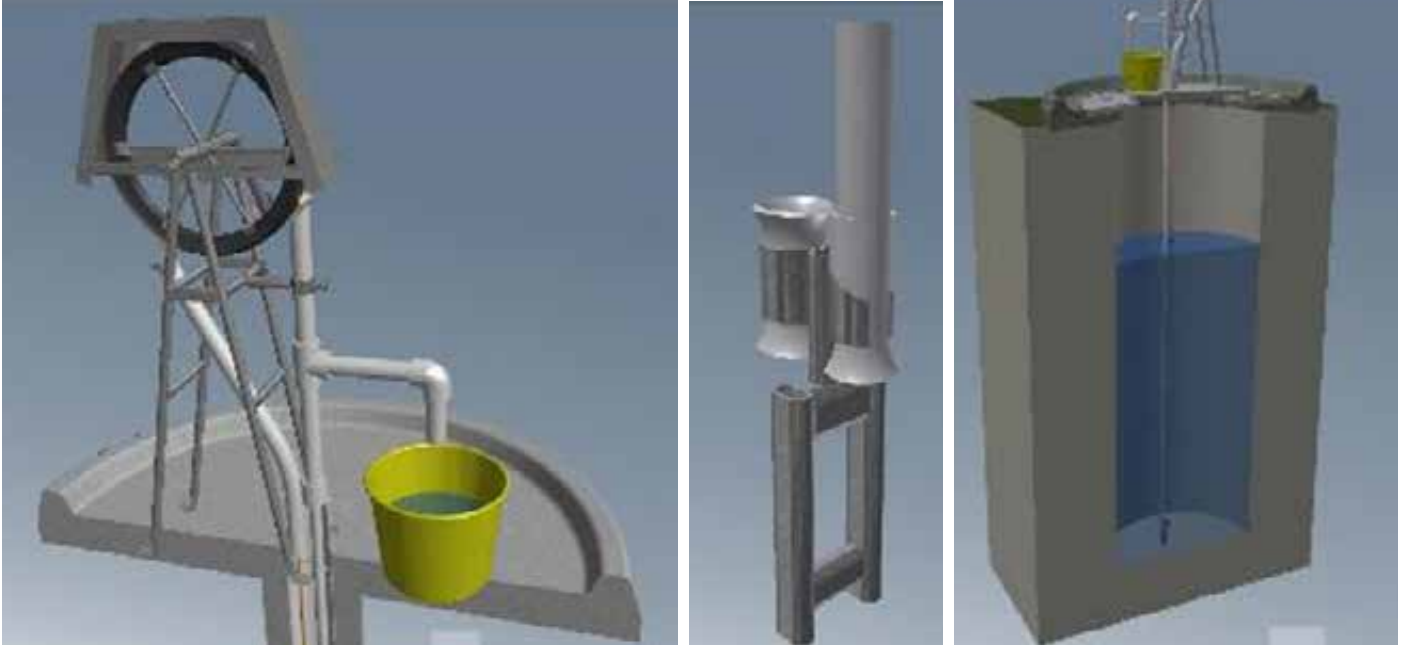


SHIPO Rope pump Model 1



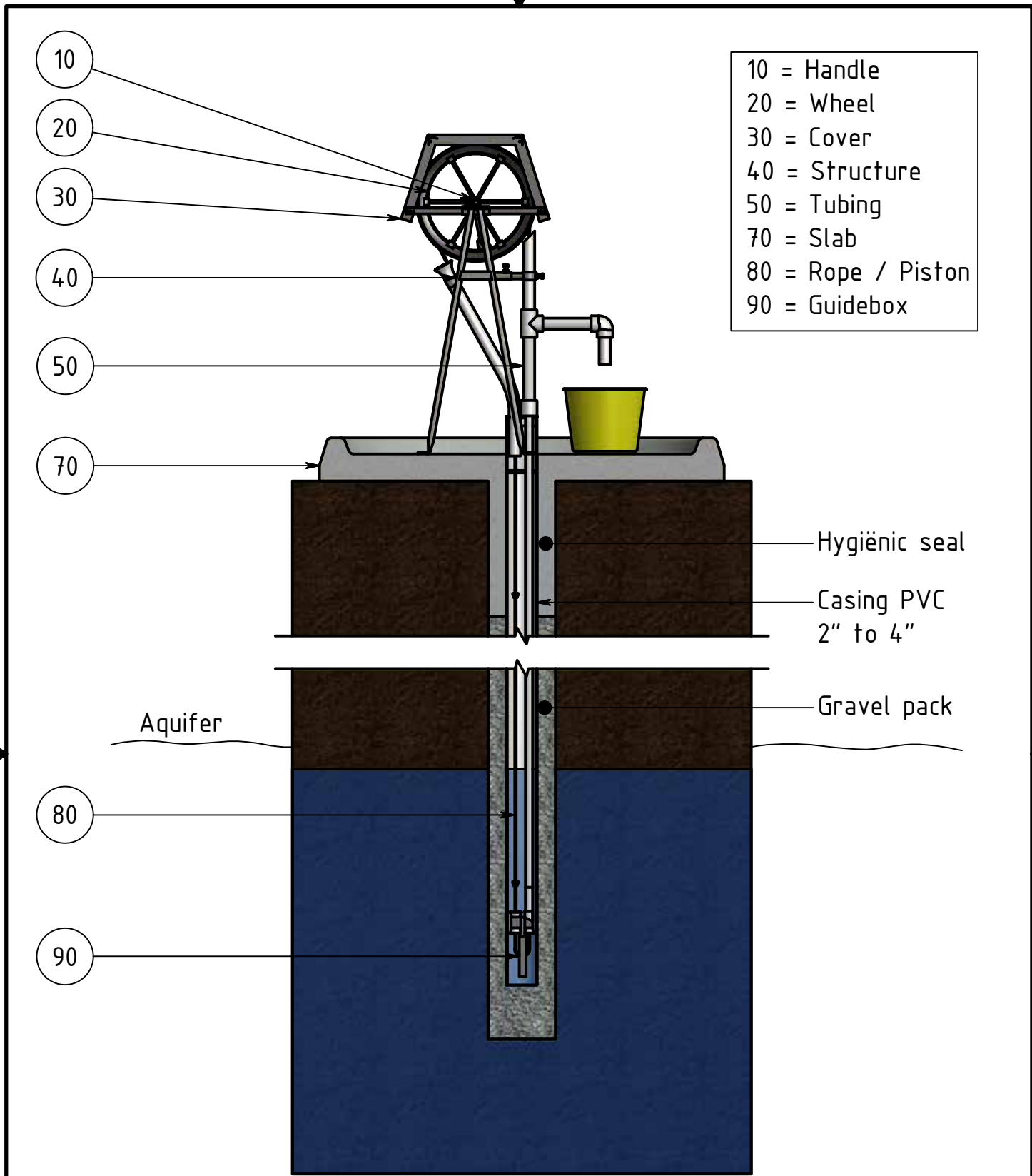
Background





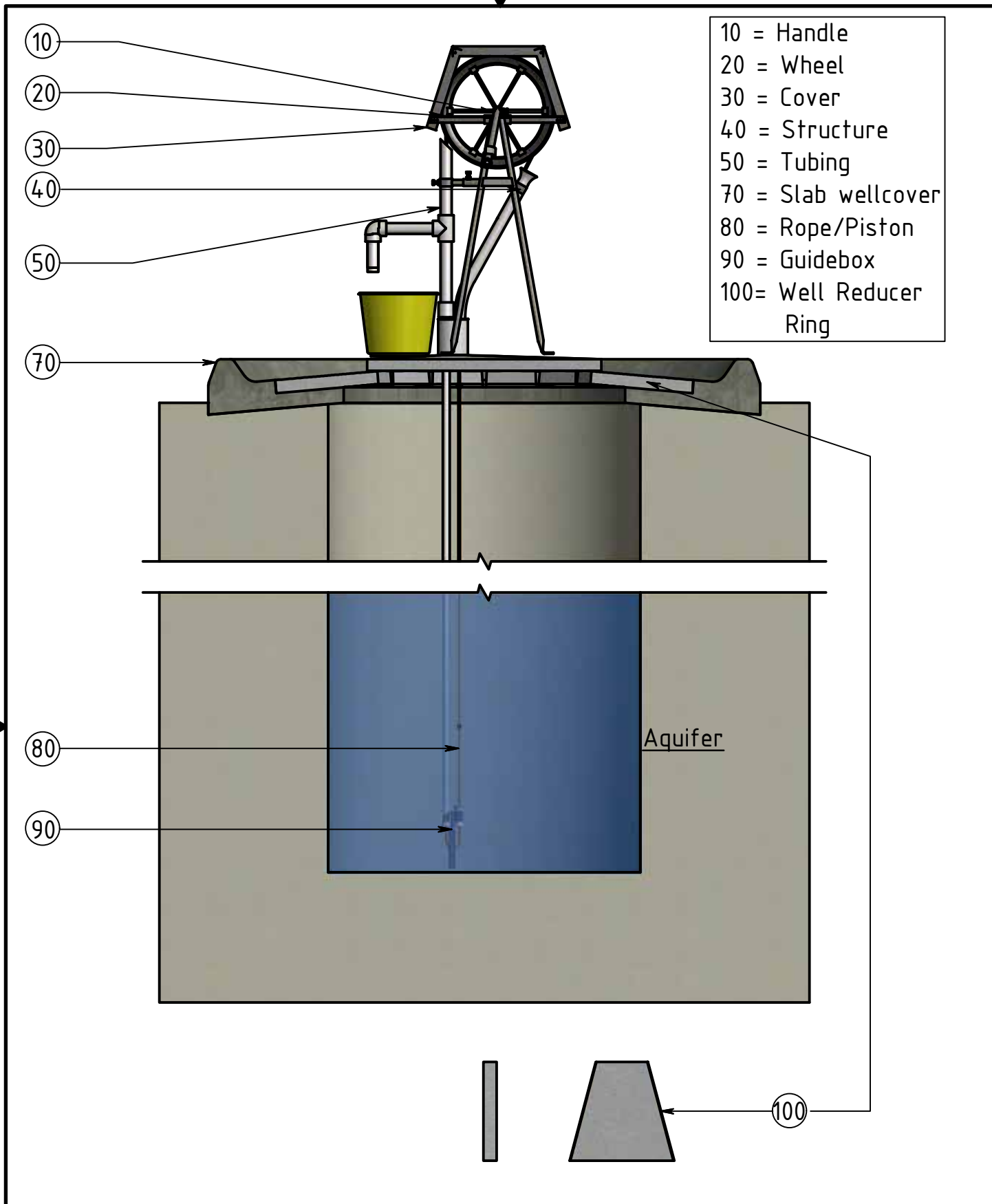
The Rope pump is an ancient technology that, with new materials and designs, now is a very effective and low cost pump option for water supply and irrigation that is used by families and small communities. It can be produced with locally available materials in local metal workshops. Compared to other low cost hand pumps, the Rope pump has a high pump capacity and can pump from wells of 1 to 35 meters deep. It can be produced in any country and is very simple to install (no black box). If properly produced, installed and maintained, over 90% of the pumps remain functional, even many years after installation. Because of these features, the Rope pump has a high potential for Self-supply. An example is Nicaragua, where over 70,000 Rope pumps were installed. Two reasons for its success in this country were (a) technical improvements that made the pump more effective and attractive and (b) the private sector that took interest in production and sales. The pump became a commercial product so there was a “profit based sustainability”. In Nicaragua the shift from imported piston pumps to locally produced Rope pumps decreased the cost for rural water points by 60%. Close to 20% of the pumps are used for communal wells and 80% for Self-supply (domestic use, cattle watering, small scale irrigation). Due to these pumps, the total accumulated income at family level in the last twelve years was 100 Million US\$. This is explained by the fact that families with a Rope pump earn an average 220 US\$ more per year than families using a rope and a bucket. Using a Rope pump saves time, results in less health related cost (water is cleaner since it is not re-contaminated by the bucket) and can provide water for income generating activities such as livestock or garden irrigation.



The Rope pump was introduced in 2004 in Africa based on the models from Nicaragua. Currently, there are an estimated 40,000 Rope pumps in Africa of which 10,000 in Ethiopia and 4000 in Tanzania. Pump introduction in several countries were not successful due to both technical and introduction errors. Improvements on both pump and well covers have been developed in Ethiopia and the SMART centres in Tanzania and Malawi. The drawings in this document are based on experiences in the several countries.

10-7-2014 H. Holtslag. J. Mc Gill



Roughness:		Dimensional tolerance:		Title/Name: ROPE PUMP Model 1			
Projection: 		Scale: 1 : 20		Drawing by: AvdHeuvelSR		Creation Date: 21-6-2014	
		Unit : mm		Approved by: H. Holtslag		Approved Date: 26-6-2014	
		Parts: Installed on a Borehole			Part number:		Sheet size: A4
© All rights reserved. No parts of this drawing and/or sketch may be reproduced, stored in a database and/or published in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written consent of the author.							

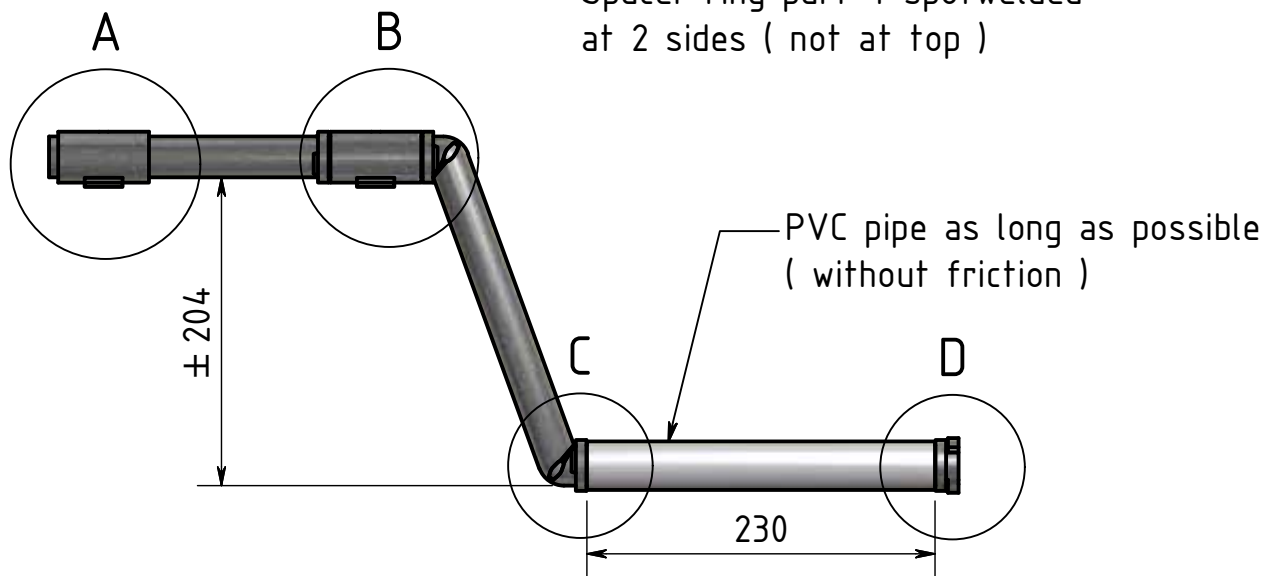
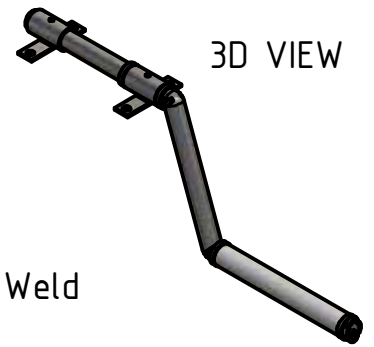
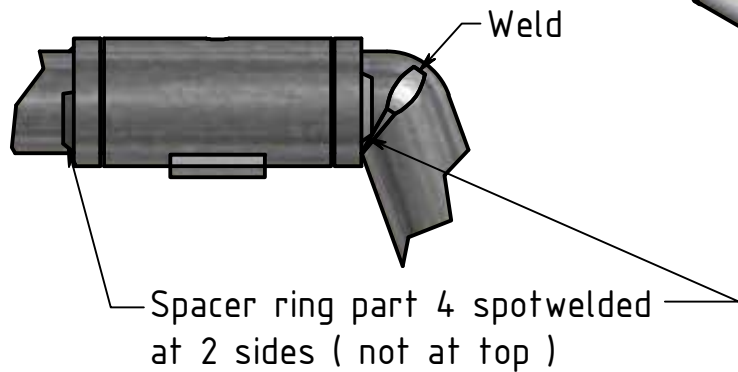


Roughness:	Dimensional tolerance:	Title/Name: ROPE PUMP Model 1		
Projection: 	Scale: 1 : 20	Drawing by: AvdHeuvelSR	Creation Date: 21-6-2014	
	Unit : mm	Approved by: H. Holtslag	Approved Date: 26-6-2014	
 META		Parts: Installed on a Dug Well	Part number:	Sheet size: A4

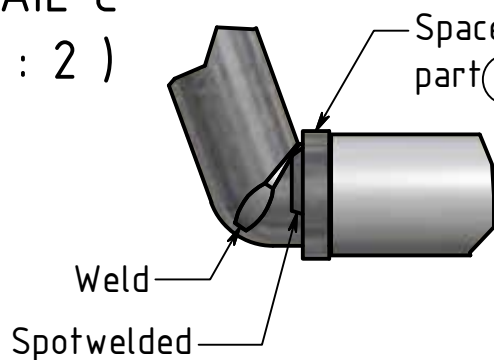
DETAIL A
(1 : 2)
Part ③ and ⑤



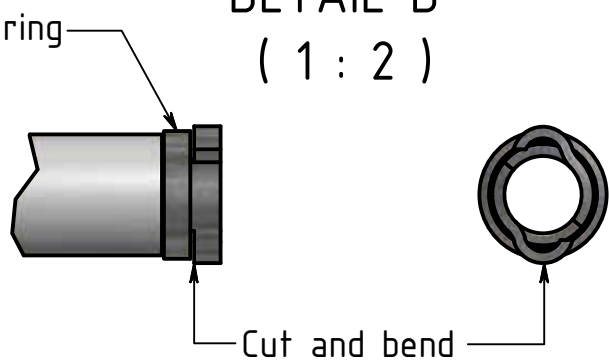
DETAIL B
(1 : 2)
Part ③ and ⑤



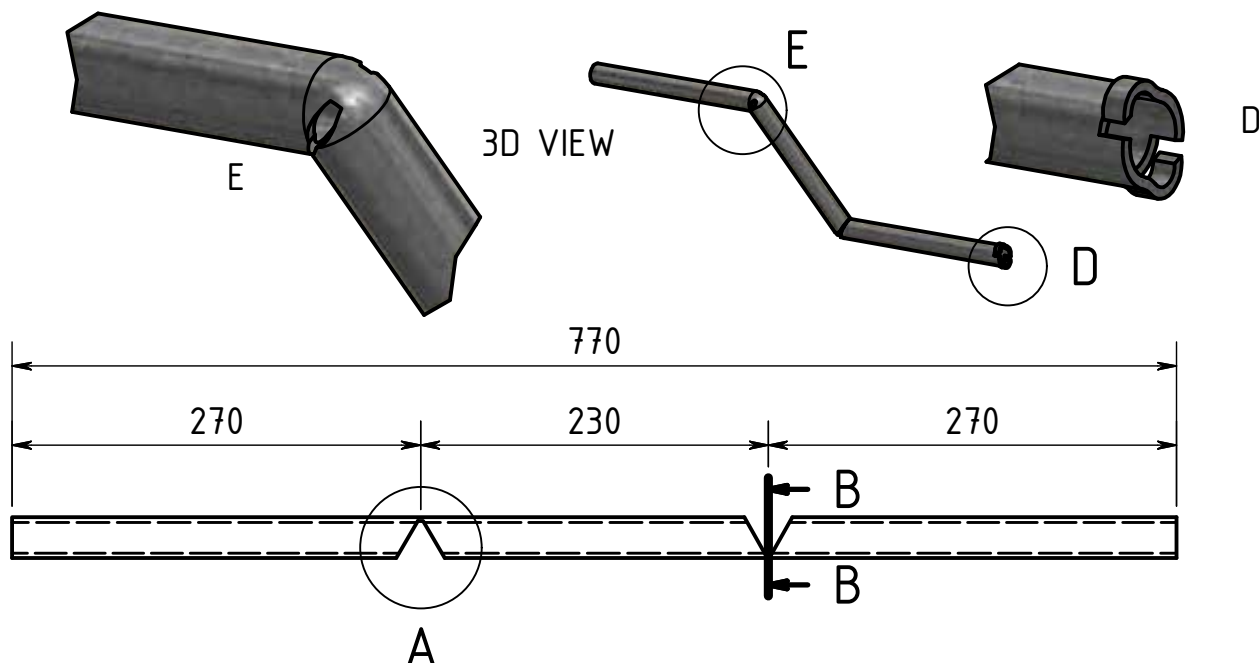
DETAIL C
(1 : 2)



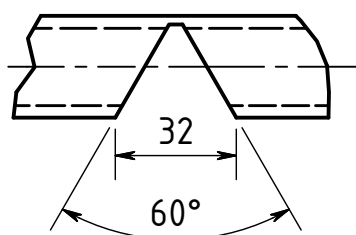
DETAIL D
(1 : 2)



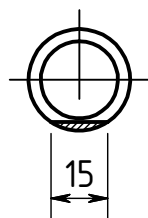
Roughness:	Dimensional tolerance: ISO 2768-1-f / -2-H	Title/Name: ROPE PUMP Model 1		
Projection:	Scale: 1:2 1:5 Unit : mm	Drawing by: AvdHeuvelSR	Creation Date: 19-6-2014	
		Approved by: H. Holtslag	Approved Date: 26-6-2014	
Parts: Handle - Assembly		Part number: 10	Sheet size: A4	



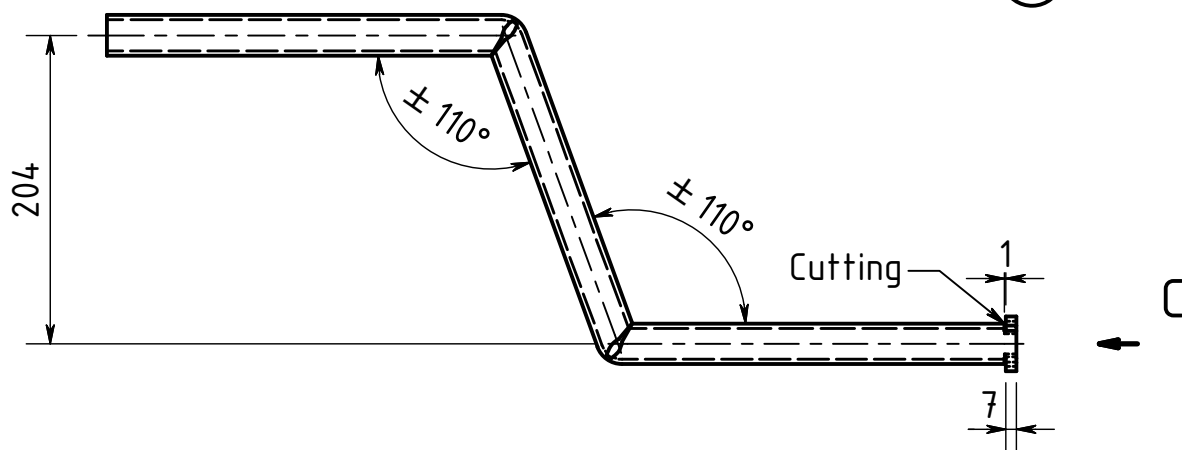
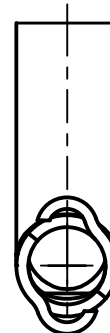
DETAIL A
(1 : 2)



SECTION B-B
(1 : 2)



VIEW C
(1 : 2)



1	1	Pipe 27 x 2,6 mm Length 770 mm	S 235 JRH	Part 10-1	1,398 kg
ITEM	QTY	DESCRIPTION	MATERIAL	PART NUMBER	MASS

PARTS LIST

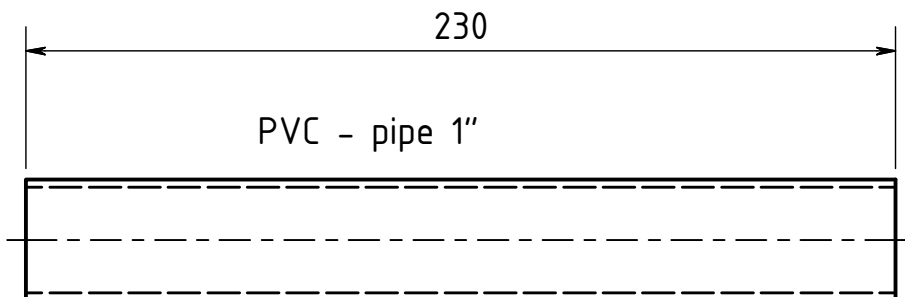
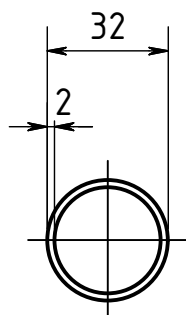
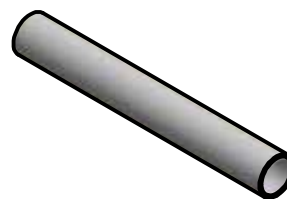
Roughness:	Dimensional tolerance: ISO 2768-1-f / -2-H	Title/Name: ROPE PUMP Model 1
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Projection:	Scale: 1:2 1:5 Unit : mm	Drawing by: AvdHeuvelSR	Creation Date: 18-6-2014
		Approved by: H. Holtslag	Approved Date: 26-6-2014

	Parts: Handle - Galvanized	Part number: 10-1	Sheet size: A4
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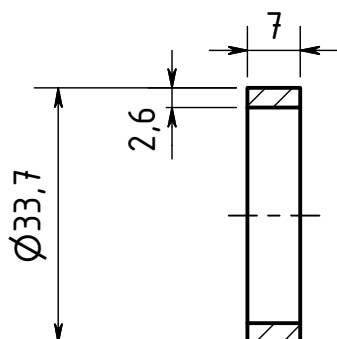


3D VIEW

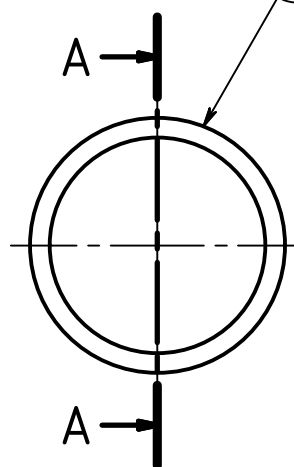


Part 2

SECTION A-A (1 : 1)



Part 4



Spacer ring
pipe 1"
Galvanized

4	4	Pipe 33,7 x 2,6 mm Length 7 mm	S 235 JRH	Part 4	
2	1	Pipe 32 x 2 mm Length 230 mm	PVC	Part 2	0,061 kg
ITEM	QTY	DESCRIPTION	MATERIAL	PART NUMBER	MASS

PARTS LIST

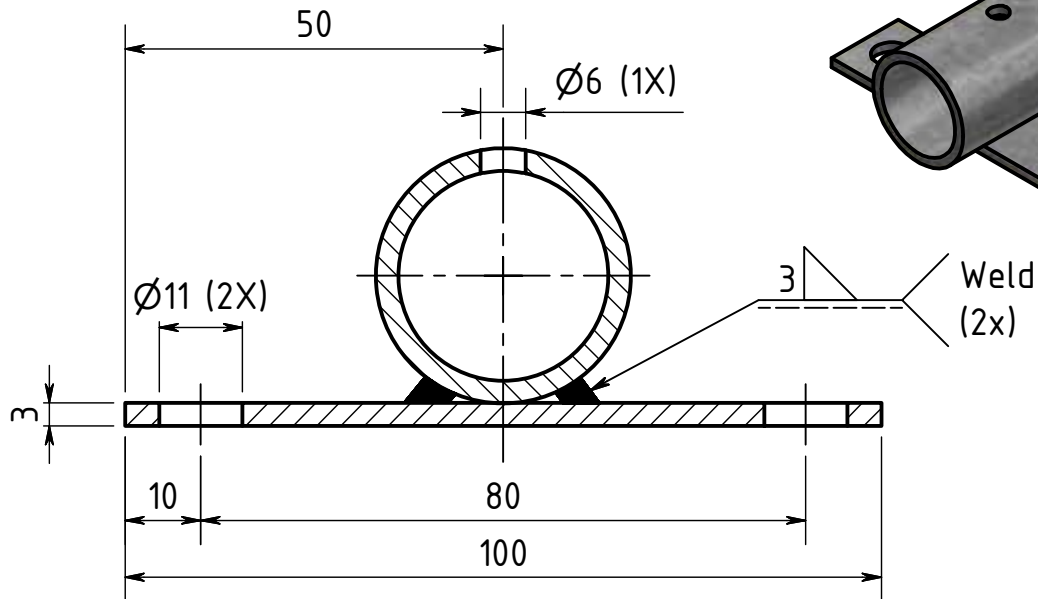
Roughness:	Dimensional tolerance:	Title/Name: ROPE PUMP Model 1
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Projection:	Scale: 1:1 1:2	Drawing by: AvdHeuvelSR	Creation Date: 19-6-2014
	Unit : mm	Approved by: H. Holtslag	Approved Date: 26-6-2014

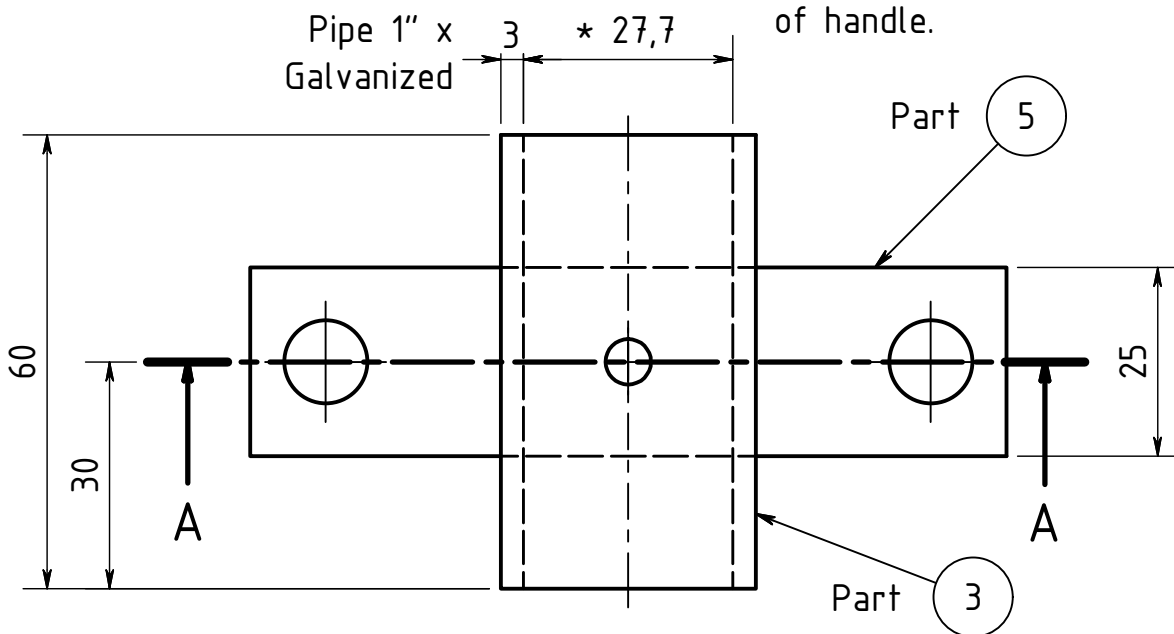
	META	Parts:	Part number:	Sheet size:
		Handle, PVC pipe and Spacer ring	10-2 10-4	A4

SECTION A-A (1 : 1)

3D VIEW



* Inside diametre 0,5-0,8 mm more than outside diametre of handle.



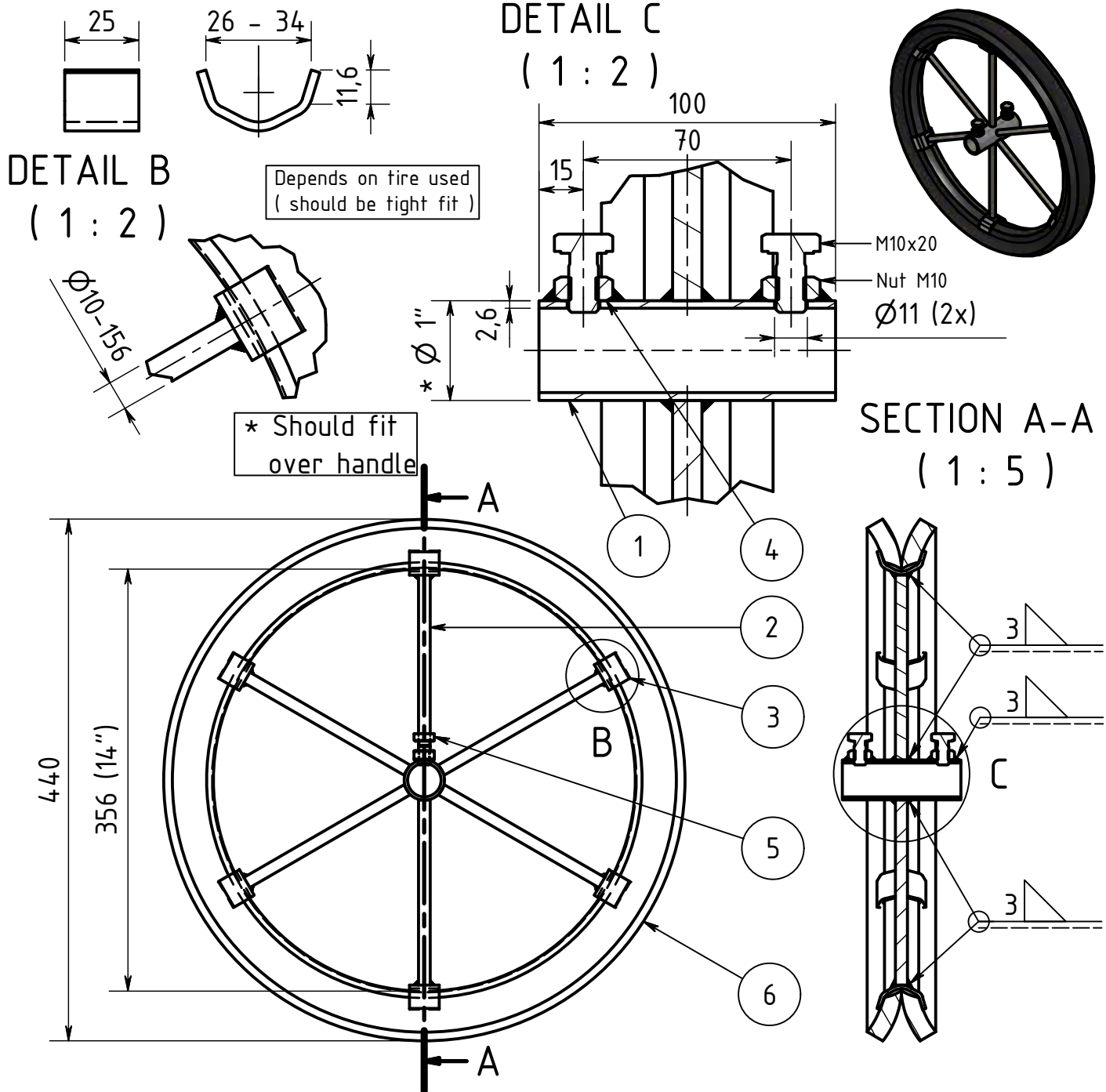
3	2	Pipe 1" x 2,6 mm Length 60 mm	S 235 JRH Galv.	Part 3	0,136 kg
5	2	Flat bar 25 x 3 mm Length 100 mm	S 235 JR	Part 5	0,054 kg
ITEM	QTY	DESCRIPTION	MATERIAL	PART NUMBER	MASS

PARTS LIST

Roughness:	Dimensional tolerance: ISO 2768-1-f / -2-H	Title/Name: ROPE PUMP Model 1
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Projection:	Scale: 1 : 1	Drawing by: AvdHeuvelSR	Creation Date: 19-6-2014
	Unit : mm	Approved by: H. Holtslag	Approved Date: 26-6-2014

	Parts: Bushing - Assembly	Part number: 10-3 10-5	Sheet size: A4
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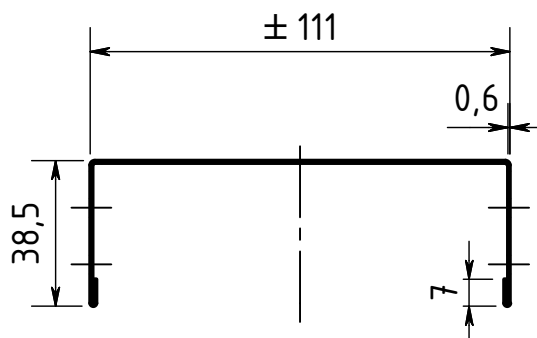
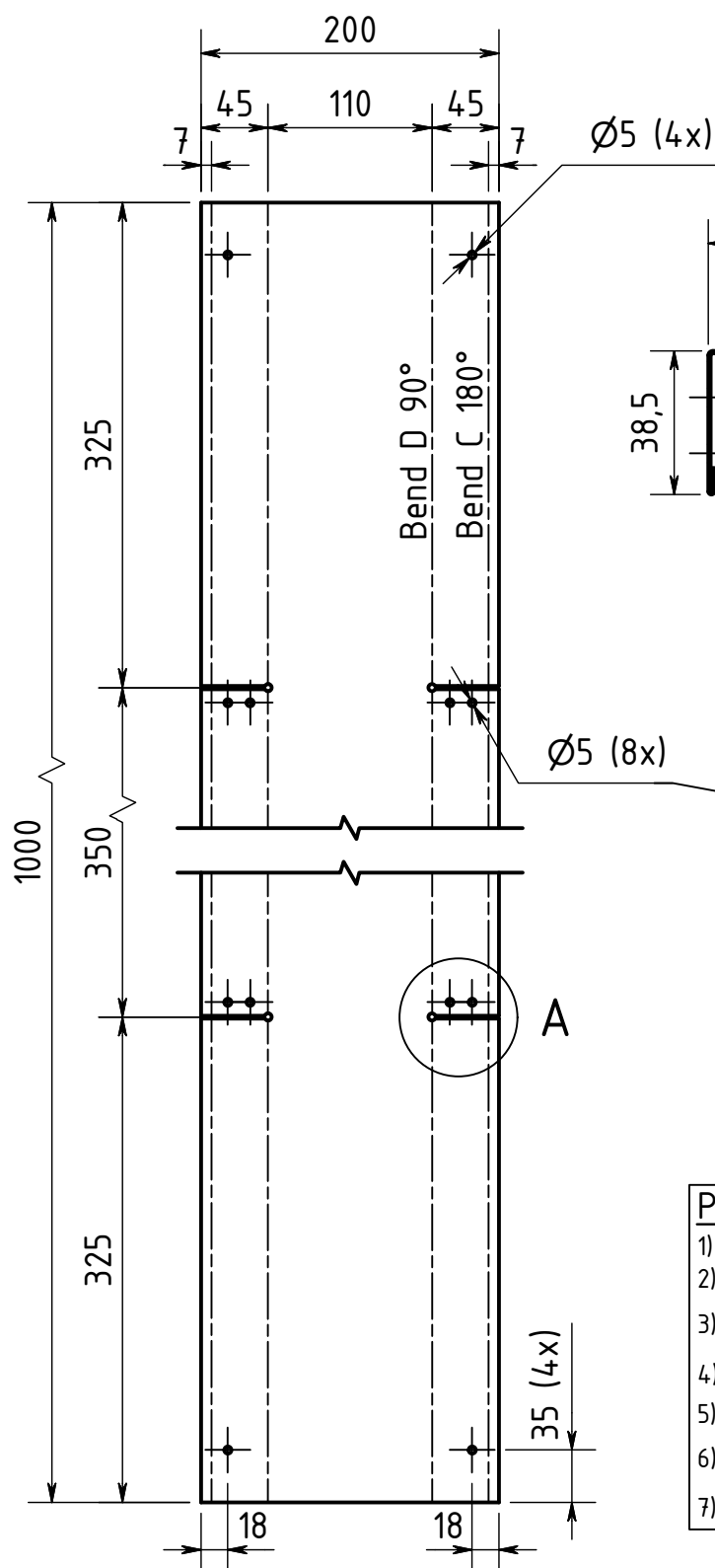


5	2	Bolt M10 x 20 mm	Steel 8.8 Galvanized	Part 5	0,024 kg
6	1	Wheel rim 14"	Car tire 14"	Part 6	1,320 kg
3	6	Flat bar 25x3mm Length 55/64mm	S 235 JR	Part 3	0,035 kg
2	6	Round 10 mm Length 156 mm	S 235 JR	Part 2	0,096 kg
4	2	Nut M10	Steel 8.8 Galvanized	Part 4	0,012 kg
1	1	Pipe 1" x 2,6 mm Length 100 mm	S 235 JRH Galv.	Part 1	0,195 kg
ITEM	QTY	DESCRIPTION	MATERIAL	PART NUMBER	MASS

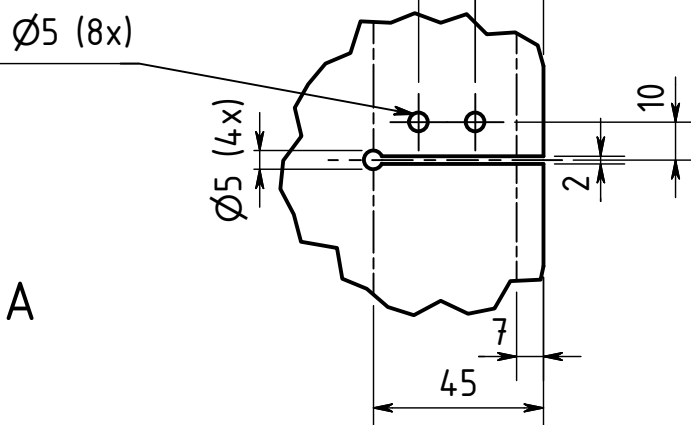
PARTS LIST

Roughness:	Dimensional tolerance: ISO 2768-1-f / -2-H	Title/Name:	ROPE PUMP Model 1		
Projection:	Scale: 1:2 1:5 Unit : mm	Drawing by: AvdHeuvelSR	Creation Date: 19-6-2014		
		Approved by: H. Holtslag	Approved Date: 26-6-2014		
Parts: Wheel - Assembly		Part number:	20-1 to 20-6	Sheet size: A4	

3D VIEW



DETAIL A
(1 : 2)



Production:


- 1) mark holes etc. using a jig
- 2) drill holes and cut at, detail A
- 3) bend at (C) 180°
- 4) bend at (D) 90°
- 5) mount in pump, drill additional holes
- 6) mounts rivets Ø5
- 7) case of bolt, use galvanized bolt M6x15mm

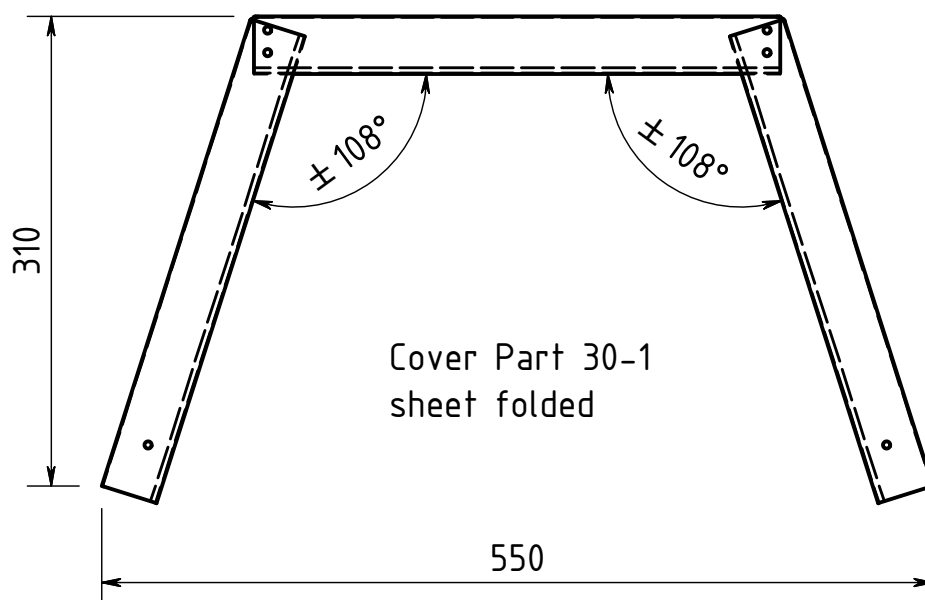
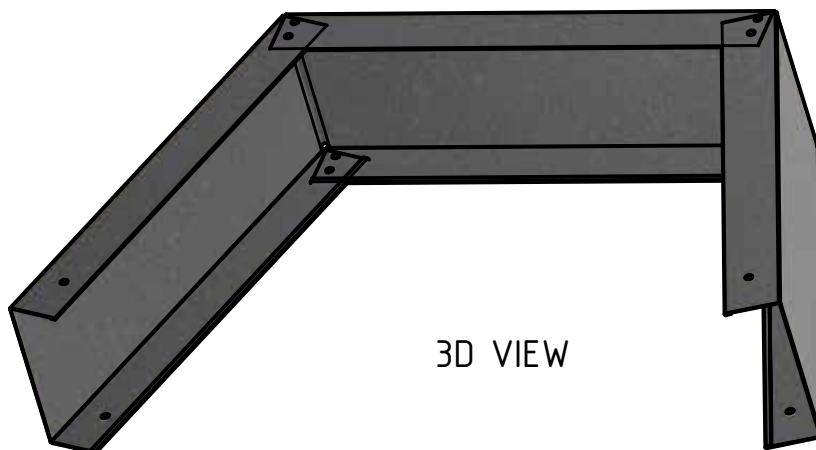
1	1	Galvanized sheet 1000x200x0,6mm	Steel	Part 30-1	0,940 kg
ITEM	QTY	DESCRIPTION	MATERIAL	PART NUMBER	MASS

PARTS LIST

Roughness:	Dimensional tolerance: ISO 2768-1-f /-2-H	Title/Name:	ROPE PUMP Model 1		
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Projection:	Scale: 1:2 1:5	Drawing by: AvdHeuvelSR	Creation Date: 19-6-2014
	Unit : mm	Approved by: H. Holtslag	Approved Date: 26-6-2014


	Parts: Cover	Part number:	Sheet size:
		30-1	A4



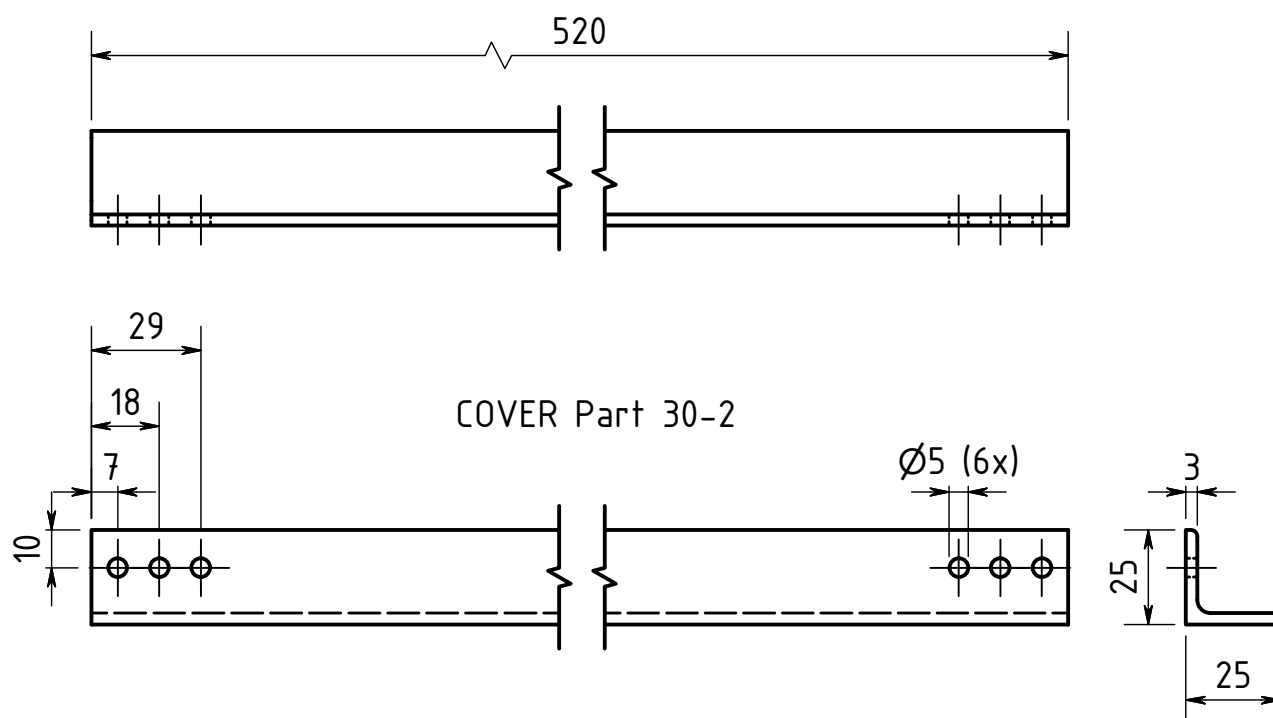
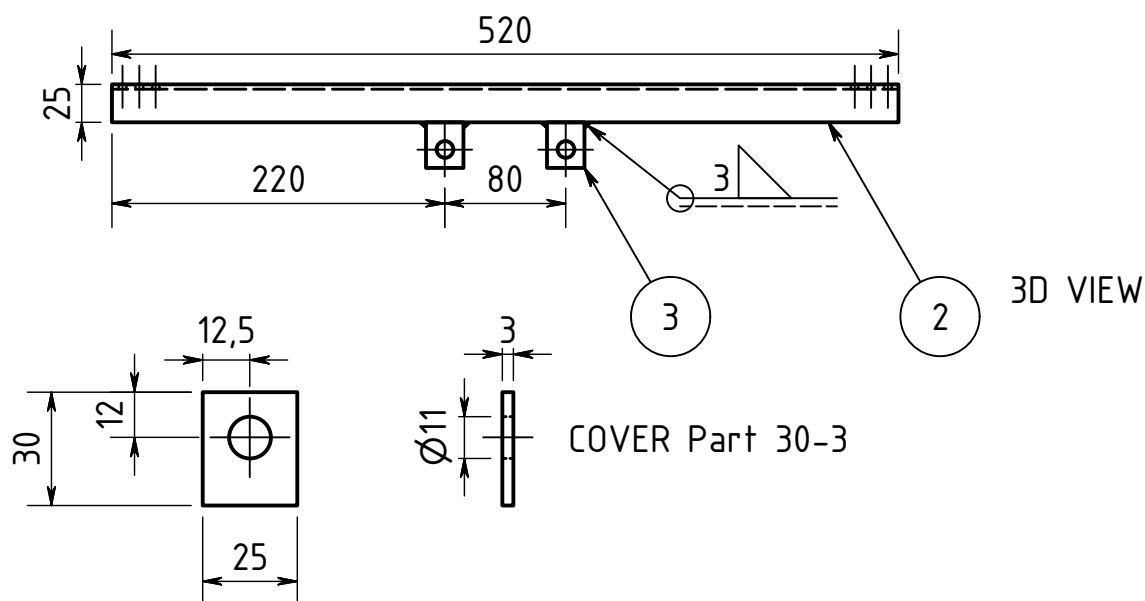
1	1	Galvanized sheet 1000x200x0,6mm	Steel	Part 30-1	0,922 kg
ITEM	QTY	DESCRIPTION	MATERIAL	PART NUMBER	MASS

PARTS LIST

Roughness:	Dimensional tolerance: ISO 2768-1-f / -2-H	Title/Name: ROPE PUMP Model 1
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Projection: 	Scale: 1 : 5	Drawing by: AvdHeuvelSR	Creation Date: 19-6-2014
	Unit : mm	Approved by: H. Holtslag	Approved Date: 26-6-2014

	Parts: Cover	Part number: 30-1	Sheet size: A4



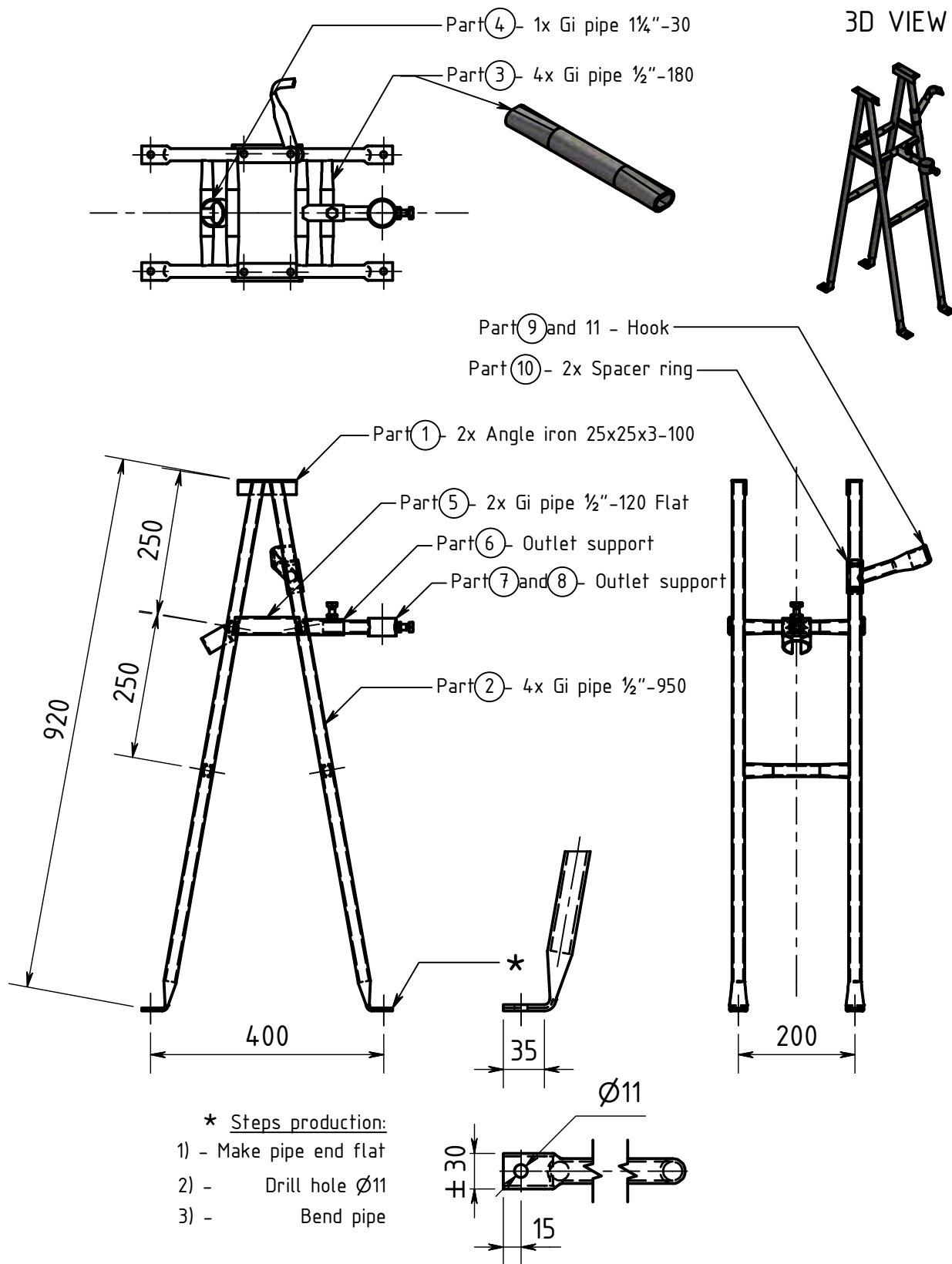
3	4	Flat bar 25 x 3 mm length 30 mm	S 235 JR	Part 30-3	0,015 kg
2	2	Angle profile 25 x 25 x 3 Length 520 mm	S 235 JRG 2	Part 30-2	0,579 kg
ITEM	QTY	DESCRIPTION	MATERIAL	PART NUMBER	MASS

PARTS LIST

Roughness:	Dimensional tolerance: ISO 2768-1-f / -2-H	Title/Name: ROPE PUMP Model 1
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Projection:	Scale: 1:2 1:5 Unit : mm	Drawing by: AvdHeuvelSR Approved by: H. Holtslag	Creation Date: 19-6-2014 Approved Date: 26-6-2014
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	Parts: Cover support - Assembly	Part number: 30-2 30-3	Sheet size: A4
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Roughness:

Dimensional tolerance:
ISO 2768-1-f / -2-H

Title/Name:

ROPE PUMP Model 1

Projection:



Scale: 1:5 1:10

Unit : mm

Drawing by: AvdHeuvelSR

Approved by: H. Holtslag

Creation Date: 20-6-2014

Approved Date: 26-6-2014



META

Parts:

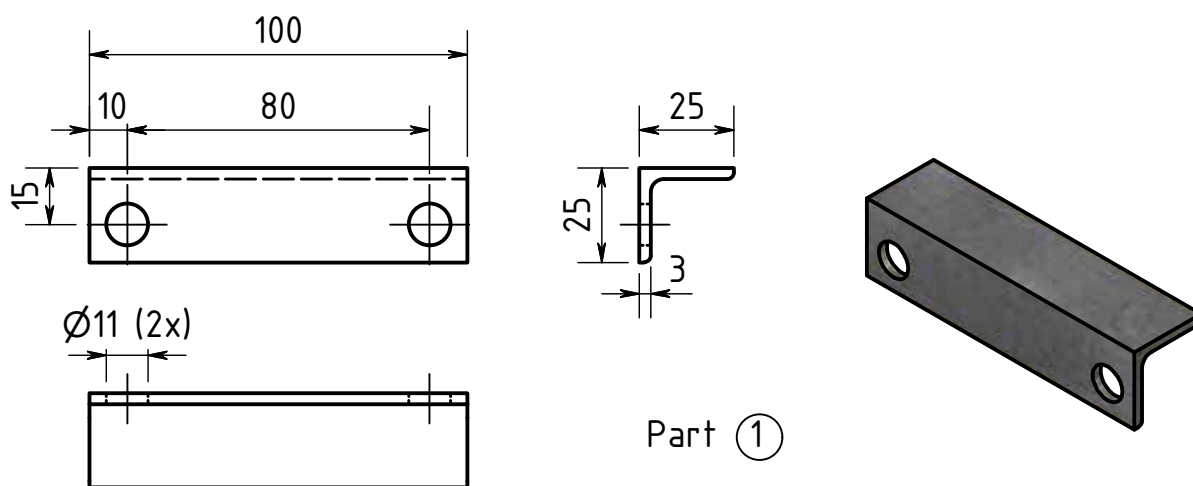
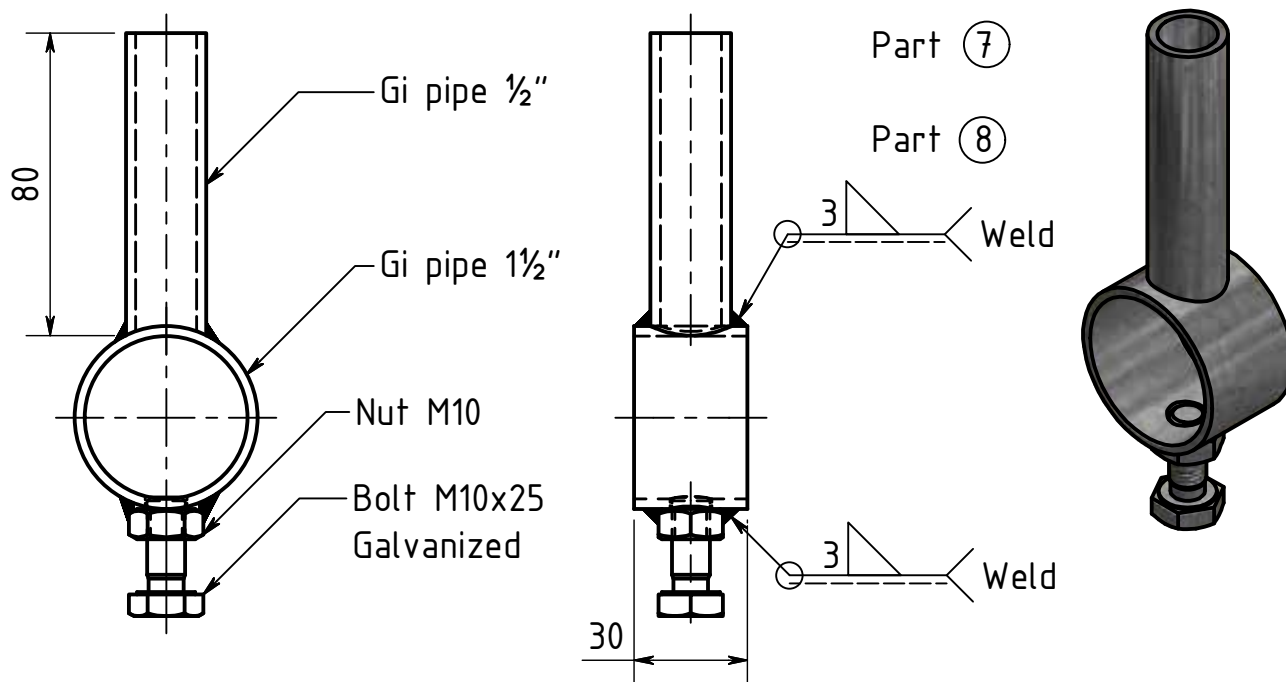
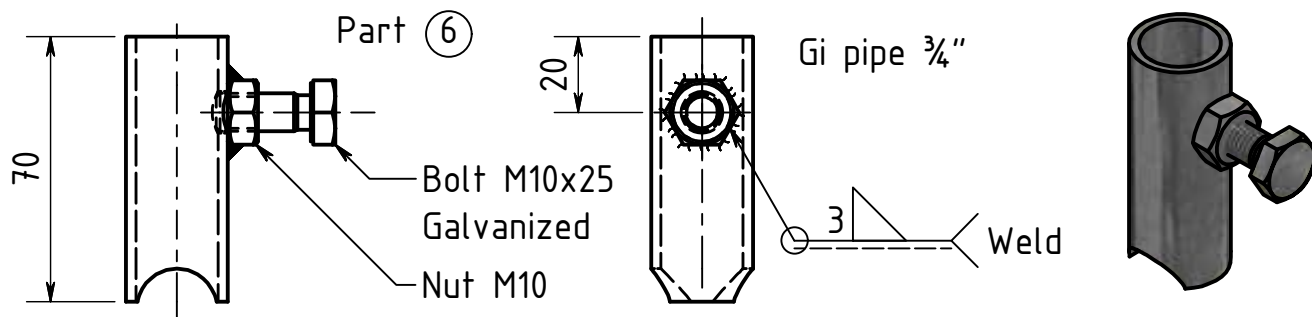
Structure - Assembly



Part number:

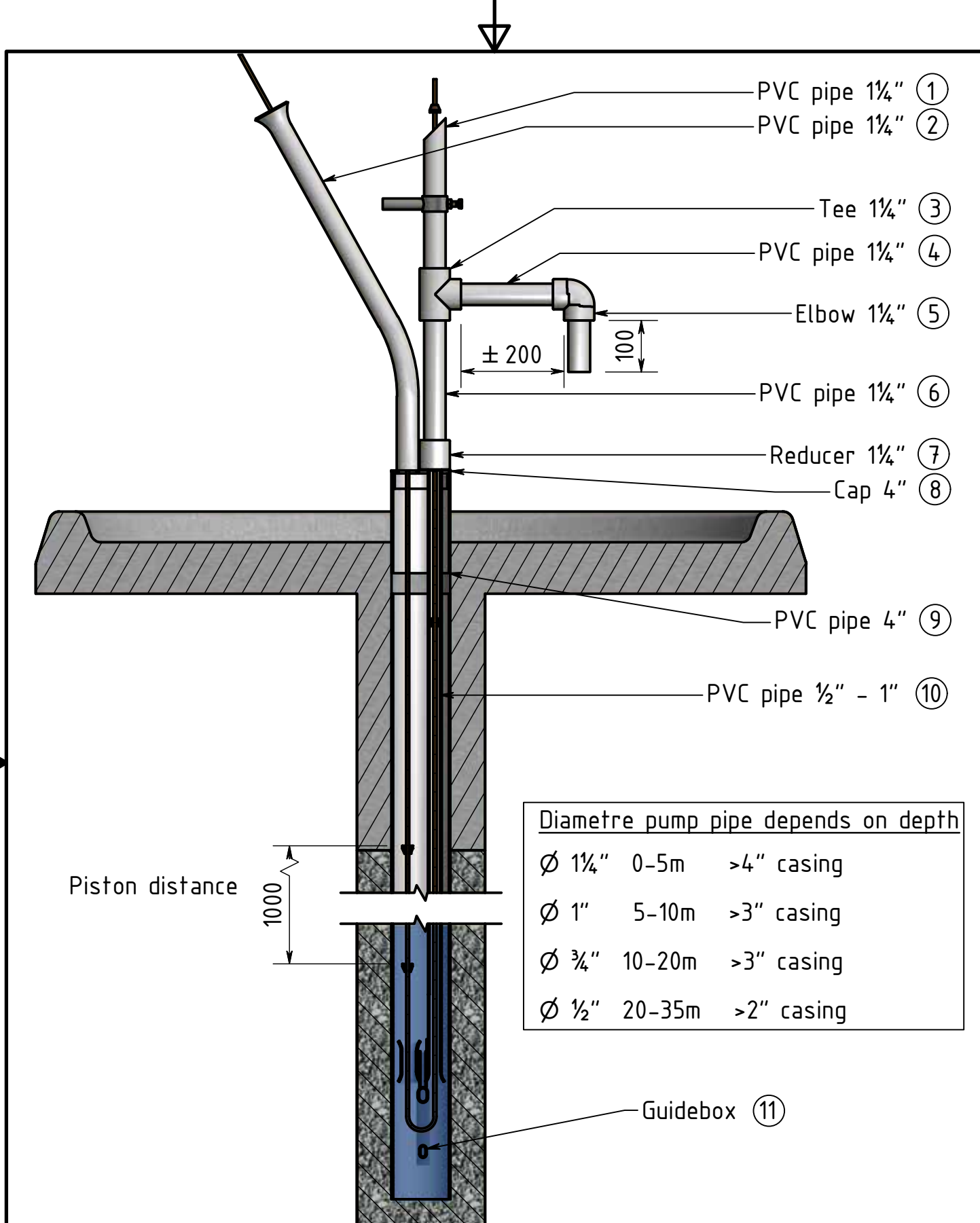
40



Sheet size:

A4



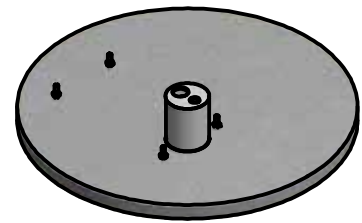
Roughness:	Dimensional tolerance: ISO 2768-1-f / -2-H	Title/Name: ROPE PUMP Model 1		
Projection: 	Scale: 1 : 2 Unit : mm	Drawing by: AvdHeuvelSR	Creation Date: 20-6-2014	
		Approved by: H. Holtslag	Approved Date: 26-6-2014	
 META	Parts: Structure - Parts	Part number: 40 -1-6-7-8	Sheet size: A4	



Roughness:		Dimensional tolerance:		Title/Name: ROPE PUMP Model 1	
Projection: 	Scale: 1 : 10		Drawing by: AvdHeuvelSR		Creation Date: 21-6-2014
	Unit : mm		Approved by: H. Holtslag		Approved Date: 26-6-2014
		Parts:			Part number:
		Tubing - Assembly			50
					Sheet size: A4
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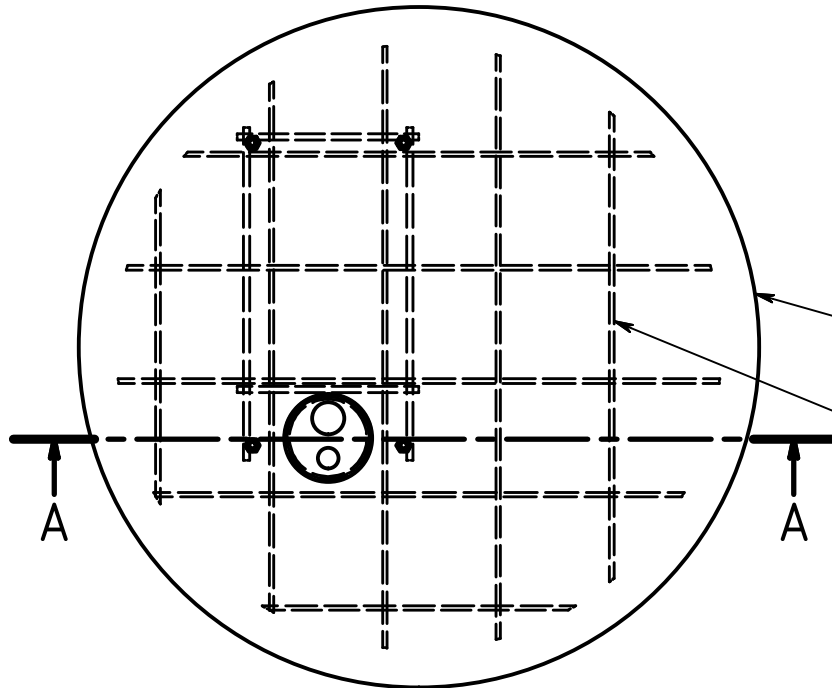
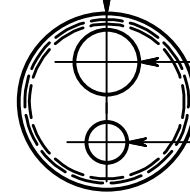
3D VIEW



Part ① - Cement slab-600 to 800

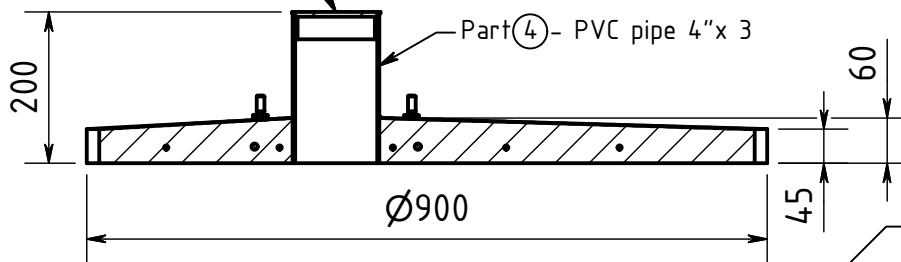
Part ② - Rebar $\varnothing 6$ - 800

Part ③ - PVC cap 4"

Hole $\varnothing 1\frac{1}{4}$ "Hole $\varnothing \frac{1}{2}$ "or - $\frac{3}{4}$ "
or - 1"SECTION A-A
(1 : 10)

Part ③ - PVC cap 4"

Part ④ - PVC pipe 4"x 3

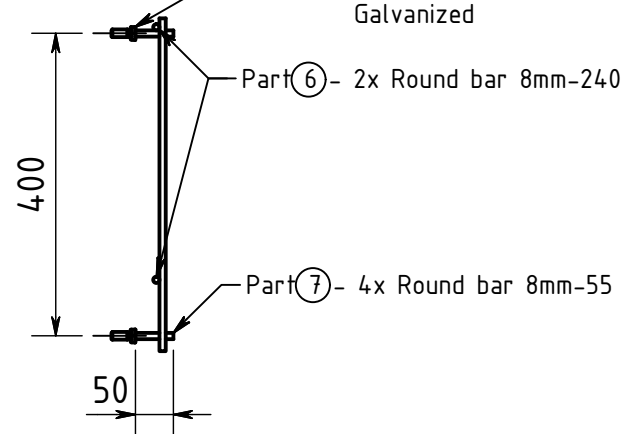
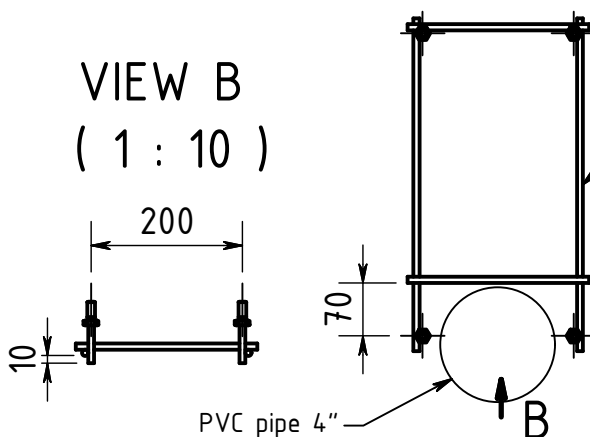


Part ⑧ - 2x Round bar 8mm-440

Part ⑤ - 4x Bolt M10x25
Galvanized

Part ⑥ - 2x Round bar 8mm-240

Part ⑦ - 4x Round bar 8mm-55

VIEW B
(1 : 10)

Roughness:

Dimensional tolerance:
ISO 2768-1-f / -2-H

Title/Name:

ROPE PUMP Model 1+2

Projection:



Scale: 1 : 10

Unit : mm

Drawing by: AvdHeuvelSR

Approved by: H. Holtslag

Creation Date: 21-6-2014

Approved Date: 26-6-2014

META
META

Parts:

Slab / Wellcover - Assembly

Part number:

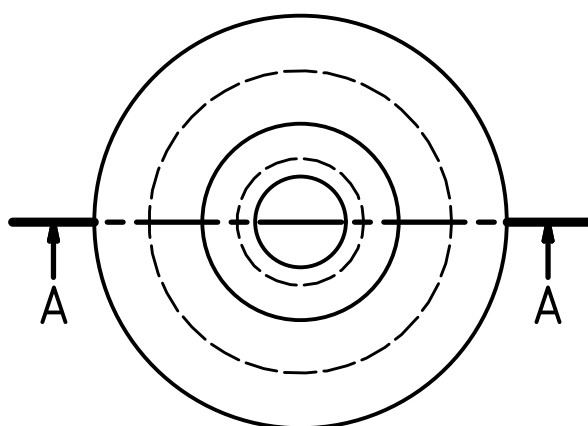
70-1 to 8

Sheet size:

A4



3D VIEW



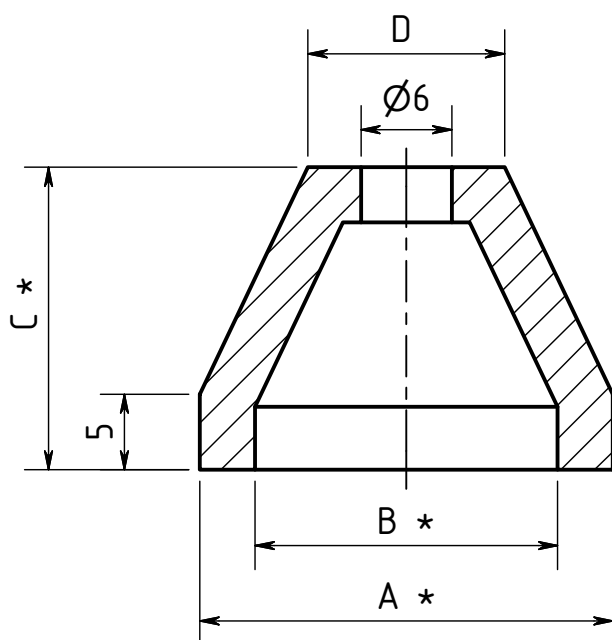
SECTION A-A
(2 : 1)

* Size depends on pump pipe
diametre inside.

Pipe	A *	B **	C **	D
½"	15,3	11	13	11
¾"	20,3	13	15	12
1"	27,3	20	20	13

* Tolerance $\pm 0,2$ ** Tolerance $\pm 0,5$

Based on pipes ½" OD = 20 ID = 16
¾" OD = 25 ID = 21
1" OD = 32 ID = 28

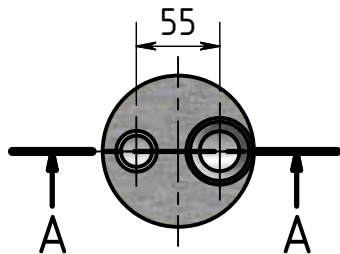


OD Outside diametre
ID Inside diametre

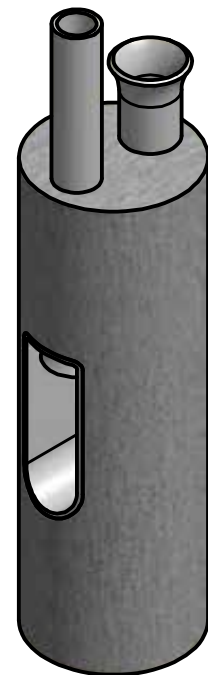
Roughness:	Dimensional tolerance: ISO 2768-1-f / -2-H	Title/Name: ROPE PUMP		
Projection:	Scale: 2 : 1 Unit : mm	Drawing by: AvdHeuvelSR	Creation Date: 23-6-2014	
		Approved by: H. Holtslag	Approved Date: 26-6-2014	
		Parts: Piston	Part number: 80	Sheet size: A4

* This guidebox is for $\frac{3}{4}$ "
For pump pipes of 1" and $\frac{1}{2}$ "
pump pipe + return pipe
are different $\frac{1}{2}$ " - $\frac{3}{4}$ "
1" - $1\frac{1}{4}$ "

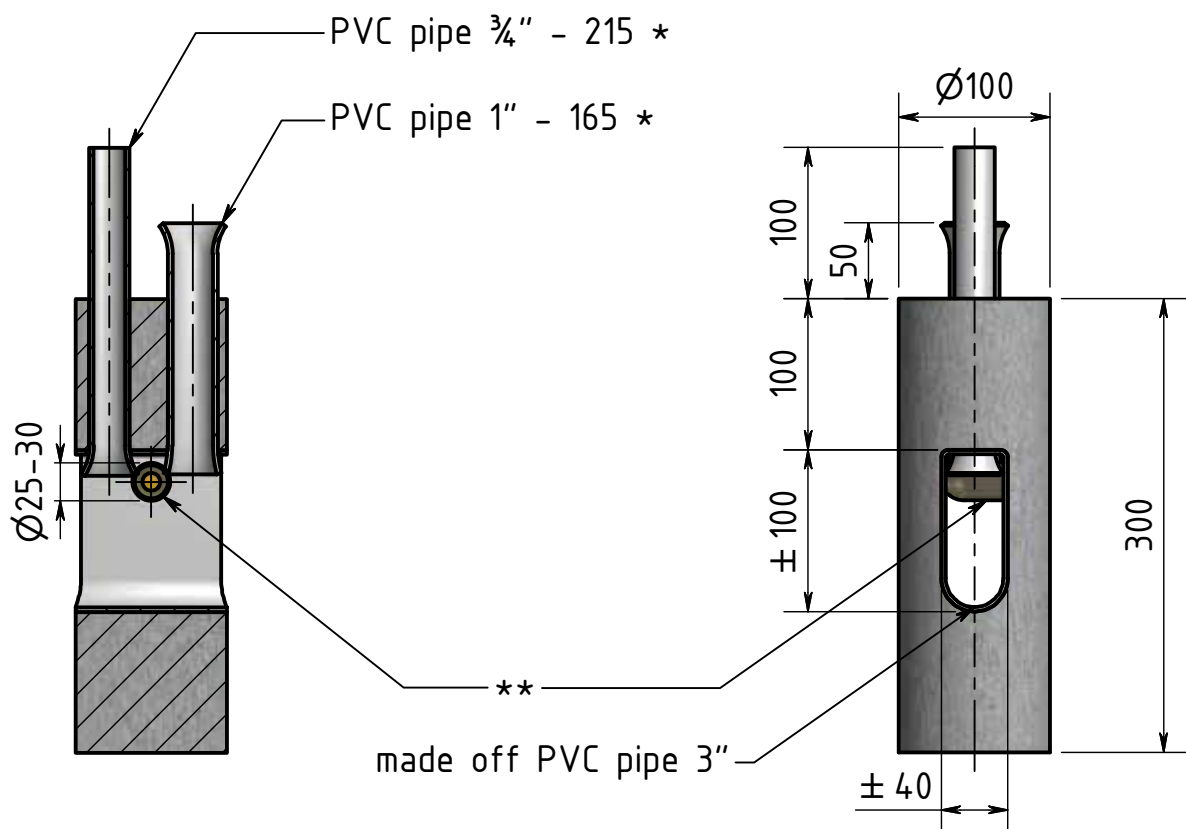
** Use small glass bottle
or Galv. pipe $\frac{3}{4}$ "






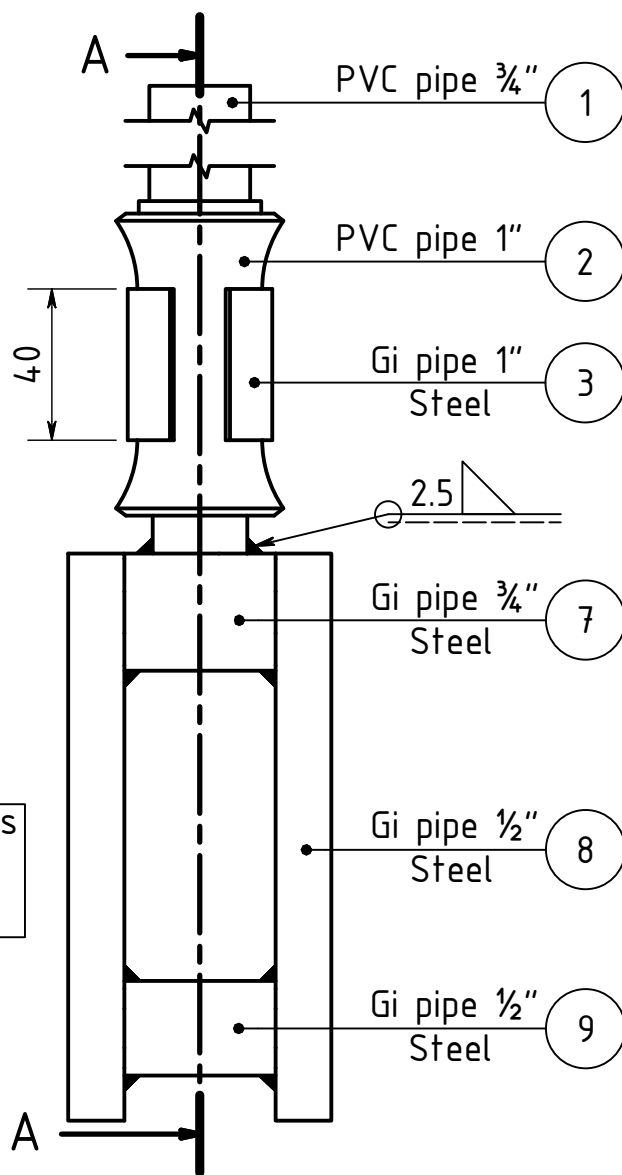
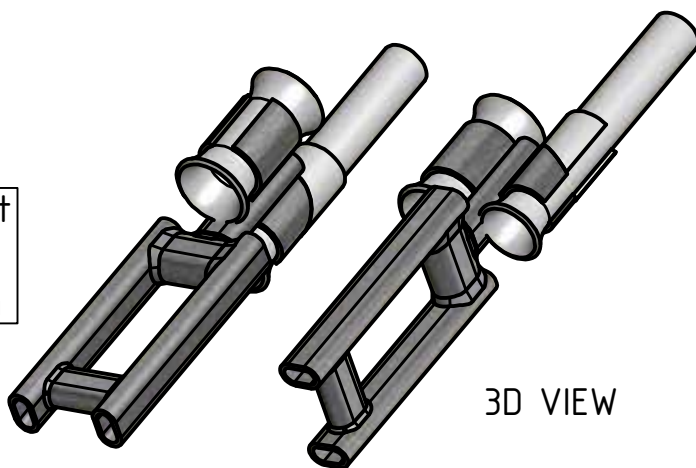
SECTION A-A
(1 : 5)





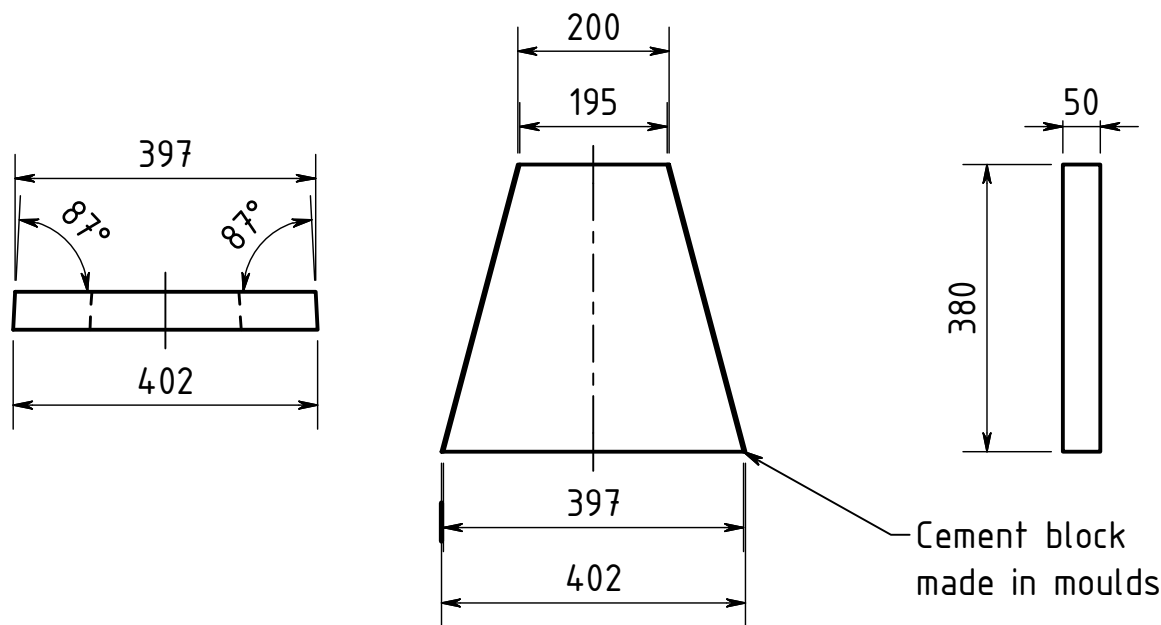
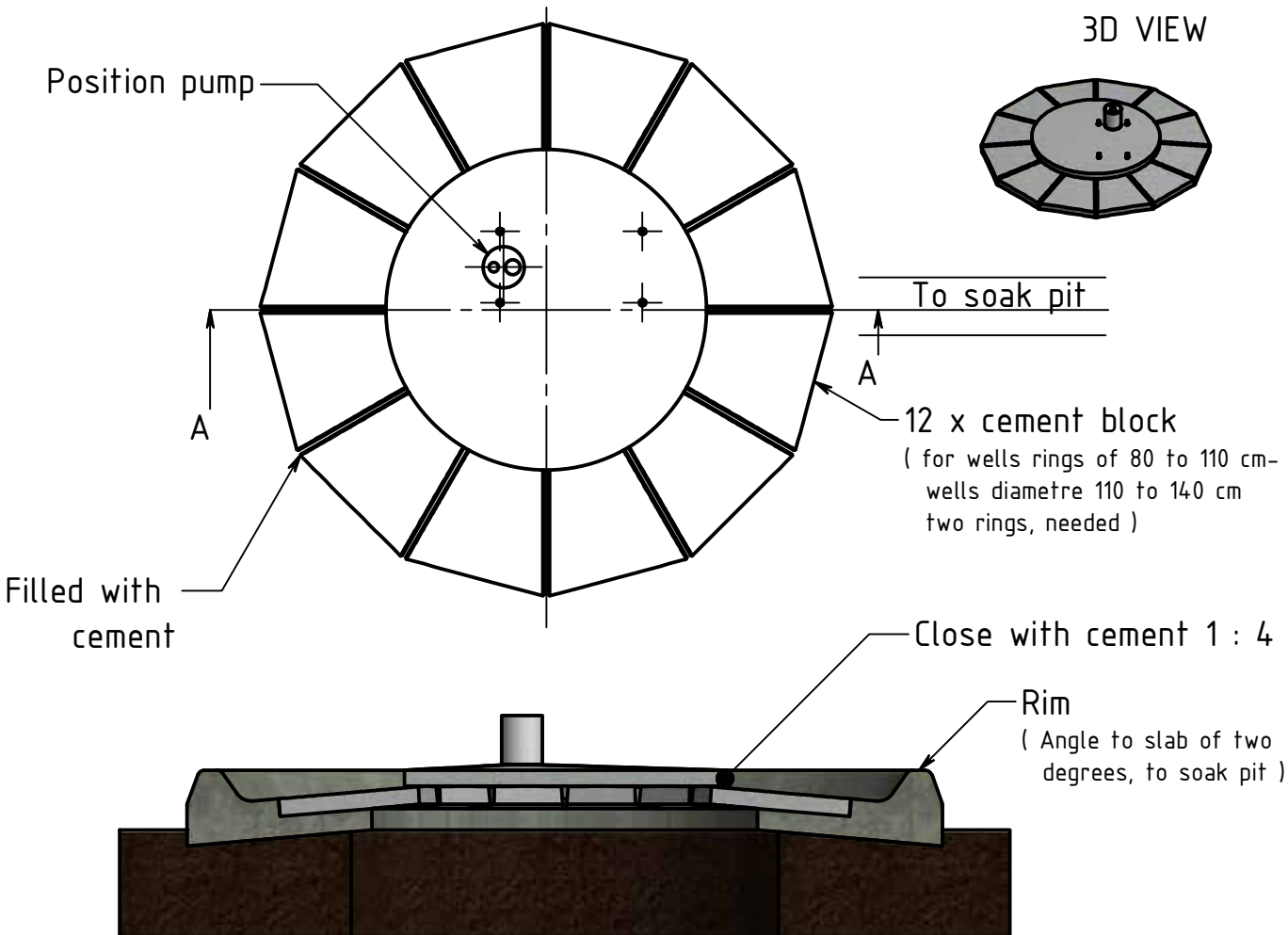
3D VIEW





Roughness:	Dimensional tolerance:	Title/Name: ROPE PUMP		
Projection: 	Scale: 1 : 5 Unit : mm	Drawing by: AvdHeuvelSR	Creation Date: 25-6-2014	
	Parts: Guidebox Cement $\frac{3}{4}$ "	Approved by: H. Holtslag	Part number: 90	Approved Date: 26-6-2014
			Sheet size: A4	



Roughness:		Dimensional tolerance: ISO 2768-1-f / -2-H		Title/Name: ROPE PUMP Model 1			
Projection: 		Scale: 1 : 2		Drawing by: AvdHeuvelSR		Creation Date: 17-6-2014	
		Unit : mm		Approved by: H. Holtslag		Approved Date: 26-6-2014	
		Parts: Guidebox - Assembly			Part number: 90-1 to 9		Sheet size: A4



Roughness:		Dimensional tolerance:		Title/Name: ROPE PUMP Model 1	
Projection: 	Scale: 1:10 1:20		Drawing by: AvdHeuvelSR		Creation Date: 20-6-2014
	Unit : mm		Approved by: H. Holtslag		Approved Date: 26-6-2014
 META		Parts: Well Reducer Ring		Part number: 100	Sheet size: A4





Model 1
Ball bearings optional



Model 2 (economy model)
Wheel cover Optional



Model 3 (Pole model)

Suggestions for minimum quality for Rope pumps

All models fit on both hand dug wells and boreholes. The pump model no. 1 is fit for small communities and all 3 models are fit for Self-supply in households. The recommendation on the minimum quality are summarized below.

Parts	Suggestions Model 1 (improved model)	Suggestions model 2 & 3 (economy & pole model)
Wheel cover		
-sheet cover	0,5 mm Galvanized sheet Preferred 0.6 mm	Wheel cover is optional
-Sides	Bent rim if less than 1 mm	
-Mounting	Bolts M6 or pop rivets □ 5mm, 2 at each connection	
- Bolts cover to	M6 x 15 galvanized or M10	
-Cover Support	12mm rebar or 20x20x2 mm Angle iron or Gi pipe ½"	
Wheel		
- Diameter	14"	14"
-Number of spokes	6	4, with clamps in between
- Material of spokes	Rebar □10 mm or galv. Pipes	Rebar □10 mm or galv. Pipes
-Tire quality	Good quality, straight, soft rubber	Good quality, straight, soft rubber
- Bolts /Nuts	M10x25 Galvanized	Optional if uses bolts than M10x25 Galvanized
Handle		
Pipe	□ ¾" Galvanized steel pipe. Wall thickness min. 2,2 mm	½" Galvanized steel pipe. Wall thickness min. 2 mm
Handle grip	1" PVC pipe, Wall thickness 2 mm	¾" PVC pipe, wall thickness 1.5 mm
Bushing	1", wall thickness 2,5-3mm Galvanized steel pipe	¾", wall thickness 2,2 – 2,5mm Galvanized steel pipe
Clearance	0,5- 0.8 mm	0,5-0,8 mm
Length bushing	60 mm	60 mm
Bushing strip	Strip 25x3 mm	NA
Diameter of the oil hole	□ 6	□6
Welding / Painting		
All welded parts	Clean weld slack, Paint with anti oxide +gloss paint	Clean weld slack, Paint with anti oxide +gloss paint
Pump structure		
-Pipes	½" Galvanized steel pipe Wall thickness 2 mm	½" Galvanized steel pipe. Wall thickness 1.6 mm
Bushing support	Angle iron 25x25x2 Angle iron	NA

Block system	Hook of Rebar or Gi pipe	NA or Gi Pipe
Outlet pipe and return pipe support	Make of ring of Gi pipe	NA or ring of Gi pipe
Name plate	Aluminium . Data incl. Producer, Tel No, Ser. No	Aluminium . Data incl. Producer, Tel No, Ser. No
Rope/ pistons	1m distance, 0,5-0.8 mm clearance	1m distance, 0,5-0.8 mm clearance
Pump PVC parts		
Pump Pipe diam [well depth]	Outside diam. - Inside diam.	Outside diam - Inside diam
1" [1 – 10m]	32mm- 28 mm	32mm- 28 mm
¾" [10- 20m]	25mm- 21 mm	25mm- 21 mm
½" [20- 35m]	20mm- 16 mm	20mm- 16 mm
Outlet pipe		
-Outlet pipe 1 1/4"	Outside diam - Inside diam	Outside diam - Inside diam
	40mm- 36 mm	40mm- 36 mm
-Tee 1 1/4"	Good quality, tight fit with reducer	Good quality, tight fit with reducer
-Reducer 1 1/4" - 1"		
-Reducer 1 1/4" - ¾"		
-Reducer 1" - ½"		
- Elbow 1 1/4"		
- Return pipe	Poly Pipe or PVC pipe. 1 size bigger than pump pipe	Poly Pipe, PVC pipe. 1 size bigger than pump pipe
Well head. Cover, Apron, Soak pit		
Well cover	Diameter 90 cm	Diameter 90 cm
	Reinforced with rebar min dia 8mm distance 15 cm	Reinforced with rebar dia 6 mm distance 15 cm
	PVC pipe 4 Inch length 15 -20cm	PVC pipe 4 Inch length 15 -20cm
PVC Cap, cover	Round or Flat top Cap	Round top Cap
Top of casing above Ground level	20 cm	NA
Top of Casing to Apron	10 cm	NA or 10 cm
Diameter apron	1 – 1.8m	1 - 1,8 m
Dist. apron to soak pit	3 -5m	3 -5m
Outlet Pump	Opposite soak pit	Opposite soak pit
Apron slope to soak pit	0-5cm	5 cm
Apron height	5-10 cm	5

Recommendations on technical aspects

The recommendations are with objectives (a) to improve quality and durability of the Rope pumps and (b) reduce the cost of the Rope pumps to increase the potential uptake in the Self-supply market. Use one size prefabricated slab of 90cm and well reducer rings eventually with prefabricated tapered blocks. This will drastically improve quality of the well head, increase hygiene and combined with standardised slabs can reduce cost of installation.

No 10 Handle/ bushings

- Clearance between bushing and pipe of handle 0.5 to 0.8 mm. So difference between outside diameter of handle and inside diameter bushing maximum 0.8 mm. This is important for alignment and good lubrication. If the bushing has more clearance, the diameter should be reduced by cutting out a slot.
- Make the diameter of the oil hole 6 mm and put the oil hole on top. This makes oiling of bushings much easier for users. Eventual rain that enters in the oil hole is not a problem and even an advantage since rain will clean the bushings.
- Length grip 270 mm. This will reduce cost of material, reduce danger of bending of the handle and is long enough as experienced in the pumps installed.

No 20 Wheel

- Make clamps long enough to be able to close them when rope starts slipping.
- Use only galvanized bolts. Also spokes can be made of ½" Galvanized pipe and the clamps of ¾" galvanized pipe, wall thickness 2.5 mm.

No 30 Wheel cover

- Use galvanized sheet, thickness of minimum 0.5 mm
- In case of 0.5 or 0.6 mm thickness, bend the rims to make the cover stronger. If sheet of 1 mm is used bending is not needed.
- Drill holes in part where the sheet is bent to avoid cracking of the sheet.
- The wheel cover supports can be made of Angle iron 25x25x3mm or Gi Pipes of ½".
- For mounting the cover support use 3 pop rivets of round 5 mm.

No 40 Pump structure

- Make a narrow structure, dimensions of base 200 x 400 mm. This will reduce the cost of material and is less work since bending of the wheel cover support is not needed
- Use the system of bended legs; advantage more flexibility in the mounting of the pump in case the distance between the bolts in the well slab (well cover) are not 100% exact.
- Have the handle at the height of the belly button of the person pumping, so the height of the handle should be 80 to 90 cm. Make the legs of the new models 95 cm, so the height of the handle will be around 90 cm, (the leg at the low end is bent).

No 50 Tubing / PVC pipes and parts

- Pump pipes with the same in and outside diameter. Work on a supply chain of standardized PVC pump pipes.
- Proposed dimensions are mentioned in the table below (see also Annex 1). In general wall thickness of all pipes should be 2 mm.
- Pump outlet pipes of 1 ¼" so they fit in jerry cans.
- Make a smooth entrance on PVC pipes. Make so called trumpets on pipes in guide boxes and return pipe. To make this, a jig (Trumpet tool).

No 60 Cap / casing

- Make the caps and the 4 inch pipes in such a way that water cannot flow back into the wells.
- The holes in the cap for the pump pipe and return pipe should have a tight fit with the pipes.

No 70 Slab/ well cover

- In field surveys it appeared that a major problem with the Rope pumps is low quality of well covers, pump installation so water leaking back in the wells. To improve this always make a well ring on which a slab can be mounted. It is suggested to use slabs with a diameter of 90 cm. to reduce risk of breakage, transport ease of removal by users. The logic of using a small, 90 cm slab is that it can be thin like 5 cm and still has the same strength than a slab of 120 cm which has to be 6 to 7 cm to make it strong enough. The small slab is much easier to transport less risk to break and it is also easier for families to remove in case of well cleaning.
- Test the cement well reducer ring. This reduces the diameter of the top of the well (well ring) to 80 cm so with a slab of 90cm the well can be covered.
- The use of manholes is strongly discouraged because of water leaking back in the well. This is due to the design and often poor construction of the well cover as was observed in the field visit. In general experiences is that when there is a problem with the pump, people tend to go back to the rope and bucket and remain using the bucket which is "back to zero".
- In case the widely available cheap 4 inch pipe is used, make the part used in the slab stronger by using a double piece of pipe. This will make the 4 inch pipe more resistant to damage.
- Bolts used to mount the pumps should be welded well to the reinforcement bar structure. Use galvanized bolts M10x 25 mm.
- Place the pump a bit aside on the slab. The person who is pumping can stand on the slab. See drawings.

No 80 Rope /Pistons

- Pistons can be Rubber or HD PE injected
- Make the diameter of the pistons 0.5 - 0.8 mm smaller than the inside diameter of the pump pipe. With a greater diameter, the pump efficiency goes down. When it is smaller friction will occur especially in the smaller pumps pipes of ¾" and ½" since PVC pipes are not always exactly round and the same diameter.
- It is strongly suggested to use standardized PVC pipes and standardized pistons.

No 90 Guide box

- Use guide boxes made completely of galvanized tube. See also drawings.
- Or use cement guide boxes. The cost will be the same or lower than metal guide boxes, but will avoid corrosion in water with low PH. For deeper hand dug wells, the weight of the cement guide box will help to keep the pump pipe straight.
- The metal and cement guide boxes should be 5 mm smaller than the inside diameter of the 4 inch pipe in the slab.

Well head / Apron

Based on the field surveys a major problem in Rope pumps is the low quality of the well heads. Pumps are to low or too high, well covers are not straight or broken. There is often no hygienic seal so with rains well rims are collapsing and water can flow into the well. So a general suggestion is to improve quality of well heads. Suggestions are;

- Install a well ring on top of which the slab is mounted, this to avoid water leaking back in the wells. If this ring is at the same time a reducer ring, the diameter of the slab can reduce.
- Test the system of the tapered prefabricated blocks for the well reducer ring. This can become the activity of well diggers and/or local masons. Make the inside diameter of the well ring 80 cm plus / minus 5 cm which allows the diameter of the slab to be 90 cm, which is still small and easy to transport.
- For wells of 90 - 110 cm use one well ring and reduce hole to 80 cm.
- For wells of 110 to 130 cm diameter use 2 rings of blocks.
- Install the well reducer rings a bit conical and put a few wires around the ring. The conical shape will avoid water leaking back in the well and is stronger, more resistant against breaking than a flat rings.
- Put some basic reinforcement in the well blocks like 5 pieces of 40 cm black wire which will hardly increase the cost but will avoid braking of the blocks.
- Make an apron around the slab to seal the well and avoid leaking and a soak away to avoid at all times water pools near the well.
- At some pumps the soak away is used as a drinking place for cattle. It is strongly suggested to avoid this since the leak water from slab and apron is contaminating the well. In case of cattle water it is much better to make a separate pit of bucket for drinking.
- Promote / train well diggers to make wells with maximum diameter of 90 cm. Calculations indicate that, compared to wells of 120 cm , a 90cm well reduces 80% in volume of material to take out so reduction of labour. Also with the small diameter only one well ring is needed.

Pump models

Based on the survey and tests, 3 pump models are recommended in order to give potential a range of options:

Model 1 (improved Rope pump model)

- The Model 1 is standard with bushings
- As an option it can be made with ball bearings. If ball bearings are used good quality and sealed bearings are needed. Also a grease pump should be included in the pump. Selling a pump without a grease pump will cause problems.
- An Allan key should also be provided as a requirement with the pump with ball bearing.
- In case of ball bearings, use 2 bolts to fix the handle to avoid it will get loose.
- The total additional costs for a model with ball bearings is estimated at 600 Birr.

Model 2 (economy model)

- This model is very basic without any bolts in the pump structure, no cover, a handle of ½" no return PVC pipe. It si completely made of Galvanized pipes so no or little corrosion
- As an additional parts a well cover and a return pipe can be sold.
- The total cost (material and labour) of Model 2 is much lower than Model.

Model 3 (pole model)

- This Model is the most basic low cost Rope pump model mounted on poles and 2 pumps like this were installed in the test field.
- It consist of a handle with bushings and a wheel which is mounted with bolts on the handle. By placing the poles in an angle, the length of the handle is reduced.
- After some initial problems the users of the Model 3 were very satisfied;

This model again can be some 30% cheaper than Model 2 with the advantage that it can be installed without a well cover. So if families do not have much money or do not want to take a loan, this can be a real first step model. Later on when they have more money, a well cover can be installed or they can opt for a Model 2 pump.

Lower cost models, Model 2 (economy model with options for a wheel cover), and Model 3 (pole model) see pictures under Use for Households (Self-supply).

With new low cost pump models and improved quality of pumps and well head, Rope pumps have a large potential to scale up Self-supply.

Model 1

Ball bearings optional Model 2 (economy model)

Wheel cover Optional Model 3 (Pole model)

Suggestions for minimum quality for Rope pumps

All models fit on both hand dug wells and boreholes. The pump model no. 1 is fit for small communities and all 3 models are fit for Self-supply in households. The recommendation on the minimum quality are summarized below.

Recommendations on non technical aspects

Besides technical aspects, there are also a number of non technical aspects which are essential for a successful dissemination of Rope pumps like.

1. Poor daily maintenance. Many users do not adjust the rope or oil the bushings in time resulting in poor pump functioning and worn out bushings. (In Nicaragua Rope pumps of 20 years old still have the original bushings because they are oiled every week);
2. Make several models and prices so customers can choose
3. Rope pumps are simple but "Simple is not easy". For any producer it is essential to realise, bad pumps = bad image = less sales;
4. The dissemination of free pumps via NGOs and is distorting the development of a sustainable supply chain;

Some suggestions for improvement are:

- To improve the quality, it is a suggestion to make example (gold) models for each pump producer including production jigs. A number of jigs were made in the 1st and 3rd mission.
- Examples and production jigs of the new models are needed which could be copied and sent out to all Rope pump producing companies.

Certification

- Improve the quality by certifying or approving the producers of these technologies;
- This is in the interest of the government and should be effected by a governmental body. Until there is such a body the partners should support.
- Operation/ Maintenance / repairs
- Improve maintenance by more and better training of users in daily maintenance;
- Most important maintenance is the adjustment of rope, (rope should not be too tight, not be too loose) and weekly oiling of bushings with new oil!!;
- Promote the custom of maintenance by a slogan like "No oil - No pump"
- A pump installation should include a (laminated) maintenance sheet and a 0.3 l bottle with new oil (10W 40). Do not use grease or used oil!;
- General repairs like adding a piece of PVC pipe, replacing bushings etc are not done by users. In each area there should be technicians who can do this work on a commercial base;
- Technicians can be of pump producing companies, pump installers or metal workshops who can do repairs as one of their activities.
- It should not be done by NGOs or local government, since this will prevent a sustainable commercial supply chain from building up!!
- NGOs and governments should rather invest their water funds in awareness training of the local private sector, quality control, building up supply chains, evaluation, and enabling funding options for instance micro credits, monitoring etc.

Training

- In general many problems are caused by a lack of knowledge of both users and caretakers. Serious investment in long term and follow up training of production quality, installation, maintenance and repairs, organisation of maintenance, (ej Circuit riders) are recommended .
- One option to guarantee knowledge and training in the long term, is a National WASH training centre where all knowledge is concentrated and which has the capacity for trainings. Then smaller training centres can start later on in the regions. Examples of such training centres are the so called SMART Centres in Tanzania and Malawi.

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Information on scaling up safe water: www.300in6.org

Information on Rope pumps www.ropepumps.org

Different pumps



Model 1 Narrow structure, Ball bearings, and Bent legs. Improved model



Model 1 Wide structure, Ball bearings, bottom reinforcement. JICA model



Model 1 Bushings, Bend legs. Pump pipe and return pipe via the 4 inch pipe. Improved model



Model 2 Economy model, Bottom structure



Model 2 Economy model, bent legs



Model 3 Mounted on poles



Problems with cover of sealed model



Corrosion of bolts, trumpet on return pipe poor quality



Heavy Guide box. New models use 60% less metal and are galvanised materials



Lack of oiling resulting in broken handles



To much clearance in bushing resulting in extra wear



Use of ball bearing but low quality. If ball bearing are used than sealed models with grease nipple



Problems in Pump installation



Return pipe not sealed, PVC parts broken, Pipe end cap is cut and has large holes so water leaks back in well.



Lack of apron so water leaking back in well



Lack of soak pit so water around the well



Large diameter outlet pipe so pipe does not fit into the jerrycans. Suggestion to reduce diameter outlet pipe to 1 1/4"



Pump high since it is mounted on a parapet. In this case short base model should have been used or a platform should be installed.



Preparing well slab



Finished well slab



Aligning the outlet support



Producing well cover with M10 Galvanized bolts



Mounting of Rope pump Model 2.
A frame, economy model. Instead of welding angle iron and rebar, legs are bend and have a hole so less material and less welding



Jigs and tools Incl. socket and trumpet tools, end caps, cement guide block.



Making cement guideblock



Making demonstration



Installing pole model pump



Making well ring reducer with bricks



Inside diameter is 80Cm



Monitoring pumps in the field



Special tapered blocks to make a well ring



Families/masons in Butajera trained in making blocs with moulds



Well reducer ring made of tapered blocks



Well cover with Manhole. Water can leak back in well since there is no rim around the hole.



The manhole makes the well cover weak. Like in this case there is a crack cracked in the corner so another source for leaking water in the well.



The inlet of the return pipe is not good. It requires a nice smooth entrance, a so called trumpet which can be made with a trumpet tool.



Here the well slab is not sealed well on the well rim.



The outlet pipe of 1 1/4 " it fits in jerry cans



Pump model 2 used for productive use. Here the pumps is used for irrigation of a garden of 300 m2



Here a hose is connected to the outlet to transport water to the garden on the other side of the house



Here water is pumped for cattle.
The cattle drink from a separate drinking bucket away from the pump.



Pump with ball bearings. In this case also supply a grease pump



Lubrication of bushings. The oil hole should be on top



Wheel with 4 Spokes of GI pipe. Clamps in between are missing



Here clamps are installed but length is not good



Bad example of Soakpit, The pit with stones was blocked and a new hole for cattle was made. This results in contaminated water.



Good example of Soakpit, all water goes to the pit. The pit is filled with stones so no water is visible so not drinking of cows, no mosquitos etc.