4 inches in diameter. Therefore, the installation of the pump into a 4 inch casing is a tight fit. Installing the pump is not difficult; however, removing the pump from the well at a future date may prove to be a challenge.

4) **Torque arresters not installed**

Torque arresters are required on submersible pump installations to center and stabilize the pump in the well. The turning and twisting action exerted on the pump by torque created from starting and stopping may cause the pump wire to rub against the walls of the well, chaffing the wire. Eventually, excessive chaffing will cause pump failure. Unfortunately, torque arresters cannot be installed in conjunction with a secondary well seal installation.

Policy Statement

Secondary well seals are useful tools when used properly and for the correct application. Properly installed, they can make the difference between a potable water supply and no water at all. However, these seals shall not be approved for use to remedy an improperly installed primary seal in new well construction.

Suggestions

Most contractors use 4" PVC casing for the well liner. However, some contractors have found that using schedule 40 steel casing in lieu of PVC has resulted in a better installation. PVC casing is sometimes not rugged enough for the application. In circumstances where the well has a caving condition, the well is not straight, or the installation will be very deep, steel casing may be the best choice for the job.

Decisions regarding sealing of the annular space with cement or bentonite grout above the secondary well seal should be made on a case by case basis. In temporary installations, applications designed to keep out sediment problems, and applications where multiple seals or packers are required, the use of grout may not

be necessary or desirable. However, in applications that are designed to keep out unwanted water, a grout seal should be installed.

When installing a submersible pump through a 4 or 5 inch casing, the pump wire should be sleeved with ¾" to 1" poly pipe. The sleeve will protect the electrical cable from abrasion and chaffing against the interior surface of the rock well and will aid in retrieval of the pump in the future.

Down-hole video cameras are available to the water well industry today and have proven to be useful tools in diagnosing well problems. These tools are also very helpful in determining where to install a secondary seal in the well to achieve the desired result.