

Amanzi Pump Construction Manual



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Werkgroep OntwikkelingsTechnieken (WOT)
University of Twente
P.O. box 217
7500 AE Enschede
wot@utwente.nl
www.wot.utwente.nl

Author: Woud Goudbeek (The Netherlands)
Designed by: Burgert Terblanche (South-Africa)

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2 Introduction

The Amanzi pump finds its origin in Bloemfontein, South-Africa. Where Burgert Terblanche together with his brother spend years on developing a pumping system which is easy to manufacture and install. The solution is a pump based on Polyethylene which has great advantages over the classical steel pumping systems and can be used as hand pump as well as under a wind pump. During development several systems are installed at different farms around Bloemfontein, where some of the pumps are running for over 10 years without problems. The main advantage is the weight of the Polyethylene tubes which makes it possible to install the pump without big hoisting equipment (as shown on the front page). Furthermore, Polyethylene tubes are supplied on rolls which make it possible to transport all the pump parts on a single car.

Since the pump rod is made out of Polyethylene it is much lighter compared to steel alternatives. This reduces the force needed to pump the water significantly for the same borehole depth.

2.1 Testing

At the WOT test field multiple tests are performed on the pump design, from slight changes in the design to testing the strength of the connections and the volumetric efficiency. No changes are made to the original design in this manual, although for some parts an easier alternative is given.

The connection as discussed in section 5.1 and 5.2 can hold up to 500kg of axial force based on multiple tests performed using a load cell and chain hoist.

Volumetric efficiency with a stroke of 22.3 cm:

Strokes / min	Volumetric efficiency	Standard deviation volumetric efficiency	Flow
37	105 %	1.1 %	20.4 L/min
57	111 %	1.3 %	32.2 L/min

3 Materials

Materials	Amount	Unit	Comments
PE tube Ø63x3.8mm PE100	20*	Meters	Depends on borehole depth
PE tube Ø50x3mm PE100	17.5**	Meters	Depends on borehole depth
PA6 Nylon rod Ø41mm	0.15	Meters	
PA6 Nylon rod Ø8mm	0.5	Meters	Cut in 6 equal lengths (80mm)
PE rod Ø25mm	2	Meters	
PE rod Ø70mm	50	mm	
Stainless steel threaded rod M12	1	Meters	
M12 stainless steel lock nut	3	Pcs	
M12 stainless steel flat nut	10	Pcs	
Leather cup 2" ***	3	Pcs	
Cup holder	4	Pcs	
Tapered spring Ø12xØ28x28mm	1	Pcs	
Polyurethane disk Ø47 x 6mm	1	Pcs	
PP socket 2" to 2"	1	Pcs	
PP coupling 2"(Male) to 3/4" (M)	1	Pcs	
PE coupling Ø63x2"(M)	2	Pcs	
Brass check valve 3/4"	1	Pcs	
Stainless steel ball Ø20	1	Pcs	
2"galvanized pipe	1.5	Meters	With the ability to cut thread on it, details see chapter 6
2" galvanized pipe couplings	4	Pcs	2x socket, 1x 45°, 1x T-fitting

* Depth of borehole - 1.5 meter = length PE tube 63mm

** Depth of borehole - 4 meter = length PE tube 50mm

*** See the manual 'leather cups for piston pumps' how to make these if not available.

3.1 Parts list

Parts	Amount	Materials	Drawing number
Pump rod connector	2	PA6 Nylon rod Ø41mm	1.1
Top rod	1	PE rod Ø25mm	1.2
Piston rod	1	Stainless steel threaded rod	1.3
Valve disk	1	Polyurethane disk Ø47mm	1.4
Cup holder*	4	PA6 Nylon rod Ø45mm	1.5
Base plate	1	Steel plate 300x300x5mm	1.6
Top cover	1	PE rod Ø70mm	1.7

* The cup holders can be ordered from the WOT (NL) and can be shipped from the Netherlands or South-Africa, otherwise they can be 3D printed or manufactured on a lathe according to drawing number: 1.5

4 Prepare components

4.1 Piston

For the assembly of the piston of the pump the following parts are required:

#	Part name	Amount
1	Pump rod connector	1
2	M12 locking nut	2
3	Flat M12 nut	2
4	spring	1
5	Valve disk	1
6	Cup holder	4
7	Leather cup	3
8	Piston rod	1

1. One of the *flat M12 nuts* is screwed on the long end of the *piston rod*.
2. The *cup holders* are screwed on the piston rod alternating with the *leather cups*. (An extra nut can be placed after every cup holder for extra security)
3. After the fourth cup holder an *M12 locking nut* is placed.
4. Place the *valve disk* and *spring* on the short end of the piston rod securing with a *flat M12 nut*.
5. Slide the *pump rod connector* on the piston rod and secure it with an *M12 locking nut* while holding the flat M12 nut above the spring.
6. Check if the valve disk can move up and down

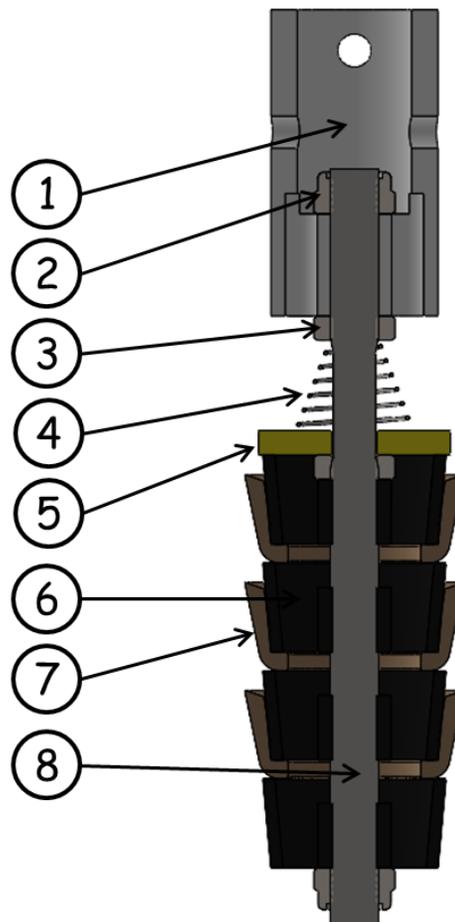
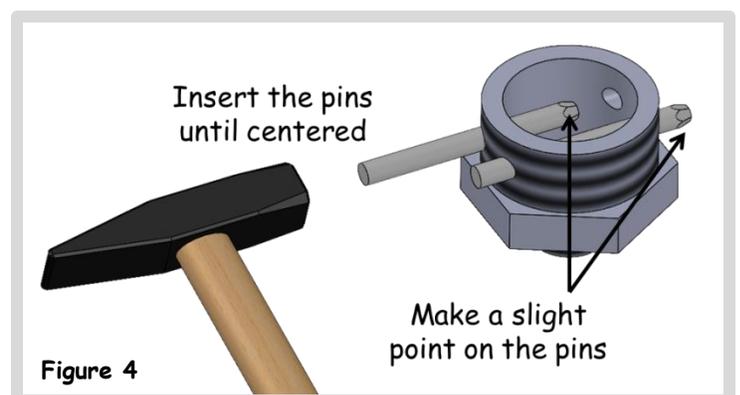
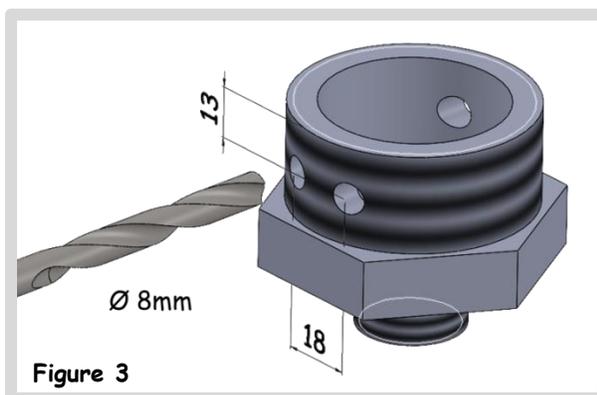
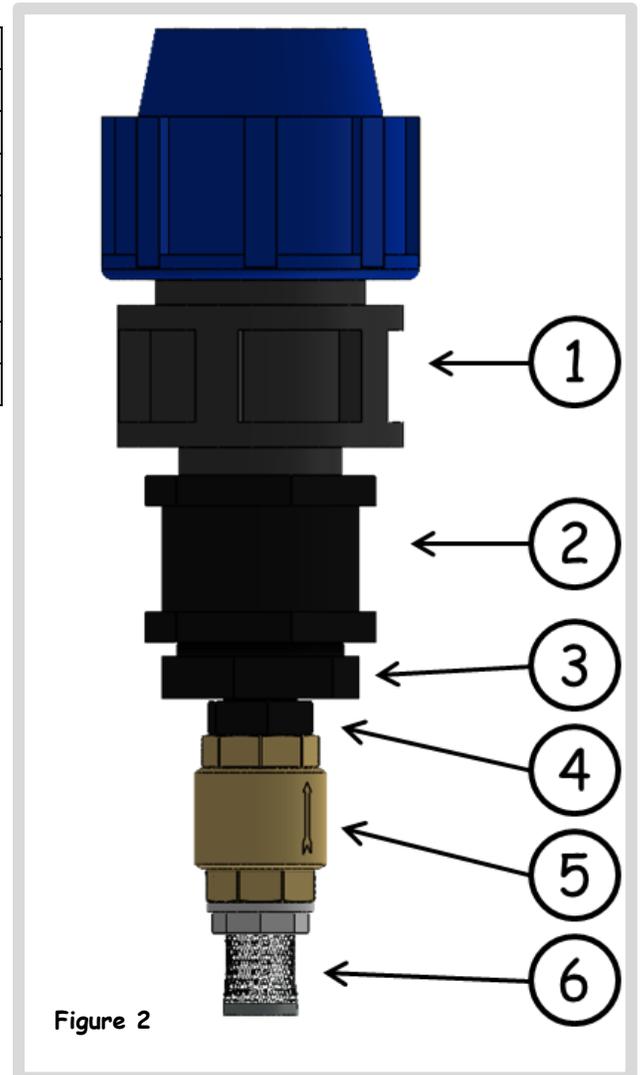


Figure 1 Piston assembly (Section view)

4.2 Foot valve

#	Part name	Amount
1	PE coupling 63mm to 2" (M)	1
2	PP coupler 2" (F) to 2" (F)	1
3	PP reducer 2" (M) to 3/4" (M)	1
4	PP reducer 3/4" (F) to 1" (M)	1
5	Brass check valve 1"	1
6	Filter	1
7	Nylon rod 80mm, Ø8mm	2
8	Stainless steel ball 20mm	1

1. Drill two holes in the *PP reducer 2" to 3/4"* according to Figure 3.
2. Put the *20mm Ball* in the *2"* side of the *PP reducer* and insert the pins according to Figure 4.
3. Make sure the ball cannot come out!
4. Trim the pins with a metal saw, to ensure minimal interference with the thread insert the pin a bit more before sawing.
5. Assemble the foot valve as shown in Figure 2. (connecting part 2 and 3 can be difficult due to the nylon pins)



4.3 Top rod

The top rod is required to connect the inner tube to the pumping mechanism. This can be either a hand pump or wind pump, in both cases the procedure is the same. To assemble the top rod assembly the following parts are required:

#	Part name	Amount
1	Threaded rod stainless steel M12 130mm	2
2	Flat M12 nut	2
3	Top rod	1
4	M12 locking nut	1
5	Pump rod connector	1

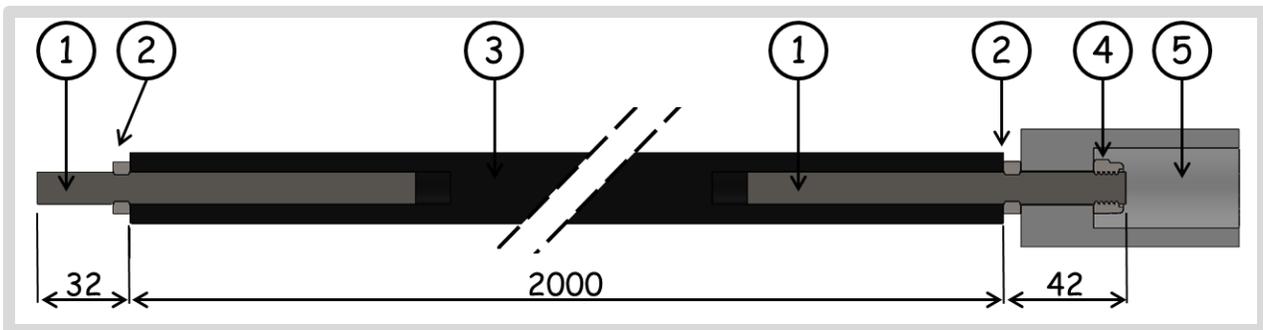


Figure 5 Top rod assembly (Section view)

1. Drill a hole in both ends of the *top rod* with a 10mm drill bit at least 100mm deep.
 2. Screw both of the *threaded rods* into the *Top rod* and secure with a *flat M12 nut*.
- To make the treading easier:

- a. Make a slight point on the threaded rod using a file.
 - b. Screw two nuts into each other to create a 'bolt head'
3. Add the *Pump rod connector* and secure with an *M12 locking nut*.

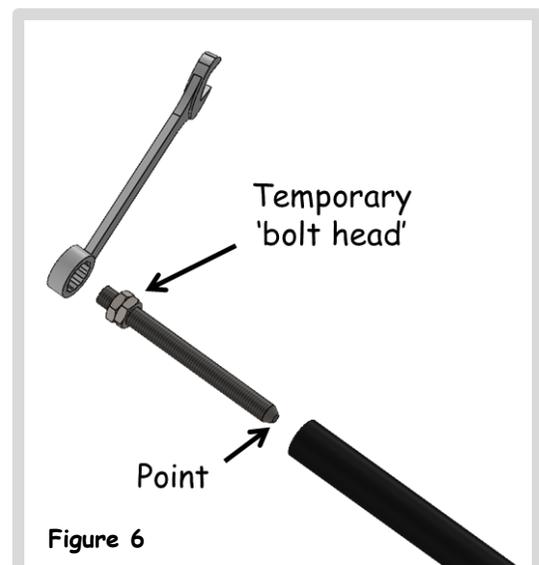


Figure 6

5 Assembling the pump

5.1 Connecting pump rod connector to inner tube

1. To connect the piston rod connector two nylon pins of 80mm are required.
2. Place the piston assembly in the 50mm tube and drill two 8mm holes as shown in Figure 8.

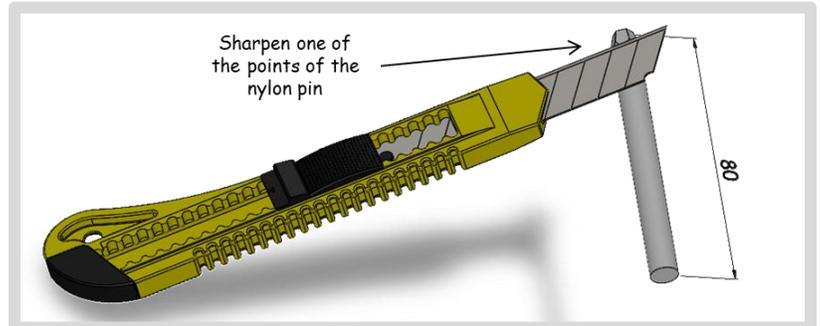


Figure 7

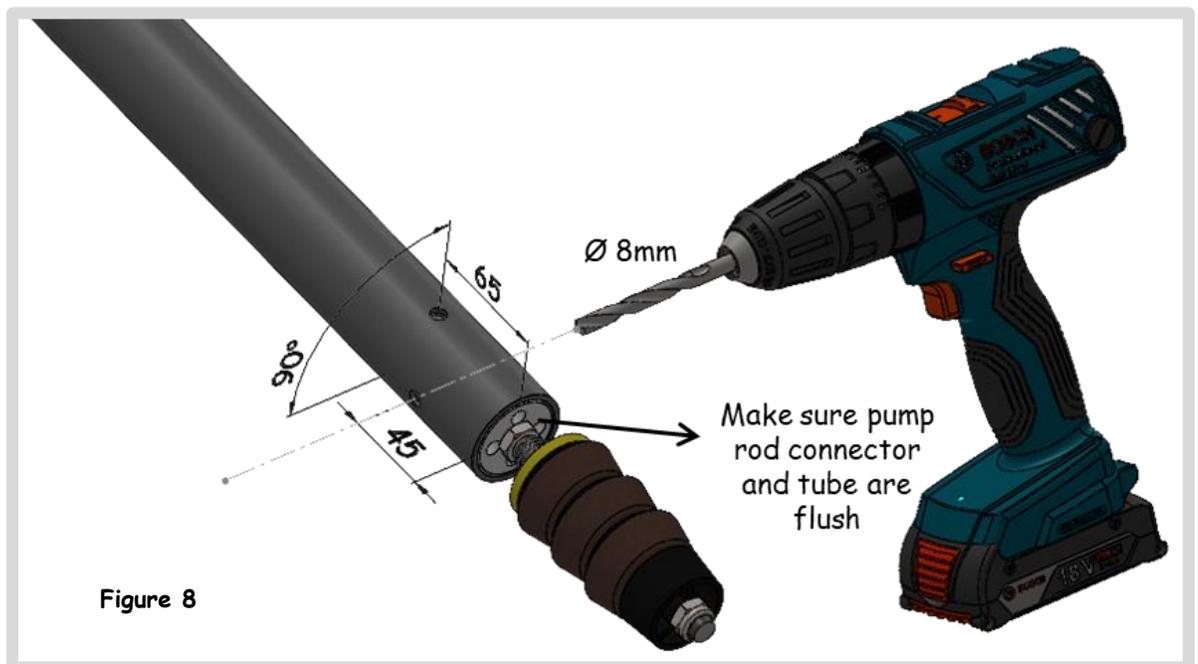


Figure 8

3. Hammer the pins in the holes to secure the piston rod connector.

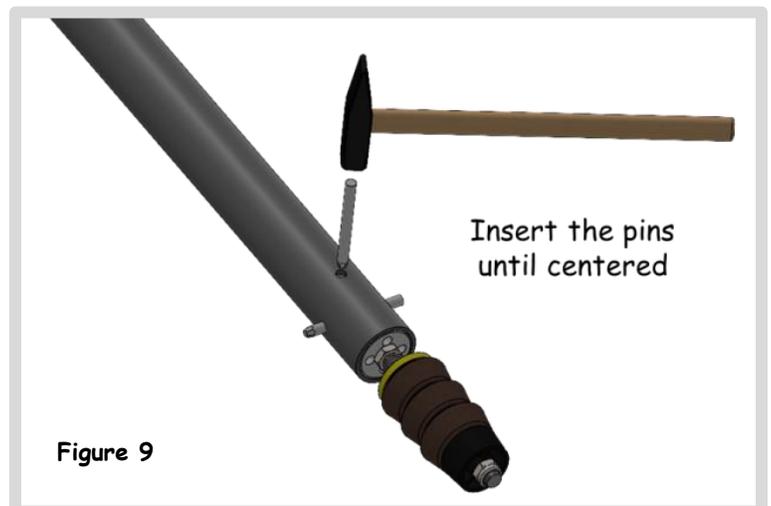


Figure 9

4. Trim the parts of the pins with a metal saw.
5. Finish with a file to ensure a smooth surface.



Figure 10

5.2 Connecting top rod to inner tube

The procedure for connecting the top rod to the inner tube is the same as for the piston. Follow the instructions in the previous section and use the figure below as reference for where to drill the holes.

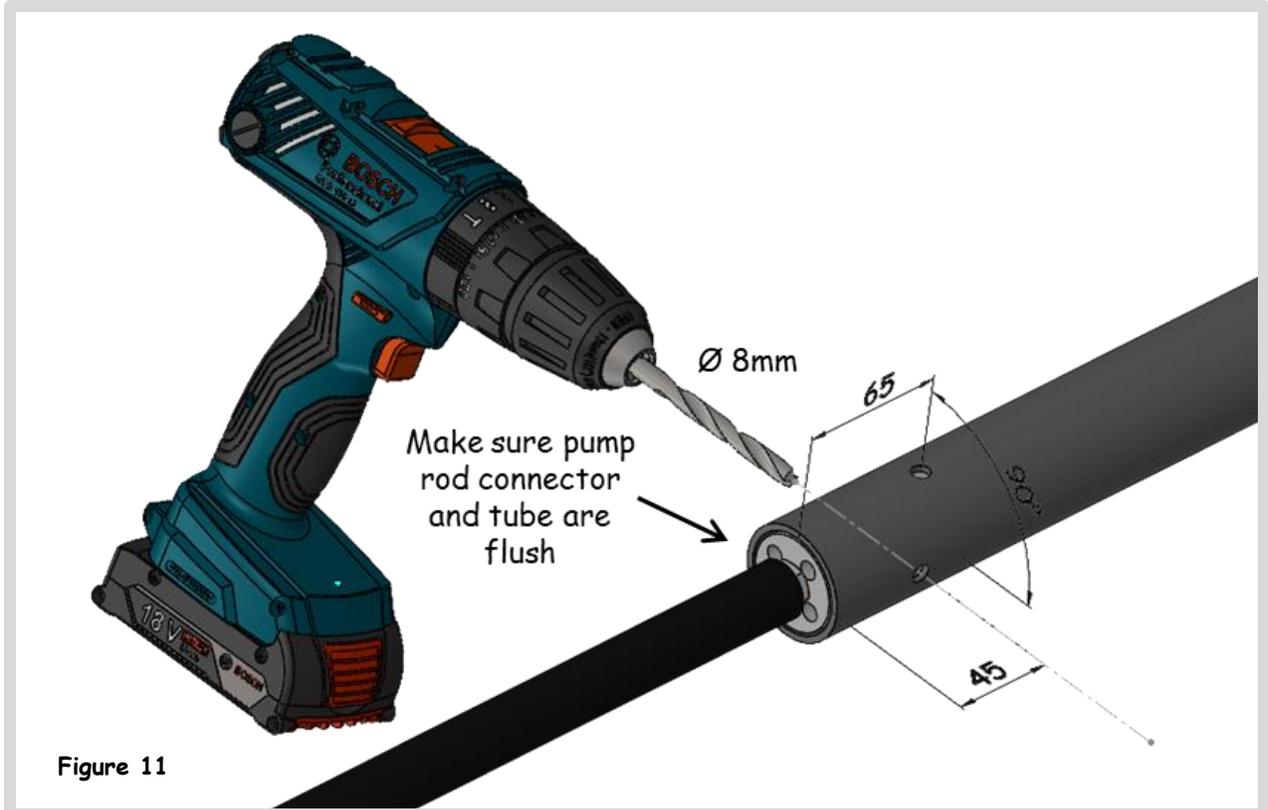


Figure 11

5.3 Hole drilling inner tube

Before the inner tube can be inserted into the outer tube, holes have to be drilled. These holes ensure that the water has an unrestricted flow throughout the pump. At least eight holes have to be drilled as shown in Figure 12.

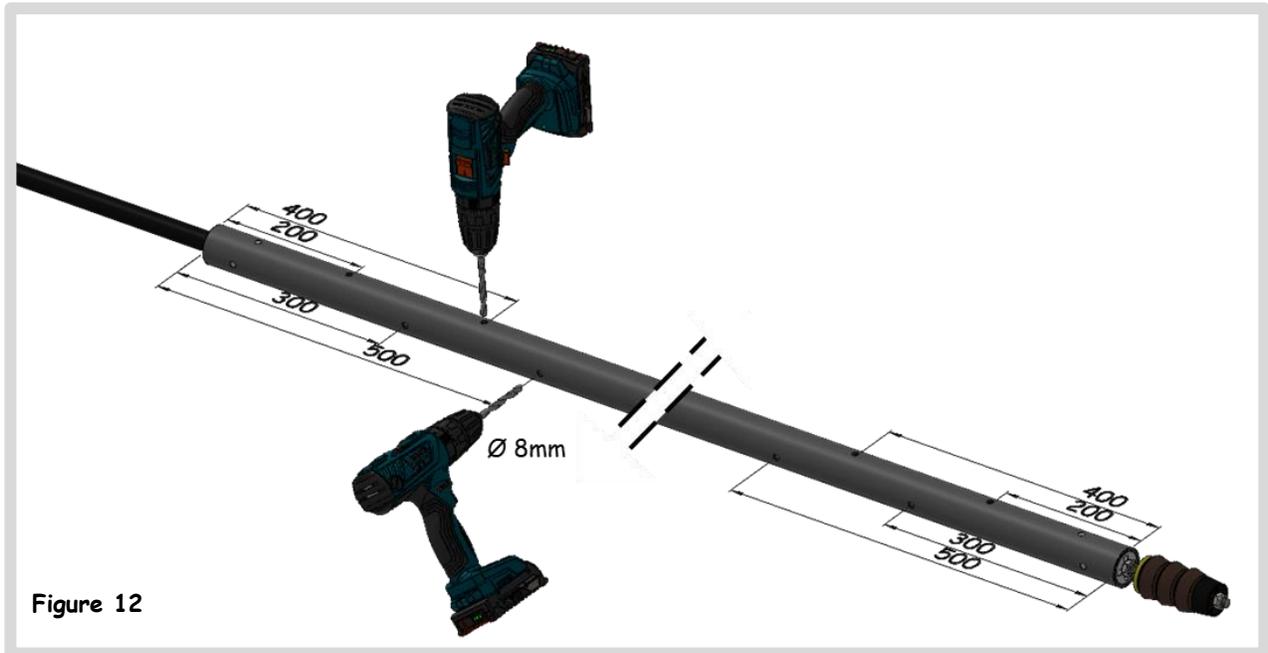


Figure 12

6 Water delivery

The water delivery part of the pump is the part above ground and can be modified to what is necessary at the location of installment. In this manual a basic installation based on 2" galvanized pipe is shown. This configuration can be combined with a hand pump or wind pump. The parts required are listed below:

#	Part name	Amount
1	Top cover	1
2	Socket 2" (galvanized)	2
3	Pipe 2" (galvanized, 250mm)	1
4	T-fitting 2" (galvanized)	1
5	Pipe 2" (galvanized, 750mm)	1
6	Base plate	1
7	Pipe 2" (galvanized, 250mm)	1
8	45°-fitting 2" (galvanized)	1
9	Pipe 2" (galvanized, 100mm)	1
10	PE coupling Ø63 to 2" (M)	1

1. The baseplate with drawing number: 1.6 should be welded to one of the 2" sockets.
2. Connect all the parts in Figure 13 → except for the top cover (1) and the baseplate (2+6).
3. The baseplate assembly (2+6) and the remaining PE coupling Ø63 to 2" (M) should be connected, resulting in Figure 14 →

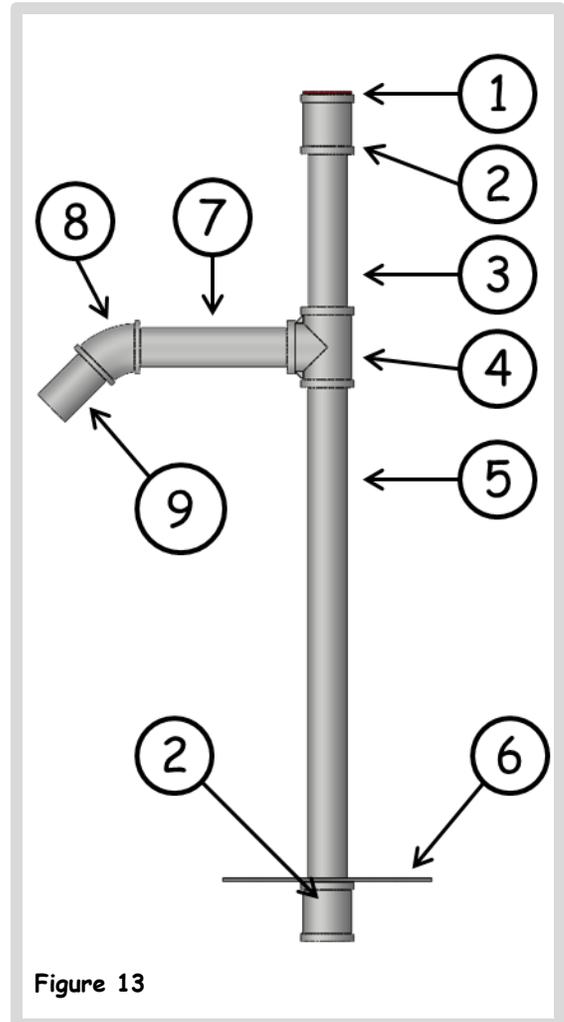


Figure 13

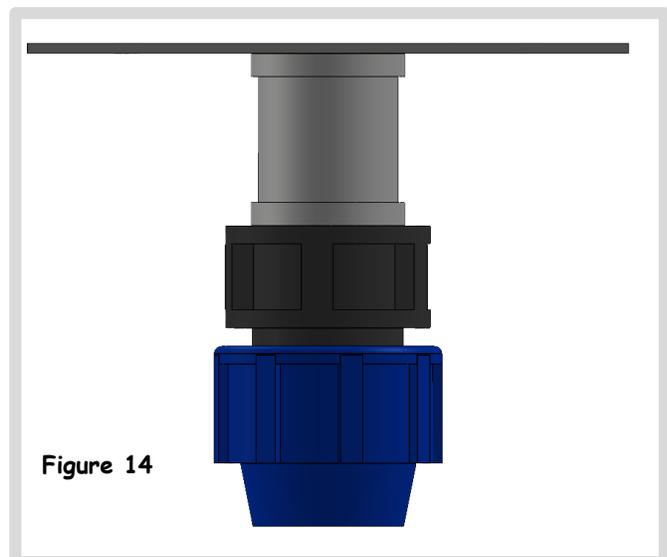
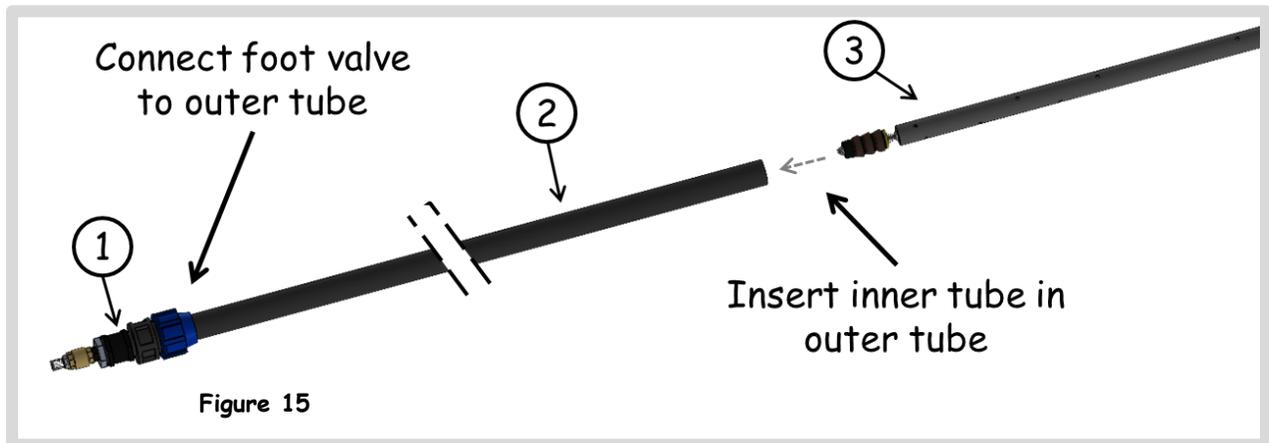


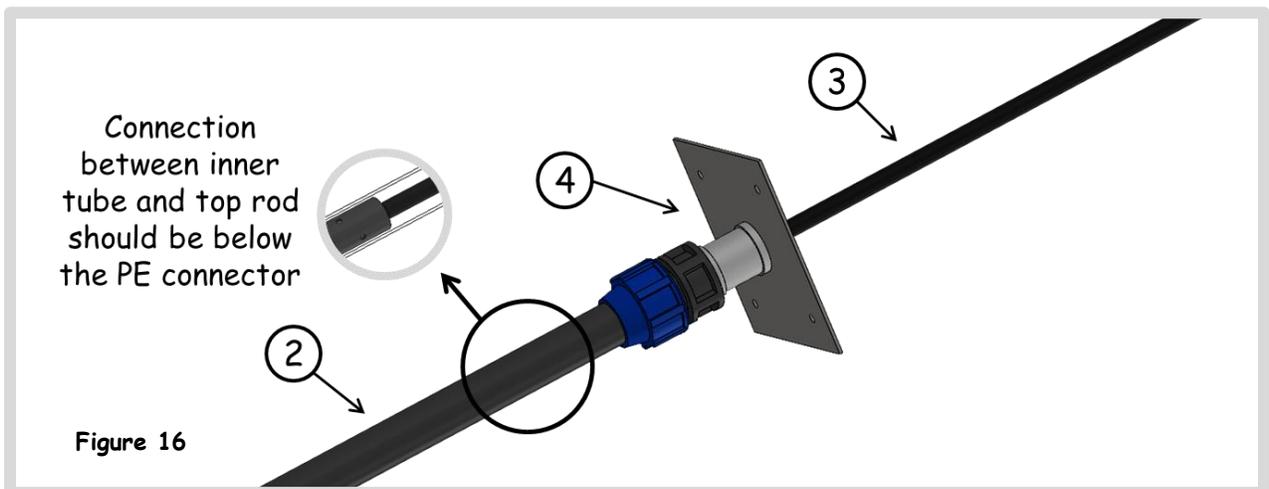
Figure 14

7 Pump installation

1. Clean both ends of the outer tube with water.
2. Make sure the tube is cut of square on both ends.
3. Make a slight chamfer on the outer side of the tube to make the next step easier.
4. Connect the foot valve (1) to the outer tube (2); make sure the PE coupling is installed correctly since all the weight of the water column will rest on it.

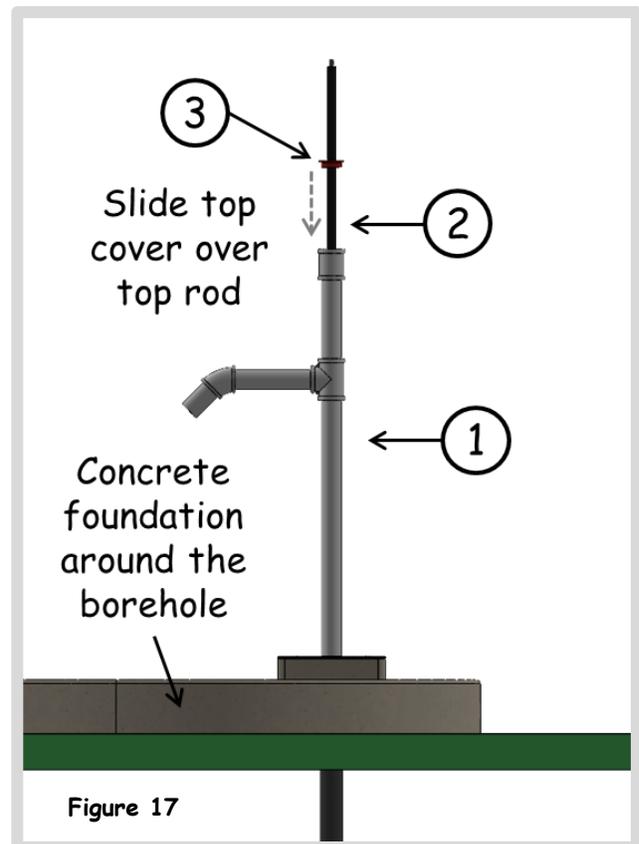


5. Insert the inner tube (3) into the outer tube (2), to make this easier lubricate with water.



6. Slide the base plate assembly over the top rod and connect the PE coupling to the outer tube. Again, make sure the PE coupling is installed correctly.
7. The connection between the inner tube and top rod should be under the PE coupling since the inner tube won't fit through the PE coupling.

8. The pump can now be lowered into the borehole as shown at the front of this manual.
9. Slide the water delivery part (1) consisting of the 2"galvanized pipes over the top part (2) of the pump and screw it into the baseplate assembly.
10. Slide the top cover (3) over the top rod and screw into the 2" socket with some big plyers or the tool in drawing 1.8.
11. The baseplate should be fixed to the ground using for instance a concrete foundation with threaded rod matching the holes in the baseplate.
Note: The baseplate should be removable to be able to do maintenance on the pump



8 Final comments

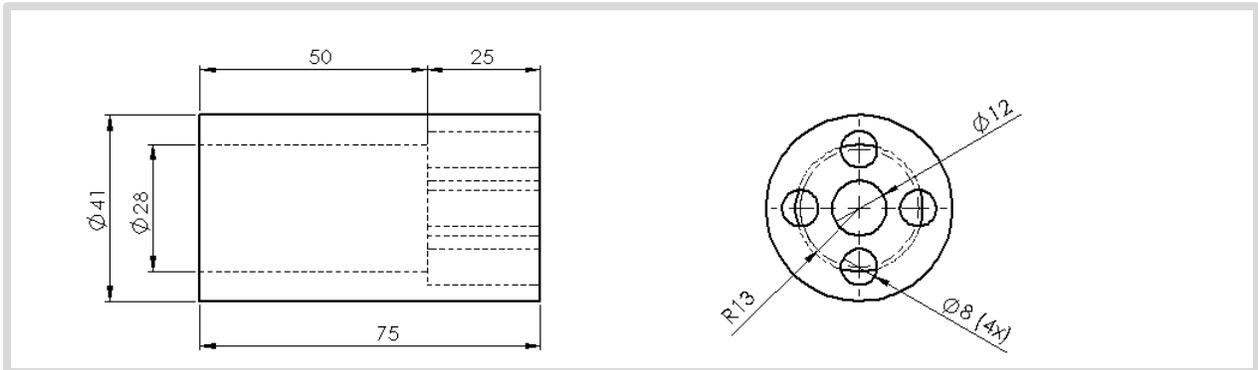
The Amanzi pump is now finished, the concrete foundation around the pump is not described in this manual. It will depend on the situation where the pump is installed.

- If the pump is used as hand pump a proper foundation has to be made to prevent contamination of the borehole by spilled water.
- When the pump is used in combination with a wind pump and the water is transported to a tank no extensive foundation is needed.

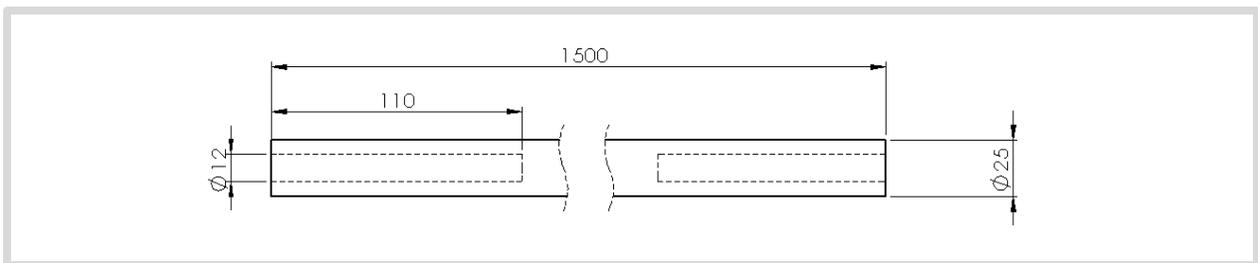
Both cases will be discussed in future manuals, furthermore if there are any questions or comments the WOT can be contacted via the contact form on our website:

www.wot.utwente.nl

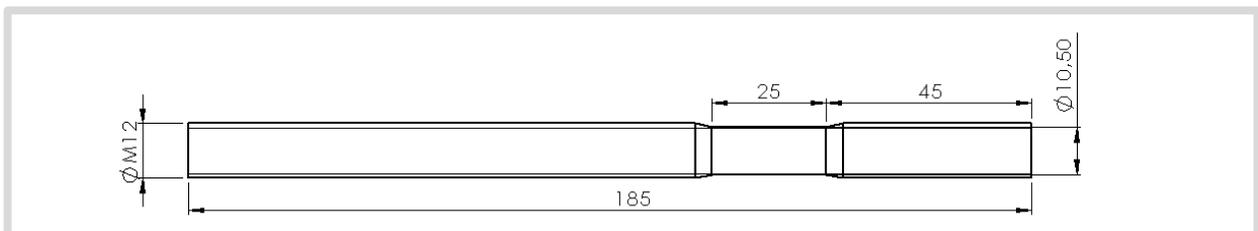
Drawings



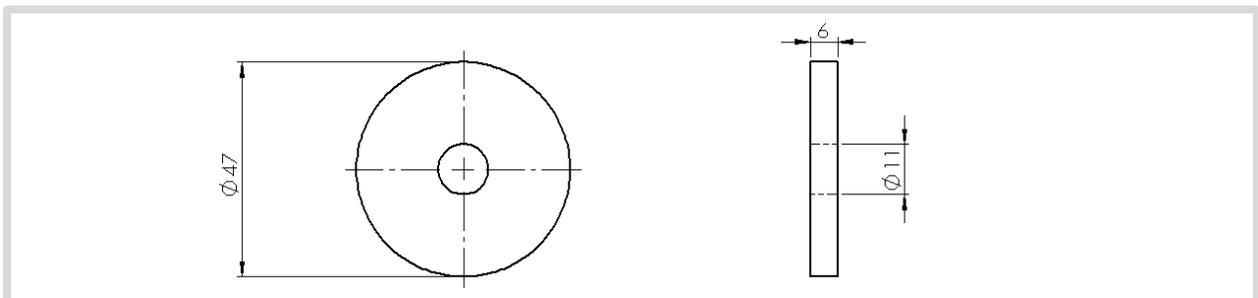
Drawing 1.1 - Pump rod connector



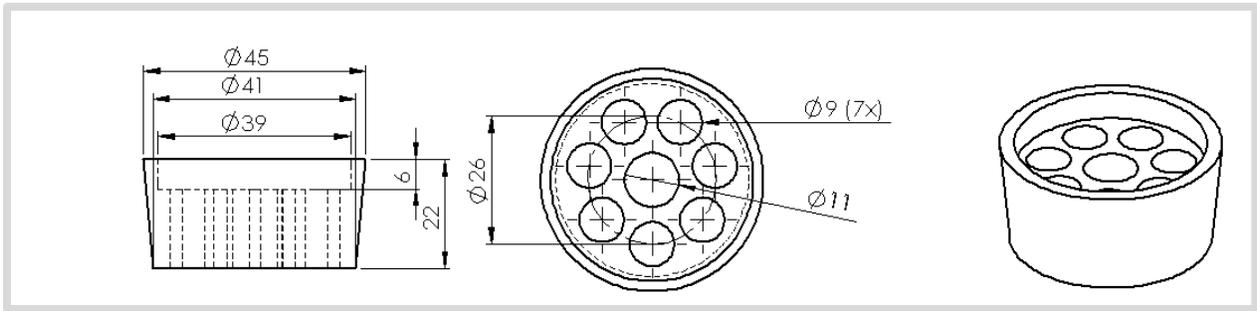
Drawing 1.2 - Top rod



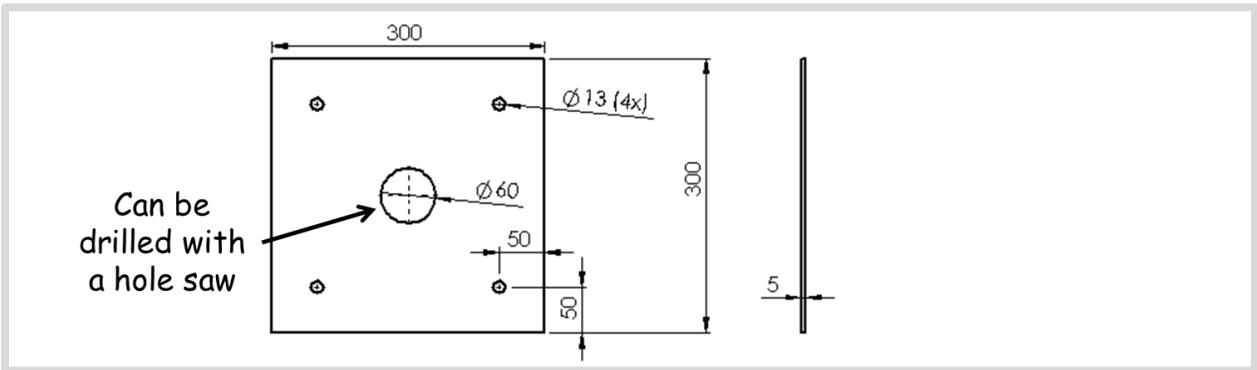
Drawing 1.3 - Piston rod



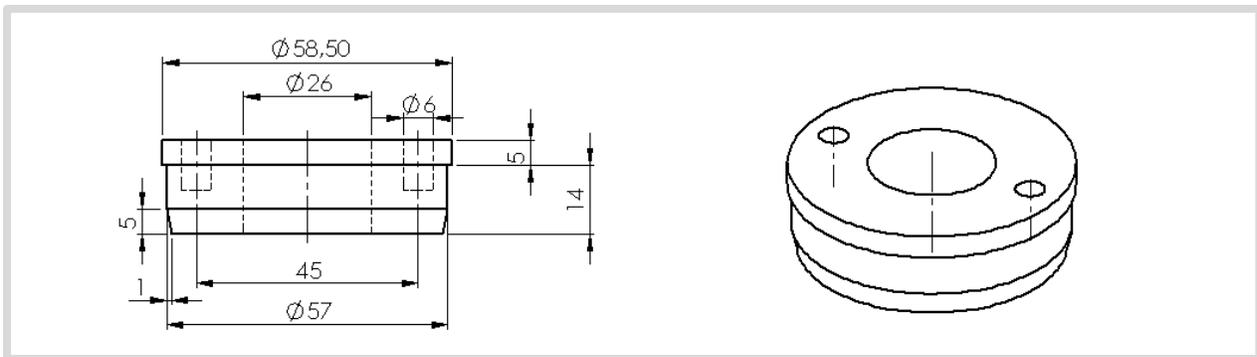
Drawing 1.4 - Valve disk



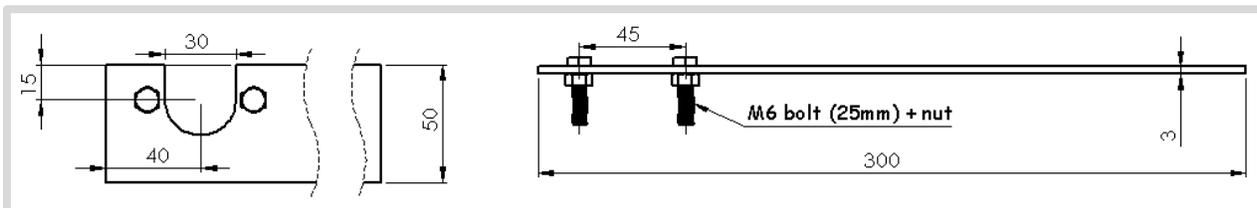
Drawing 1.5 - Cup holder



Drawing 1.6 - Baseplate (steel)



Drawing 1.7 - Top cover



Drawing 1.8 - Top cover tool