OPERATING INSTRUCTIONS

10.04 DIRECT WELL

Installation of a Direct Well with the drive cone technique

Installing a Direct Well

Necessary: Electric or gasoline powered hammer. Casings of which one should be fitted with a drive cone holder to hold the lost point. Lost points (also mentioned "drive cones"), tubing 10x12 mm, knife, Direct Well and bentonite plugs, some wet bentonite for smearing thread connections, ring key wrench 30 mm, 2 man operated rod puller with bars, filling ring, rod puller clamp and wedge clamp for casings 54 mm, drinking water, boots, hearing protection, helmet.

Principle

A hollow casing is fitted with a lost point and hammered, meter by meter, into the ground until the installation depth for the well is reached. Then a Direct Well screen is fitted with a tubing, ballasted with two or three bentonite plugs and lowered in the casing. Then the casing is filled with water and more bentonite plugs are added (or the water is added after having filled the casing with bentonite plugs). Then the casing is pulled out of the ground leaving behind the Direct Well. The bentonite will swell and plug the borehole in 48-72 hours. Sand catchers (with spacers on top) placed between filter part bentonite and at regular distances between the bentonite plugs will prevent sand or other back fill material from flowing down; which would prevent the correct swelling of the bentonite plugs. The sand catchers will also centralize the tubing in the casing and borehole.

Water level in the well can be measured (after stabilization) with a 5 mm outside diameter water level sounder. The Direct Well can be purged and sampled with a peristaltic pump or with the smallest diameter foot valve pump (9 mm with a 6 x 8 mm PE tubing) if the water table is deeper than 8 m.

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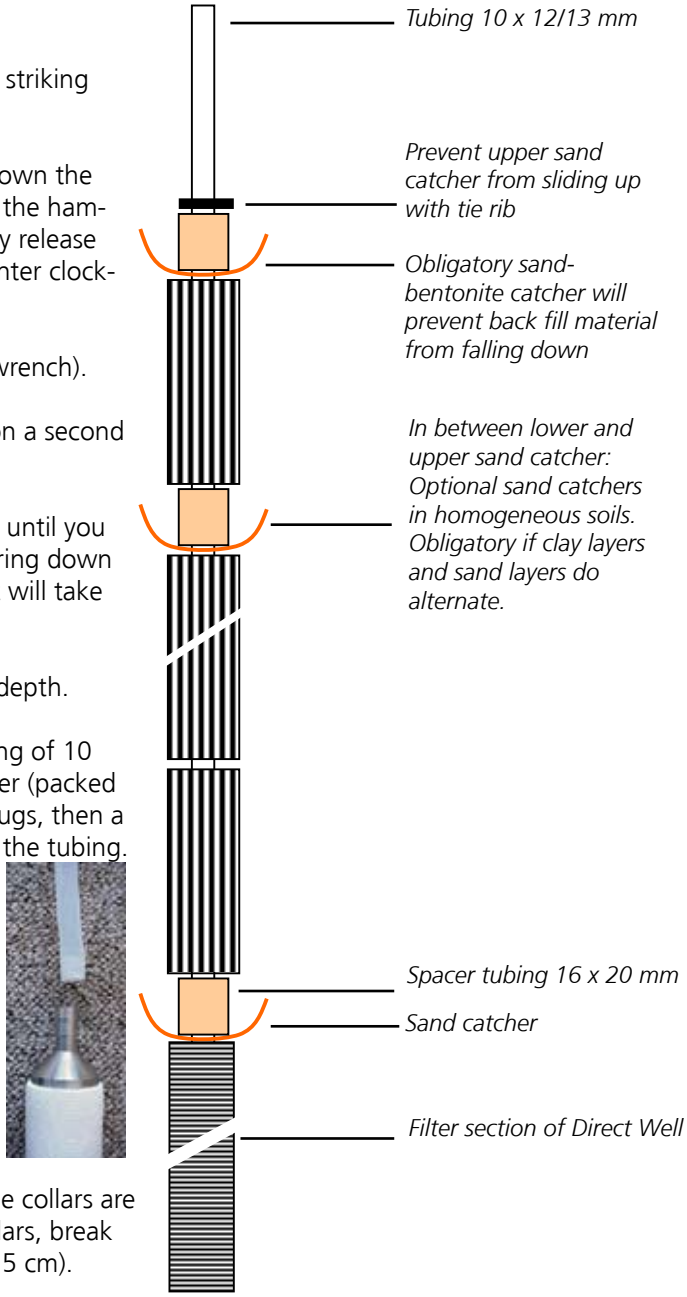
Procedure

- ❒ Take a casing and fit it with the drive cone holder (a 15 cm long short piece of casing with on one end a screw connection; the other end is blunt. (After having connected the drive cone holder to this casing you will generally leave this drive cone holder permanently connected).
- ❒ Take a lost cone and remove the O-ring that is close to the point itself. The other O-ring should always stay on the drive cone.
- ❒ Put some bentonite in water and smear the O-ring and inside of the drive cone holder with bentonite paste. Smearing with pure water also helps.
- ❒ Push the cone in the casing.
- ❒ Smear the threading of the striking pen and twist the striking pen on top of the casing.
- ❒ Put on the Makita (or Cobra) hammer and hammer down the casing while keeping the threading closed by turning the hammer gently to the right ! Just before stopping you may release the threading by twisting the hammer vigorously counter clockwise.
- ❒ Remove the striking pen (if necessary with a 30 mm wrench).
- ❒ Smear the threading of the second casing and twist on a second casing. Remount the striking pen.
- ❒ Hammer down the second meter of casing and so on until you reach the required depth. Stop hammering if hammering down one meter takes more then 5-10 minutes (generally it will take only 1-2 minutes).
- ❒ Remove the striking pen; you are now at the desired depth.
- ❒ Now the well needs to be assembled. You need: Tubing of 10 mm I.D. max 13 mm O.D. + a sand catcher with spacer (packed together) and bentonite collars. Slip two bentonite plugs, then a spacer , then a sand catcher over the "lower" end of the tubing.



- ❒ Then take a Direct Well, cut off the top of the packaging.
- ❒ Then take the "lower" end of the tubing and fit it on top of the Direct Well (be careful to avoid folding the tubing).
- ❒ Remove the plastic bag keeping the Direct well clean and lower the Direct Well string with sand catcher, spacer and bentonite collar in the casing. generally the collars are not straight. To reduce friction while lowering the collars, break every collar at three to four spots (so at about every 15 cm).

☞ **Important warning: The spacer should be on top of each sand catcher; so below the bentonite collar. Otherwise the bentonite collar may get blocked in the casing during pulling out of the casing (see drawing).**

- ❒ With every winding of tubing that you pull out of the dispenser box, turn the dispenser box with one turn. This will prevent wrinkling of the tubing. You may also hang the tubing-roll vertical in stead of horizontal. Then the wrinkling problem can be completely avoided.

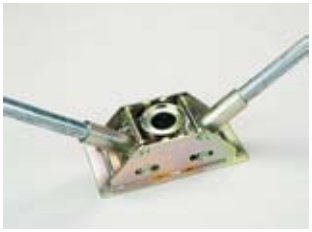
- ❒ Leave at least 1 m of tubing sticking out of the top of the casing

- ❒ Fill the casing with water.

- ❒ Slip a sand catcher, then a spacer, then two bentonite collars over the tubing and push them down into the casing. Again break the collars a few trimes while putting them in the casing to reduce friction. Repeat this until a bentonite collar is sticking out of the top casing.
  Note 1: You may break a collar if it is insufficiently straight to slide into the casing.
  Note 2: In stead of filling the casing when it is filled with water you may lower all Direct well parts in the casing when it is dry. After dry filling you must fill the casing with water prior to pulling up.

- ❒ Slip (if available) the large black rubber scraping plate over the casing (this will clean the outside of the casing while pulling up).

- ❒ Lift the two-man operated rod puller and slip it over the top of the casing.



- ❒ Then slip the filling ring over the casing and lay it on the rod puller.

- ❒ Then slip the universal casing and rod puller clamp over then casing and place it on the filling ring.

- ❒ Finally slip the clamping jaws over the casing top and slip it in the rod puller clamp.

- ❒ Let two persons take the steel rod puller bars and simultaneously start lifting the casing while checking visually that the Direct Well / drive cone stays down in the hole! If the drive cone is not well "clamped" by the soil it may not slip out of the drive cone holder. Then push out the lost point by pushing on the bentonite staves sticking out of the casing!

- ❒ If one meter of casing is pulled out it can be removed using the pipe tongs. Beat the thread connection with a hammer if the connection does not loosen directly!

- ❒ After having removed all casings the bentonite will keep on swelling. This will after 72 hours result in a well that is in accordance with standards for environmental research.

- ❒ In brackish water allow more time (one to two weeks) for swelling.

- ❒ You may have to add some additional loose bentonite pellets in the top of the bore hole.

- ❒ An adapted street cover is available to finish the job in a neat manner.

- ❒ Later the water level can be checked with the micro water level gauge 11.03.18

Sampling can be done with a peristaltic pump until a water level depth of -9.5 m (volatiles -6 m) (with pump tubing 4 x 8 mm) or with a very small foot valve pump 12.13.05 fitted with 6 x 8 mm PE tubing. This was tested until a depth of - 30 meters.