



Ministère de la pêche,
de l'hydraulique
villageoise et pastorale

English

PRACTICA
FOUNDATION

**Technical standards for low cost manually drilled boreholes
for depths between 30 and 50 metres
(exceptions only allowed in exceptional hydrogeological situations)**

The Ministry of Fisheries, Pastoral and Rural Hydraulics has, after consultation with national and international experts, decided to maintain standards for boreholes drilled manually to a depth between 30 and 50 metres (exceptions only allowed in exceptional hydrogeological situations and after consultation of the responsible department) as explained below.

General

- Good quality of work should be maintained at all times;
- During drilling operations sufficient safety precautions for staff and bystanders are arranged;
- Contamination of the aquifer should be prevented by all reasonable means;
- A bore-log according to the standards is maintained for all boreholes (successes and failures).

In addition to the general technical requirements the following specifications on boreholes and slabs should be attached to the tender documents:

Borehole

Drilling technique	All drilling techniques are allowed as long as technical standards are being reached.
Diameter	6-inch for manual drilling (NOT less than 6-inch and preferably not more than 8-inch).
Verticality	Deviation from the vertical is not more than 5 %.
Straightness	The specified non-rectitude meter (which dimensions are specific to the inner diameter of the casing used, see specifications in annex) can be lowered smoothly and without force to the bottom of the borehole.

Casing pipe

Material	uPVC casing for deep wells. Casing pipes must be certified according to international standards (for example DIN-casing, or IS 12818, CM series)
Inside nominal diameter	minimum of 100 mm (India Mark II, III and Vergnet pumps have to fit in the casing)
Outside nominal diameter	maximum of 125 mm
Wall thickness	minimum 5 mm
Joints	Threaded type (sockets with solvent cement (glue) NOT allowed)
Notes:	In practice a 100 or 125 nominal diameter PVC casing pipe can be used as long as the inside and out side limits are observed. The minimum spacing between the nominal bore diameter and the casing is 19.5 mm on both sides.

Screen

Remarks	Only in the factory fabricated screens with the below specifications can be used. This excludes "homemade" and/or manual cutting of casing pipes into a screen.
Material	Same as casing pipe.
Diameter and wall thickness	Same as casing pipe.
Slot size, (maximum)	1.0 mm (for normal and coarse sands, standard use).
Slot size, (minimum)	0.5 mm (used for very fine sands in Kanem). Slot size 0.5 mm is used in combination with special gravel (smaller) for the gravel pack.
Slot direction	Horizontal slots.
Screen position	Depends on geological site condition. Screen preferably below first impermeable layer. Screens are only placed in aquifers and screens are never in an impermeable layer or within a distance of 0.5 m of an impermeable layer. It is possible to place several screens in different confined aquifers.
Screen length	Depends on geological site condition. In general a minimum 6 meter filter screen in good aquifers, in thin aquifers a screen of 3 meter is allowed only after approval of the quality controller.
Notes:	For hand pumps with a production of 1 to 2 m ³ /h a correct position is more important than creating a maximum length. In situations where these standards do not allow a well installation, a hydro-geologist (of DH) can decide to overrule the standards so to provide water where it is needed.
Filter cloth	No filter cloth of any kind can be used.
Centralisers	Centralisers are installed over the full length of the casing and screen with intervals of 3 m. The diameter of the centraliser matches with the diameter of the borehole and casing. Centralisers specially designed for small boreholes can be used.
Blind end or sump	Below the lowest screen a blind end of 1.0 m (same material as casing pipe) for sand collection is used. In fine sands (screen slot size is 0.5 mm) the length of the blind end is increased to 3 m. The bottom of the sump must be sealed so that sand cannot enter the borehole. This can be done with a PVC cap, or by heating and folding the bottom of the pipe and closing it with cement mortar (1:2). This must be prepared at least 24 hours before installing the sump in the borehole).

Gravel pack

Filter gravel size	Standard gravel size between 1.5 – 3.0 mm for screens with a slot size of 1.0 mm. For screens with a slot size of 0.5 mm the gravel size is between 1.0 and 2.0 mm.
Filter gravel material	Best quality filter gravel (silica, quartz, basalt). Schist, scale, mica or clay material is NOT allowed.
Thickness of pack	Minimum of 19.5 mm. Actual thickness depends on bore size and outer diameter of casing.
Height	Minimum 1m above the screen, maximum 2 m above screen.
Notes:	The gravel is first washed several times with clean water, then sieved (between 1.5 and 3.0 mm in general, between 1.0 and 2.0 mm in the Kanem).

Sanitary seal

General purpose	A surface sanitary seal prevents contamination of the aquifer from the surface around the borehole. A seal above the filter screen prevents possibly contaminated water from the first (freatic) aquifer to flow to a lower water producing aquifer.
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Surface seal

Material Grout mix of cement : sand with mix-ratio 1:3
Position Starting at ground level
Height 5 meter

Seal above filter screen

Material Clay seal of locally available swell clay. Alternatively cement grout (1:2) can be used mixed with clean water (22 liter per 50 kg cement)
Position Placed 2 meter above the gravel pack or at the level of the best impermeable soil layer.
Height Minimum 2m

Notes: If cement or grout is used as seal material then the first half meter above the gravel pack is of clay to prevent the cement from entering the gravel pack.
The precise location of the sanitary seal above the screen is an expert decision and depends on the actual hydro-geological situation.

Rest of the backfilling

Between the surface seal and the seal above the filter cuttings (drilling material) can be used.

Development

Purpose Borehole development is done to remove drilling fluid and fine particles from the pores. It will compact and stabilize the gravel pack, and improve the permeability of the aquifer around the screen.

Notes: Development can be done by compressor or submersible pump.
Development should continue until the pumped water is clear and free of sand.
Wells with a poor performance during the pumping test must be redeveloped to improve the performance.

By compressor: The compressor must have a minimum working pressure of 4 bars, and a sufficiently big air flow that must be regulated with a valve. The air outlet will be placed just above the screen and development will be done for at least 2 hours for a 6m screen.
Air lifting can be used to pump the well and create high water velocities in the aquifer and gravel pack in order to remove the fine particles and clean the pores. Air lift pumping can remove the incoming fine particles from the well.
Air surging can be used to create shock waves by allowing the water in the casing to fall back and create a reversal of flow around the screen. Both methods can be used alternately to obtain the required development result.

By submersible pump: Suction depth is just above the highest screen, discharge (flowrate) 5.0 m³/h for first 1 hour followed by an increased discharge of 10 m³/h for 1 hour hereafter.
Before developing with a submersible pump, it is possible to remove the sediments at the bottom of the well by injecting clean water with a motor pump and thus lifting the sediments out of the sump. This practice can increase the lifetime of the submersible pump.
It is also possible to create small shock waves (surges) with a rubber piston or surge block.
These techniques can be used complimentary to development with a submersible pump, but cannot in any case replace development with a submersible pump.

Cleaning

Purpose

After development the borehole should be pumped clean with a submersible pump with a flow between 1.0 and 2.0 m³/h and this should continue until the water is clear and free from particles. The flow rate during cleaning is in the same order as the flow rate during normal operation. Pumping from the bottom of the well to clean the blind end.

Pumping test

Basic procedures

After the cleaning operation, and at least 12 hours after development, the borehole must be pumped continuously for 3 hours in 3 periods for 1 hour each, with respective flow rates of 0.5; 1.0 and 2.0 m³/hour. (= 8.33; 16.7 and 33.3 l/min). Before and during the pumping the static and dynamic level are measured at specific moments (see annex). After pumping has stopped the recharge and increase of water level of the aquifer is measured for a period of 1 hour.

Note:

The more accurate “constant flow test” method is not part of the standard pumping test because of its complexity in the analysis.

Hand pump position

The hand pump cylinder should be placed at least 6.0 m below the static water level measured at the end of the dry season. If the seasonal fluctuations are unknown and the static water level is not measured at the end of the rainy season then the pump cylinder should be placed 8.0 m below the static level at that moment. The cylinder must be placed at least 1.0 m above the screen.

Above ground works

Circular platform with a circular gutter taking water to a collection basin via a drainage channel (see drawings and exact dimensions in annex).

Design specifics:

- ✓ Circular pump foundation (Diameter D = 1.2 m and thickness 0.3 m)
- ✓ Circular sanitary slab around the pump foundation (Diameter D = 2.6 m, thickness 0.1 m) with a 5% slope leading water from the centre towards the outside and the opening of the drain channel
- ✓ Small wall, 0.1 m above the slab and 0,1 m wide, preventing water from going out of the slab, and leading water to the drain channel
- ✓ Drain channel with measurements:
 - 3 meter length,
 - 0,20m height,
 - 0,30 m width, with a water conduct inside open 10 cm
 - Channel slope is 2,5 cm / m down to the collection basin (1m x1mx1m, filled with rocks or pieces of bricks, surrounded with a 0.1 m thick wall)

Materials:

- ✓ Pump foundation, sanitary slab, channel material ; reinforced concrete (300kg/m³ or 1:2:4, with reinforcement of Ø 8 mm)
- ✓ Circular small wall; clay bricks or concrete blocks with cement mortar (1:3), plastered with a 10 mm thick layer of cement plaster (1:4)

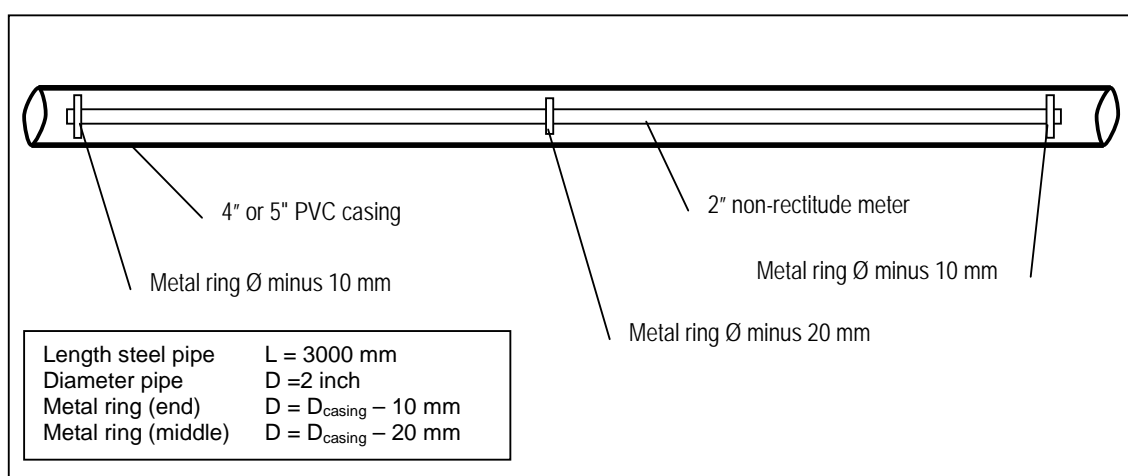
Annexes

Annex 1, straightness tester or non-rectitude meter

The non-rectitude meter consists of a 3 meter long 1½ " or 2" steel pipe (Galvanized Iron / GI). At the top and the bottom of the steel pipe a perfectly circular metal ring (5 mm thick) is fitted with an outer diameter that is 10 mm smaller than the inner diameter of the casing. In the middle of the GI pipe also a metal ring (5 mm thick) is fixed but this one has an outer diameter which is 20 mm smaller than the inner diameter of the casing (see sketch below for explanation where the casing is drawn horizontally).

The exact diameters of the metal rings depend on the internal diameters of the casing pipe. Each size and type of casing pipe will have its own specific sets of metal rings.

Non-rectitude meter



Examples

Casing pipe	Nominal diameter (= ND) [mm]	Inside diameter [mm]	Metal rings end [mm]	Metal ring middle [mm]	Outer diameter [mm]
uPVC blue casing pipe as per IS 12818	100	101,6 - 103,0	92	82	113
uPVC blue casing pipe as per IS 12818	125	110,4 - 112,0	101	91	140

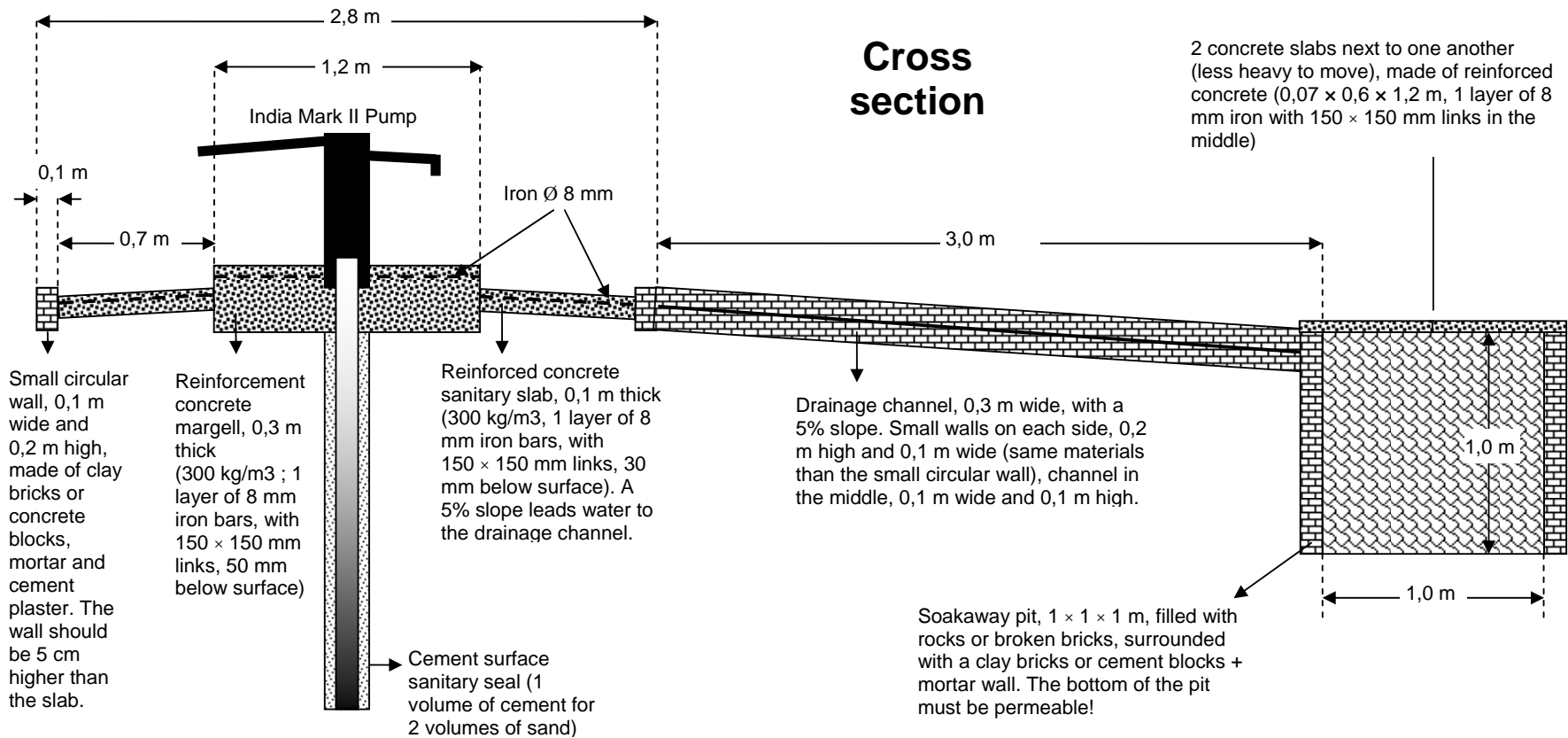
Annex 2, pumping test form

Pumping test form for boreholes fitted with a hand-pump
with an estimated capacity of 1 m³/hour

borehole identification		
Village name	Coordinates	x =
Borehole code number		y =

testdate:
operator names:
pump type and model:
referencepoint is top of casing or:
Static water level (SWL):
Level of submersible pump: m
time at start of pumping:

Theoretical time of measurement	Actual time of measurement	Measured dynamic water level (DWL)	Drawdown (= DWL-SWL)	Measured flow rate
hh:mm:ss	hh:mm:ss	[m]	[m]	[m ³ /h]
1) Pump for 1 hour with a flow rate of 0,5 m³/h (= 8,3 l/mn)				
0:00:00				Q =
0:00:30				
0:01:00				
0:02:00				
0:05:00				Q =
0:10:00				
0:20:00				Q =
0:60:00				Q =
2) Then, pump for 1 hour with a flow rate of 1 m³/h (= 16,6 l/mn)				
1:00:00				Q =
1:00:30				
1:01:00				
1:02:00				
1:05:00				Q =
1:10:00				
1:20:00				Q =
1:60:00				Q =
3) Then, pump for 1 hour with a flow rate of 2 m³/h (= 33,3 l/mn)				
2:00:00				Q =
2:00:30				
2:01:00				
2:02:00				
2:05:00				Q =
2:10:00				
2:20:00				Q =
2:60:00				Q =
4) Stop pumping, but measure recharge				
3:00:00				
3:00:30				
3:01:00				
3:02:00				
3:05:00				
3:10:00				
3:20:00				
3:60:00				
				End of test



Remark : a 300 kg/m³ concrete is made with 1 volume of cement for 2 volumes of sand and 4 volumes of gravel.

Upper View

