

Installation procedure for NAPL blank liner in open borehole below the water table

(see note on last page for installation in the vadose zone)

This liner is a blank liner covered with a reactive covering. The liner is shipped inside-out with the cover on the inside of the liner. Care must be exercised to assure that the outer covering is not twisted with respect to the liner. This is especially true while the liner is inside-out on the reel.

1. Tag the hole depth to assure that it is known.
2. Tag the water level in the hole. Compare to the bubbler depth if a bubbler is included in the installation.
3. Smooth the top of the casing to assure that there are not very sharp edges that will threaten the liner.
4. Set the liner reel on an axle and supports to allow easy deployment of the liner. The liner is marked with an arrow. The arrow should point towards the well over the top of the reel. Unwrap the reel protective layer. Do not use any blades. A scissors without sharp edges is okay, but be careful to not cut the liner.
5. Insert the steel rod in the end of the vent tube. Tape the last 2 inches of the rod so that it is wedged firmly in the vent tube and will not fall out of the tube. Install the vent tube to the bottom of the hole. Tie the top end of the vent tube so that it is suspended about 4 inches off the bottom of the borehole.
6. Pull off about 10 ft. of liner and evert the liner back upon itself about 5 ft. as in the drawing. Evert the covering over the everted liner if the liner is not stapled to the cover. Be careful that the covering is not twisted relative to the liner. The cover may have been stapled to the liner to assure that it is not twisted.
7. Slide the everted liner down into the casing as shown.
8. Slit the open end of the liner/cover about 6 inches and fold about 3 inches of the liner and cover over the top edge of the casing. If the casing is large, make two slits on opposite sides. Tape the cover to the top of the casing. Put two clamps over the tape to hold the liner and cover securely to the casing. The vent tube can pass through the slit.

9. Set the wellhead roller over the casing. Drape the inverted liner over the wellhead roller to guide the liner into the hole. If a wellhead roller is not available and the reel axle is higher than the casing, the liner can be deployed directly from the reel.
10. Water can now be added to the interior of the liner. Lower the liner until about 10 ft deep in the casing. Fill the liner to the top of the casing, if the wt. is not too deep. For a 6 inch or larger diameter, 5 ft of water is sufficient.
11. Stop the water addition, and lower the liner slowly to the water table. See the footage marks for that distance (if footage marks are on the liner). The hanging wt. of the liner should decrease dramatically as the liner descends into the water.
12. Keeping about 5-10 lb. of tension on the liner (i.e., restrain the descent), continue to add water to the liner until it reaches the bottom of the hole. At about the half distance into the hole (i.e., the eversion point is at the half depth.), the liner will stop until the air has bled out of the end of the liner via the press. relief valve. Add another 10 gallons of water to submerge the air bubble to hasten the air vent. When the liner starts to move again, continue adding water until the liner reaches the bottom of the hole. *This venting of the air is only needed at the end of the liner.*
13. Be very careful to not let the tether go down the hole. Secure it to the tether bar supplied with the liner when the liner is all the way down the hole. If there is no tether because of the liner length, tape and tie the liner so that it does not continue down the hole. The liner should be sitting on the bottom of the hole.
14. Leave about 5-10 ft. of excess water head in the liner. More is not a concern. This will press the liner/cover firmly against the borehole wall.
15. Let the liner sit in the hole until the retrieval is to be done. This can be done after ~1/2-1 hr. if desired. -or longer to allow a good absorption from fractures.

The retrieval

1. Untie the tether (or liner) and extend it from the wellhead over the wellhead roller. Locate the winch plate (or other towing device) so that the tether/liner can be pulled from the well over the wellhead roller and beneath the small roller on the back of the well head roller. The current wellhead roller and winch system is called a “green machine”. BE CAREFUL to not drop the tether down the inside of the liner.

2. Lower a Grundfos or similar pump into the liner to remove the water. **Do not lower the pump below a point 5 ft or more above** the original water level in the hole (10 ft is better for 3-4" holes). This assures that the liner is always inflated. Pump the water from the liner until the pump runs dry. Immediately stop the pump. Never allow the water level inside the liner to be lower than 5 ft above the water table. A somewhat higher level is better insurance that the liner will not buckle in the hole and become jammed.
3. Winch the tether from the hole. This will go slowly for a time, but then it will be easier. This will take about 30 lb. of tension on the tether at the least. (note at about 150 lb. of tension on the winch, the crank is very hard to operate. Any additional tension is that needed to pull the water into the well.) The crank should be relatively easy to turn. Note, if the liner, and not the tether, is being pulled from the well, it may be easier to pull it out by hand without the winch, using several people to pull on the liner.
4. Wind the tether, and later the liner, on the shipping reel as it is pulled from the hole. Do not drag the liner on a rough surface (e.g., concrete, pavement, stubble, ...) if the liner is to remain leak tight.
5. Adjust the pump speed to keep the water level a short distance above the pump. This will reduce the winching effort.
6. When the liner knot and valve appears at the surface (if the tether was being used to pull the liner), the liner may be able to be pulled from the well by several people over the roller.
7. When the liner reaches the depth of the water table, the pump can be removed from the liner. **Do not pump out the last 5 ft of water in the liner. The water slug is needed to invert the liner.**
8. Now the liner can be pulled from the hole without further pumping until the water begins to spill out the top of the hole. Lower the pump into the liner and remove the remaining water.
9. Pull the liner out of the hole.
10. Remove the clamps from the well head, and wrap the liner on the reel.

Examination of the liner

1. Pull the liner off the reel out on a relatively clean surface like a lawn or plastic film. Slide the liner off of the cover to expose the white backside of the cover. If the liner is very long, the liner may need to be removed by bunching the liner, pulling the cover out, bunching the liner, etc... until the cover is removed. (the wet cover adheres a great deal to the wet liner,

so sliding a portion of the liner off the cover is easier.) (If the liner is not to be reused, it can be slit to expose the cover.) It is very helpful to insert a blower hose between the liner and cover to collapse the cover and inflate the liner before pulling the cover from within the liner. Spread the cover flat to allow easy examination of the white (unstriped) surface. Turn it over to examine the other side. When the cover is exposed to the end of the liner, the cover can be cut off to allow reuse of the liner to seal the hole.

2. Lay a tape measure the entire length of the cover with the top at the ground surface position.
3. Record and photograph the location of any stains on the cover caused by the wicking of the dye through to the white side of the covering. The stains will be obvious. They will not be the faint variations of the dye lines that may be seen through the cover. If in doubt, expose a small piece of the cover to the pure product under water. For oily substances (non-solvents), the stains will be clear and translucent, like an oil drop on paper. If the NAPL is dark, the stains on the cover will also be dark.
4. The blank liner can be re-extended and replaced on the reel. The blank liner can then be reinstalled into the hole to seal it against flow in the open hole

If you have any questions, call FLUTE at 888-333-2433. Or call Carl Keller on his mobile phone 505-930-1154.

Note for installation in the vadose zone:

The procedure is the same except the water addition fills only 5 ft of the liner (10 ft for 4" holes). With the water in the liner allow the liner to evert to the bottom of the hole. Seal the top of the liner to an air blower of 1-3 psi capacity and inflate the liner against the hole wall for an hour. Then remove the air source and invert the liner from the hole by hand. Use gloves for the tether portion. Don't drop the tether and keep it anchored firmly to prevent loss down the hole (a very awkward situation). If the grip on the tether is lost, the liner will rapidly descend down the air filled hole taking the tether with it. Roll the tether and liner onto a shipping reel as it is being removed. If the liner is to be installed later to seal the hole, do not drag the liner on a rough surface. That will damage the coating and cause a leak.

NAPL FLUTE liner installation in open borehole

