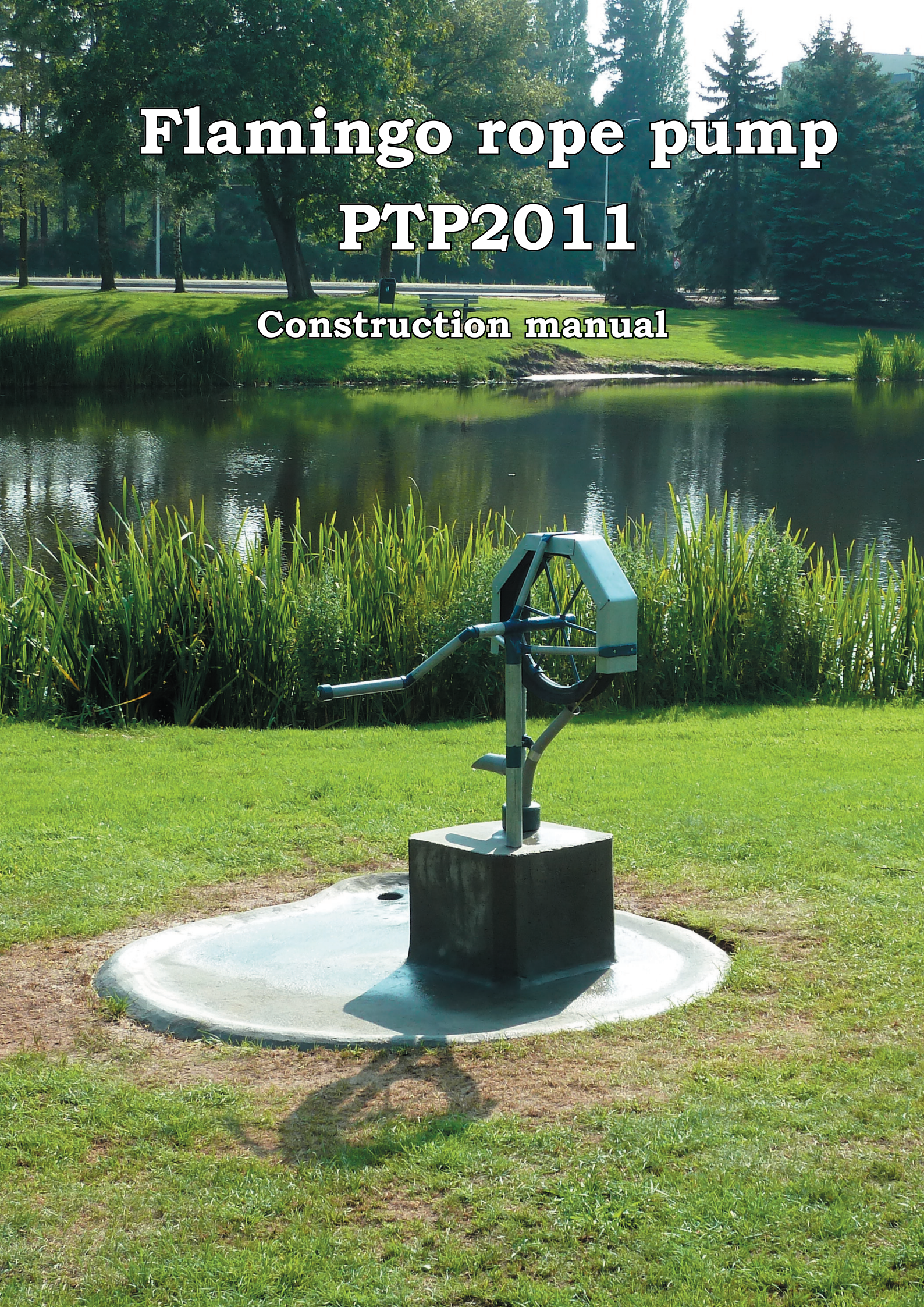
Flamingo rope pump PTP2011

Construction manual



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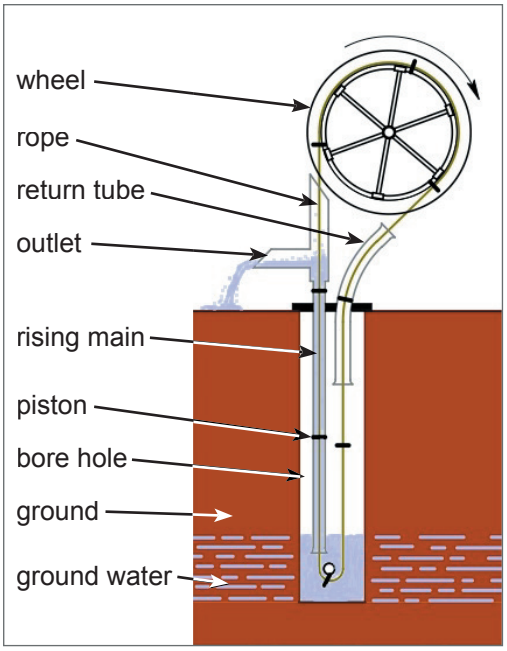
Special thanks to:
Henk Holtslag for his review and comments on the design. Members of the WOT who helped installing the prototype.

WOT, november 2012.

Contents

Priciple of working

The basic parts of a rope pump are the rising main and the rope with the pistons. The rising main is a pipe, usaly made of PVC, that hangs with one end in the ground water and the comes with the other end above the ground. By moving the rope, and therefore the pistons upward, water will be lifted.



To easy the driving of the rope though the pipe a wheel is used and the rope is made endless by knotting both rope ends together.

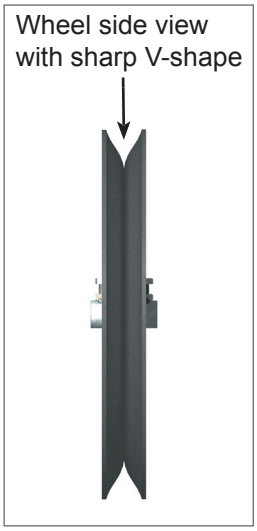
Key features

The wheel is made of the side walls from a car tire. By putting the two walls together a sharp V-shape is created. This V-shape ensures that the wheel has a good grip on the rope so it won't slip and thereby prevents excessive tear and wear.


A rope with piston in a transparant pipe

The pump and inlet guide are made completely from PVC. No iron parts are present in the water of the well who otherwise corrode easily.

The frame is based on a simple one pole structure that reduces costs and simplifies the manufacturing. The bearing for the wheel axle is made out of one piece of pipe. This avoids aligning problems. The bearing has an integraded automatic one directional brake. This will prevent that the wheel and handle turn in the opposite direction by the pulling action from the water in the raising main when stopped with pumping.



Pump capacity

How much water a hand pump can deliver is determined by the strenth of the user. The general assumed input power is approximately 80 Watt. The rope pump will be operated at an avarage revolving speed of one turn every second. With the use of a wheel made out the prescribed 14" tire, the lifted water mass is limited to 7 kg. When simple rubber disc are used for the pistons, the hydrolic eficiency will be approximately 80 % wich reduce the amout of water that is pumped. This all together results in the table below:

Table 1: lifting height, pipe diameter and pump capacity

Lifting height [m]	0...6	6...11	11...17	17...35
Tube outer diameter [mm]	Ø40	Ø32	Ø25	Ø19
Tube inner diameter [mm]	Ø37,4	Ø28,4	Ø23,0	Ø16,2
Pump capacity [liter/minute]	80	45	30	15

Use this prescribed pipe diameter for the given lifting height! When using a larger pipe diameter the pump will work to heavy to use.

General techniques

Sawing

Use a sharp iron saw for sawing the galvanised steel pipe and PVC-pipe. Deburr the edges with a file.

Squeezing pipe ends

Some pipe ends must be squeezed to make welding easier. Pay attention to the final thickness mentioned in the drawings.

Welding

Al weldings are done with 3.25 mm rutile electrodes at 120 ampere. Use a welding mask with a shade 10 to protect your eyes. Before welding remove all the sink plating and loose rust at the places where the parts are welded together.

Painting

The bare metals and the places where the parts are welded together have to be painted to protect it against rust. The galvanised pipe is protected against rust by itself. Before painting undo the parts thoroughly from grease and dust.

Concrete

Don’t expose fresh poured concrete to the full sun. Cover the concrete with plastic foil and keep it contiuously wet for at least 4 days after pouring. After pouring concrete compact the mass by jab it with a stick.

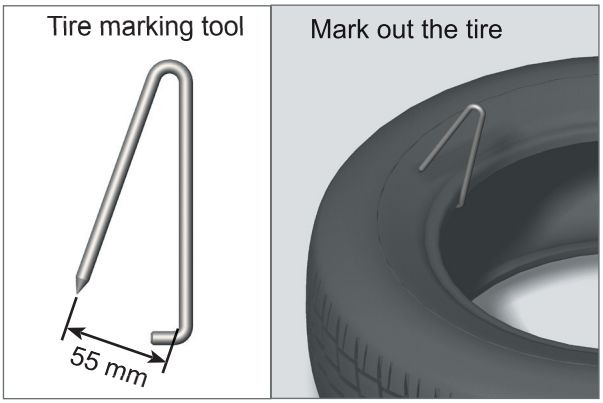
Bulding the frame

The following pages describe how to build the wheel, handle and the frame.

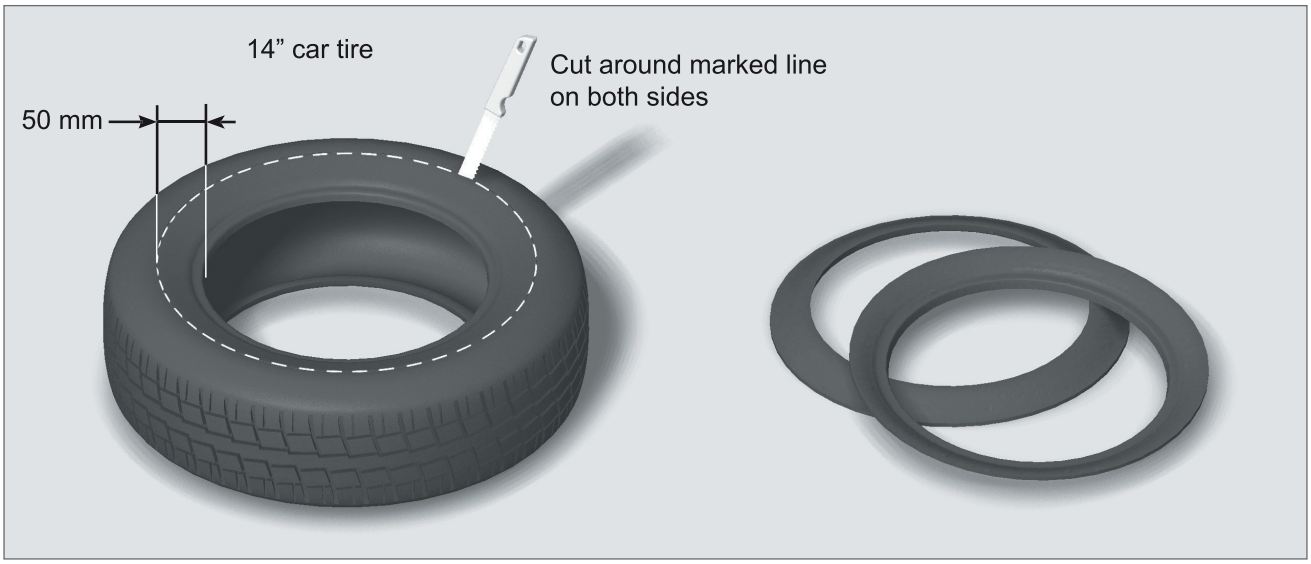
The Wheel

Preparing the tire

The two rubber parts that make the V-shaped wheel are made from a 14” car tire. The inner parts has to cut out. To guarantee the right dimensions, the tire has to be marked out first with the marking tool below.



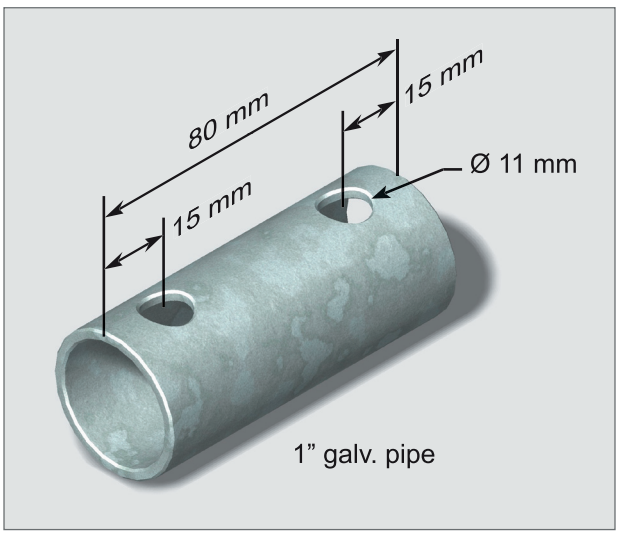
Cut the tire as shown in the picture below. Do this on both sides. The cutting is easiest done by using a serrated knife and by lubricating the rubber with water.

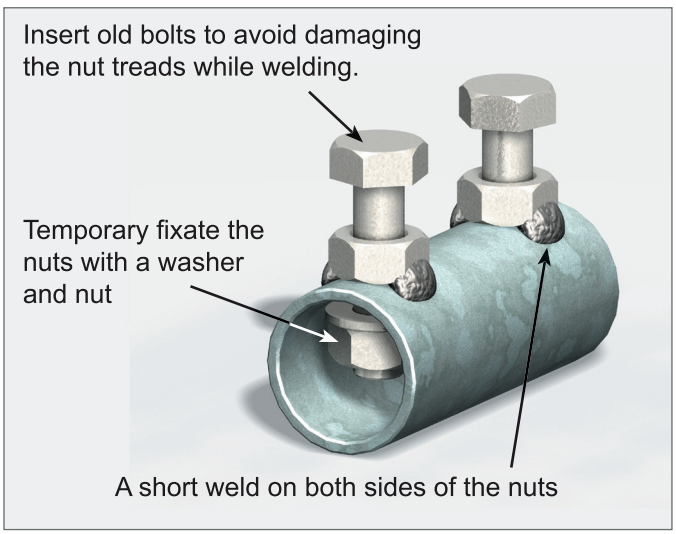


The hub

The hub is made of an 80 mm long, 1” galvanized steel pipe. Drill two 11 mm holes in the side wall.

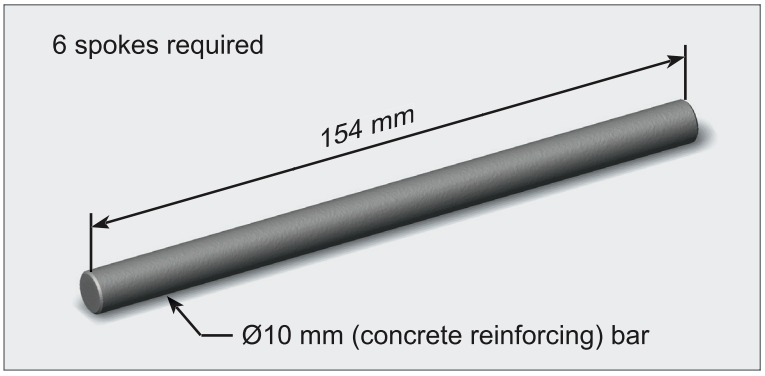
M10 nuts must be welded above the two holes. Fixate the nuts to easy the welding.

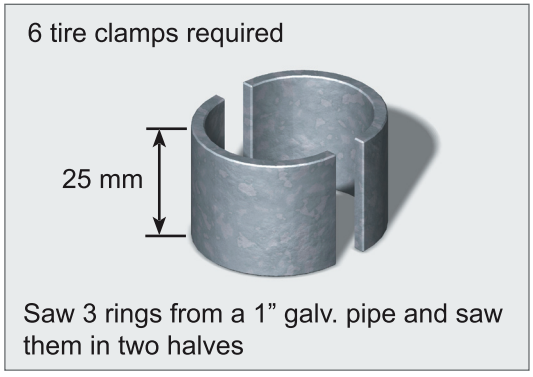




Spokes and tire clamps

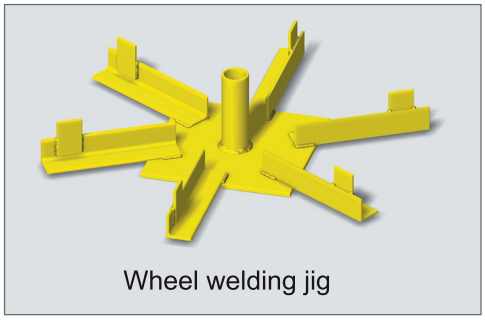
Each wheel requires six spokes and tire clamps.

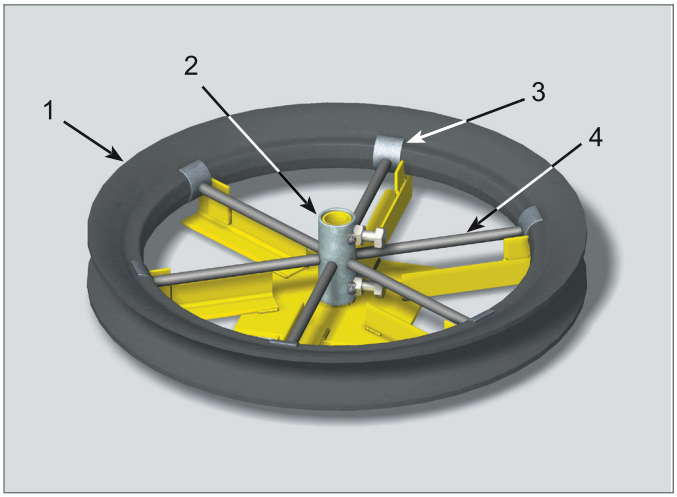




Welding the wheel

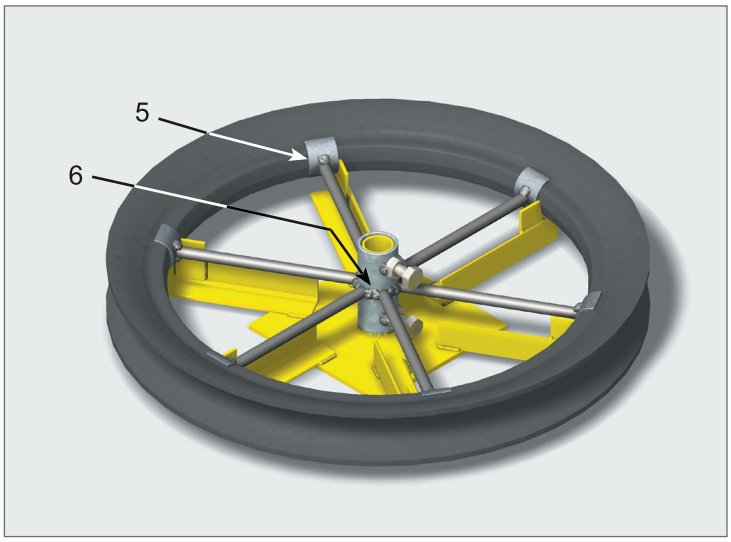
A welding jig will ease the alignment and welding of the wheel parts. The wheel jig is described on page 33.

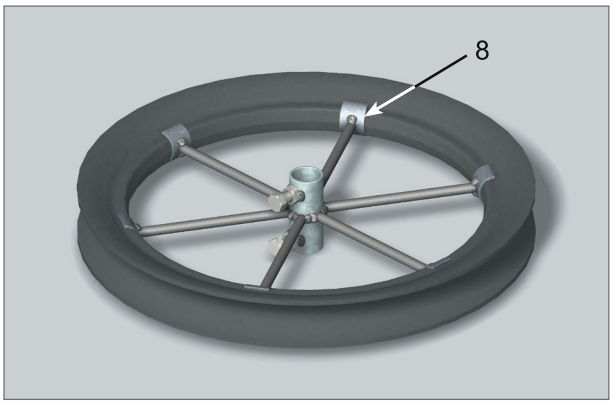




1) Place the tire parts on the jig.
2) Place the hub over the jig centerpole. Screw old bolts into the nuts of the hub to protect the screw treads while welding and tighten them to secure the hub.
3) Push the 6 wheel clamps over the tire parts
4) Clamp the six spokes between each tire clamp and hub.

5) Weld the spokes on one side onto the tire clamps. Cool directly after each weld the clamp with plenty of water to avoid burning the rubber.
6) Weld the spokes onto the hub. Do this only on the spots between the spokes so the spokes can later on be adjusted.





7) Separate the wheel carefully from the welding jig.

8) The spokes and wheel clamps can now be welded together on the other side.

9) Finish the work by replacing the old bolts by new ones.

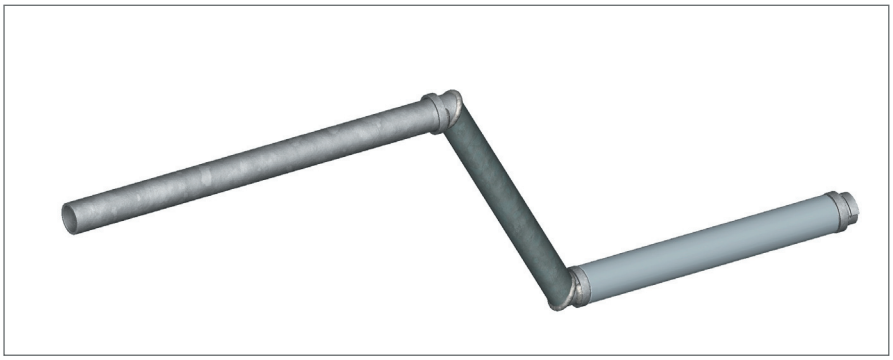
Adjusting the wheel

Slide the wheel over a 3/4" tube (don't tighten the bolts) and turn the wheel. Probably a wobble in a side motion is visible. Gently hammer on the spokes that cause the wobble to reposition them and so straighten the wheel.

Painting

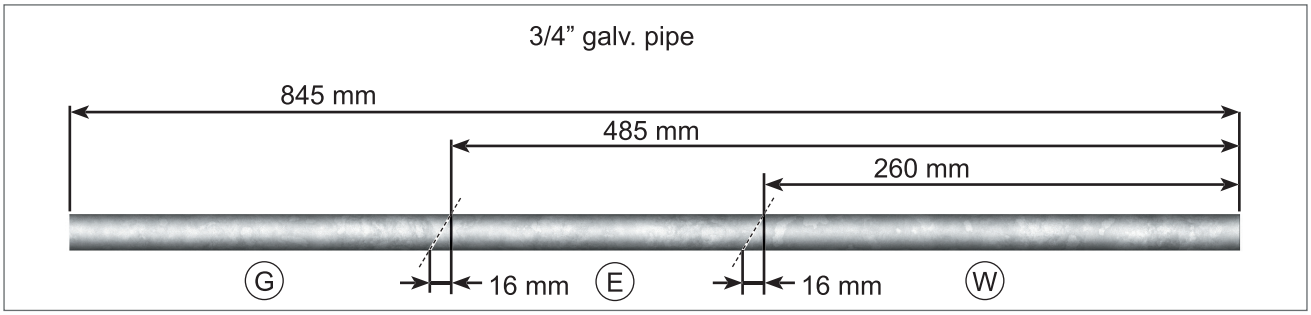
Paint all the iron parts on the completed wheel to protect it agains rusting.

The handle



Sawing the tubes

The handle consists of three parts made of a 3/4" galvenised pipe. Saw the pipe as shown below.

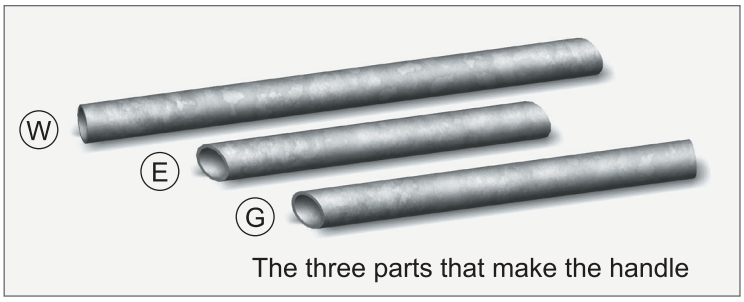


The three different section are marked as follows:

G) Grip

E) Eccentric

G) Wheel side

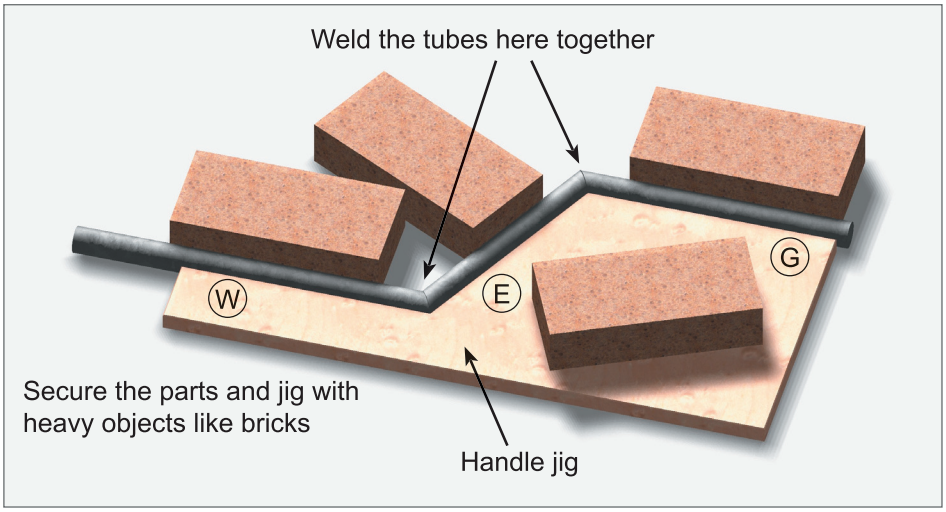


The three parts that make the handle

Welding the tubes

Line up the three tubes on a flat surface as shown in the picture. Use the wooden jig for a correct alignment and secure the tubes with bricks. Weld the tubes together on one side.

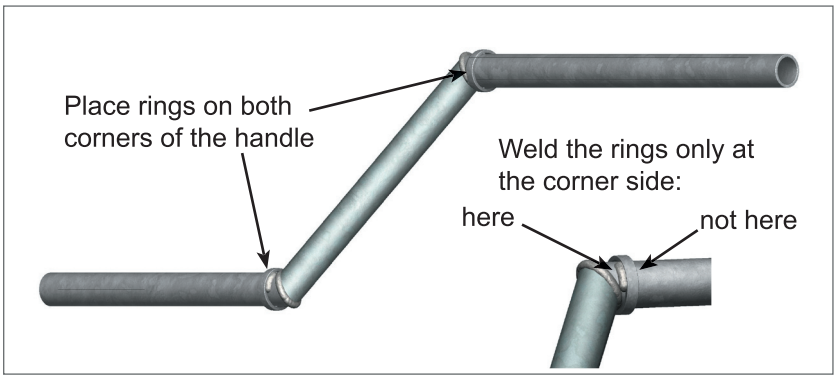
The handle jig is described on page 31.



Check the alignment, correct if nessesary and weld up the joints on the other side. After that, complete the welding so that all the joints are welded all around. It's very important that the two end tubes are alignd exactly parallel.

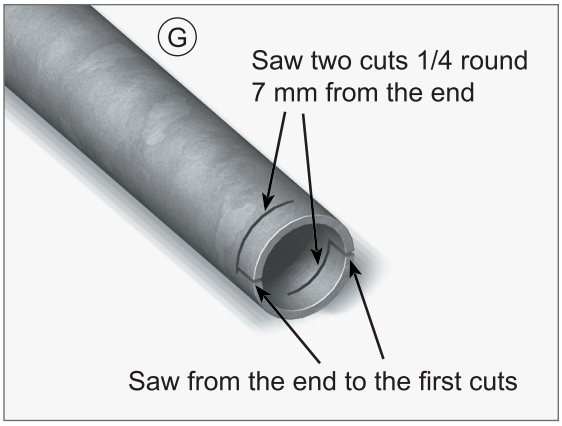
Rings

For a smooth operation of the pump a grip is added. To secure the grip on the handle three rings needed.



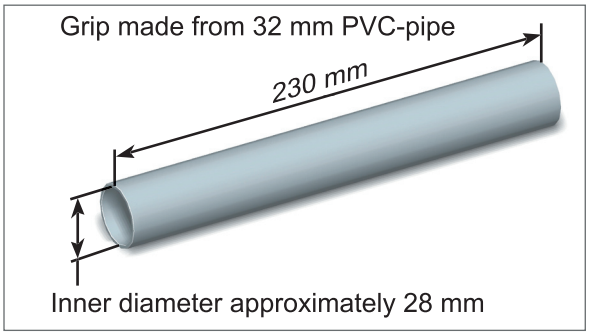
Locking lugs

One end of the handle pipe marked with “G” must provided with locking lugs. Pay attention to the saw directions so the lugs wil bend open in the right direction. This is to avoid injuring the user.



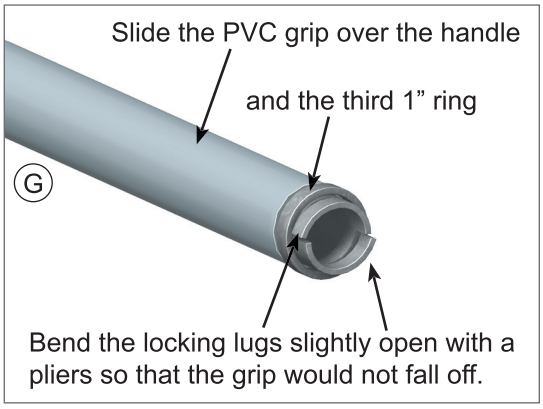
The grip

The grip is made of a PVC pipe. The inner diameter of the pipe has to be wide enough to easily slide over the handle tubes, but small enough to avoid rattling to much.



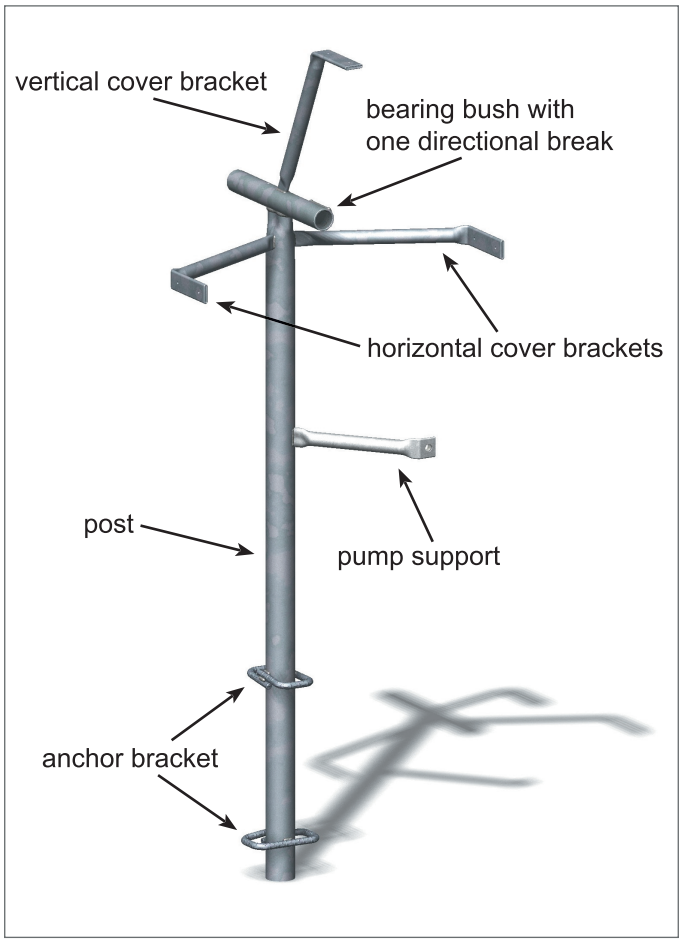
Locking the grip

The PVC grip is locked into place with the third ring and by bending the locking lugs a little bit outward.

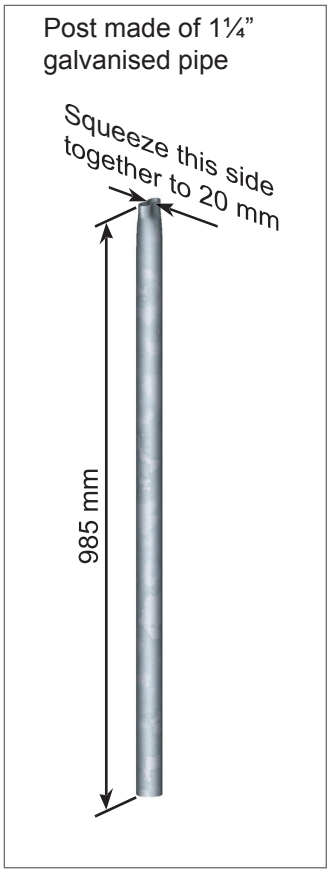


The frame

The frame is shown in the drawing below. All the part required to construct the frame are described in the following paragraphs.

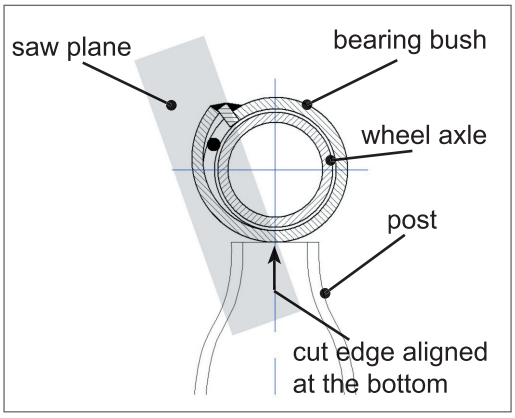


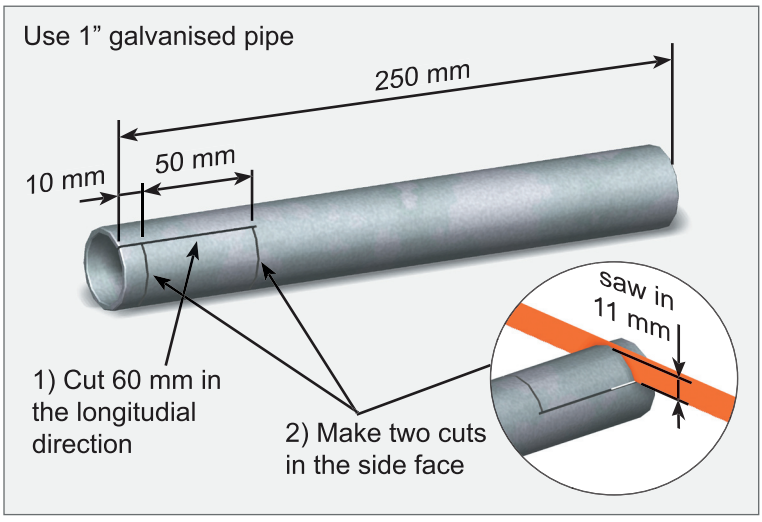
Post

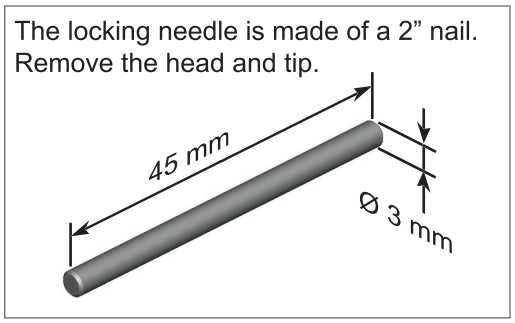


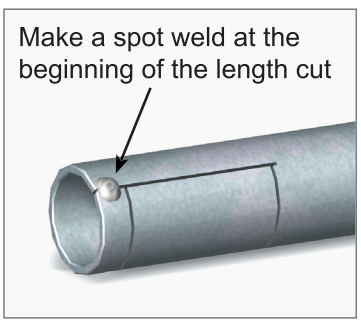
Bearing bush

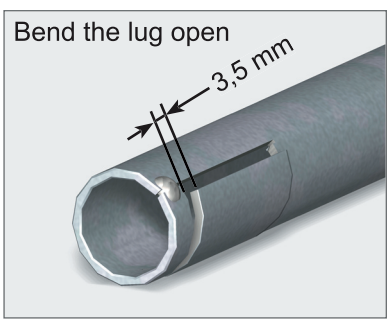
The bearing bush has an integrated one direction break. Therefore the pipe needs some modifications.

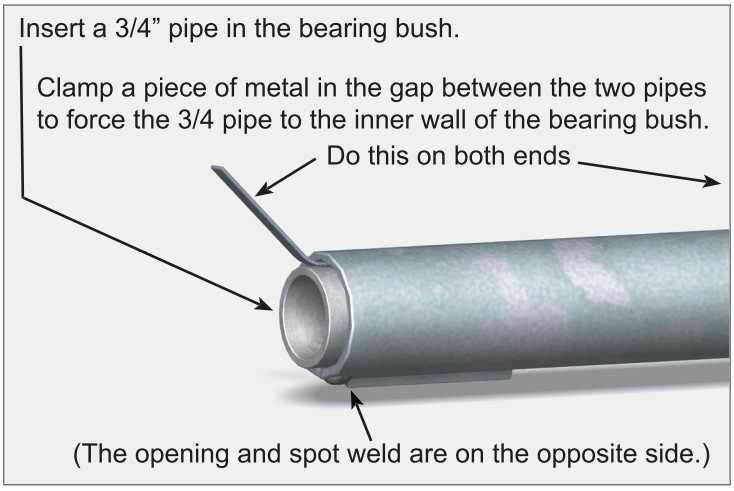


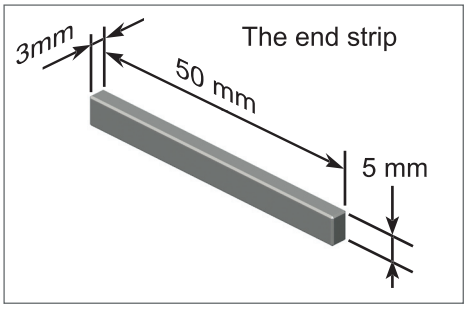


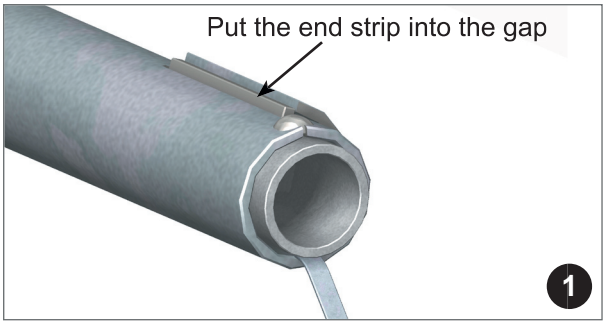


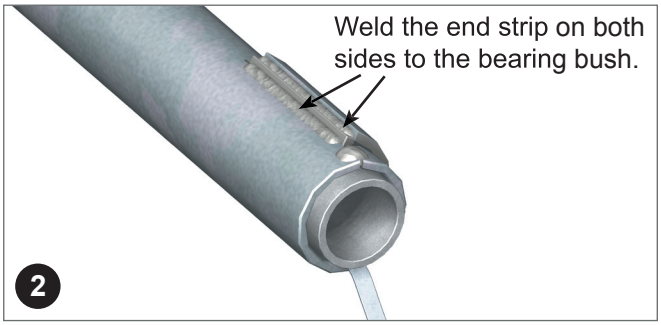


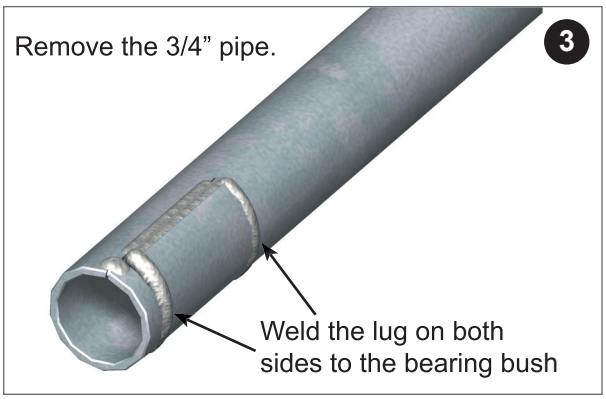


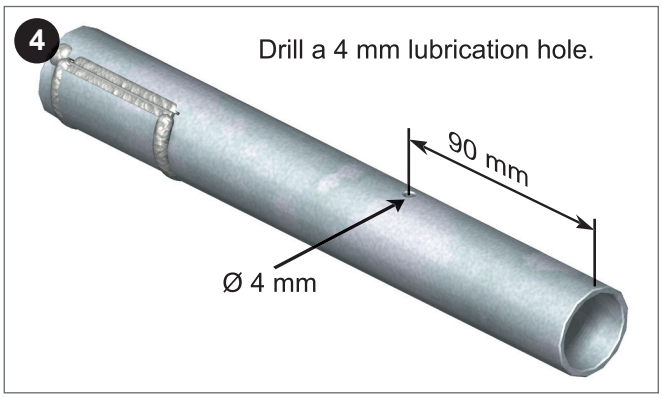




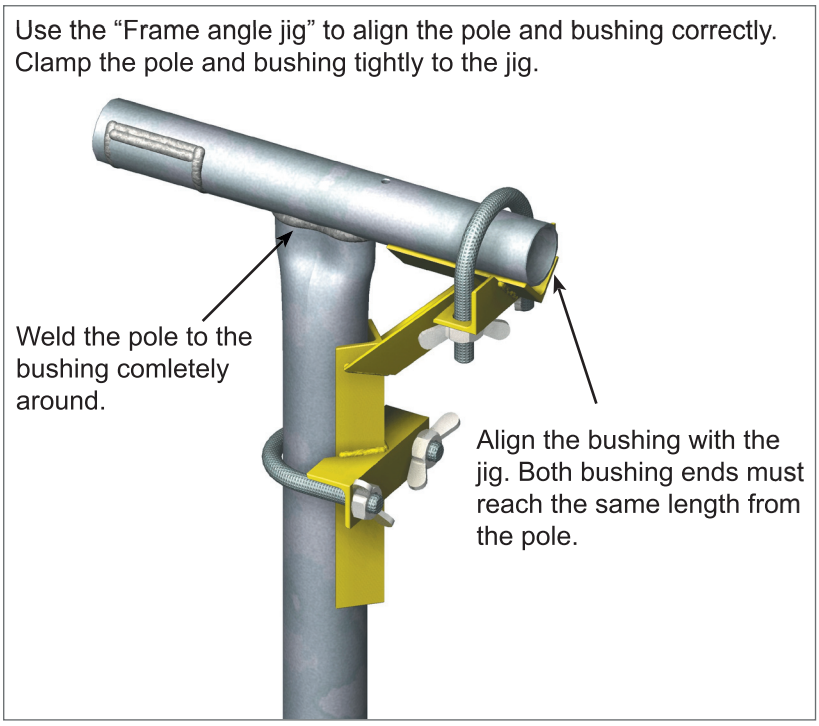








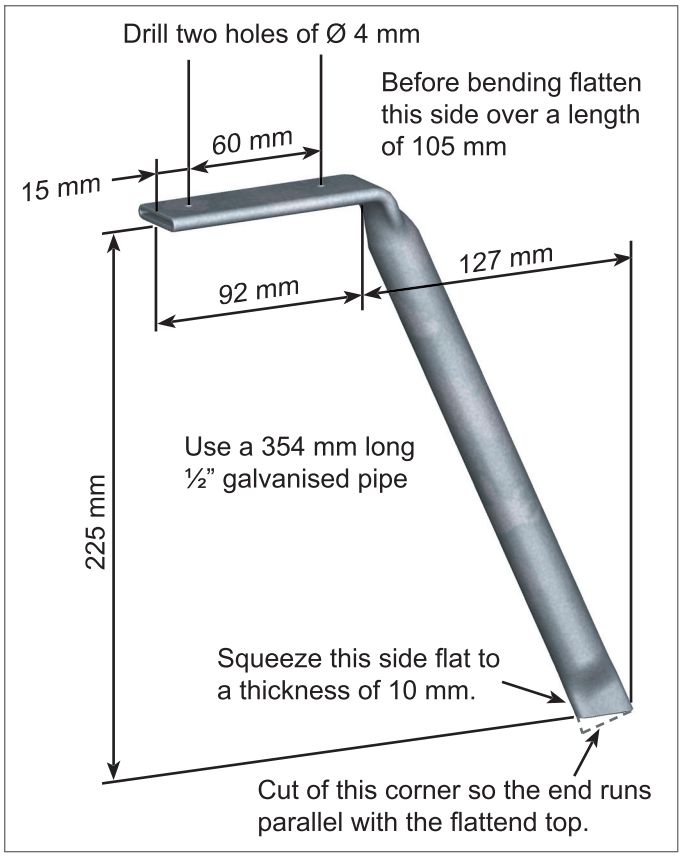
Welding the bushing to the frame



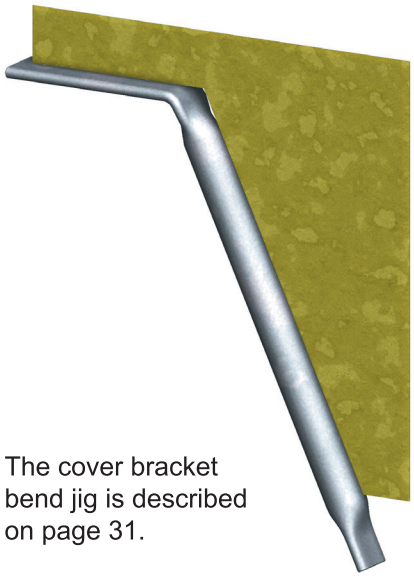
Make sure that bearing bush is positioned with the right angle onto the post. The start of the lug must point to the bottom side.

The used frame angle jig is described on page 32.

Vertical cover bracket



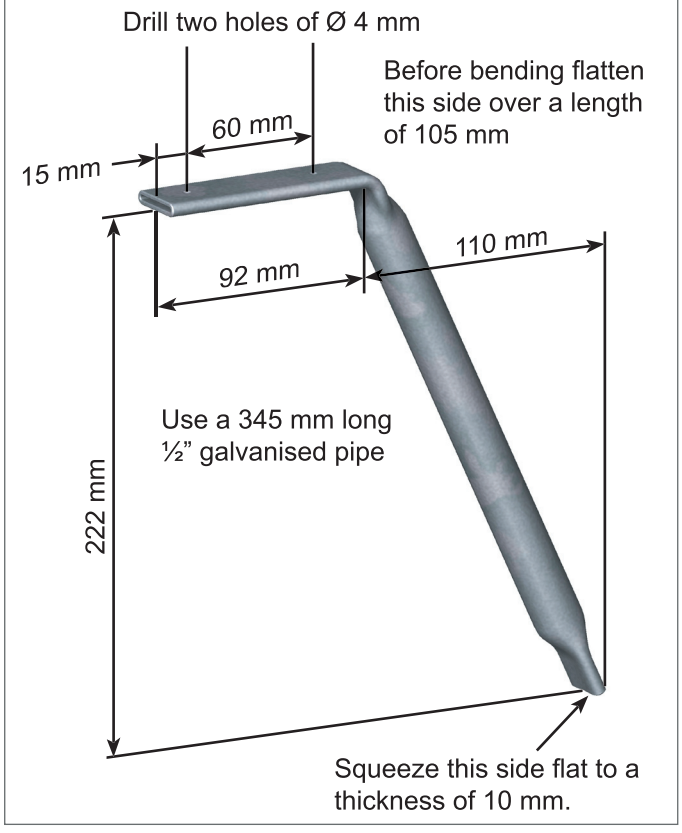
Check the bend angle of the vertical and horizontal cover brackets with the "cover bracket bend jig".



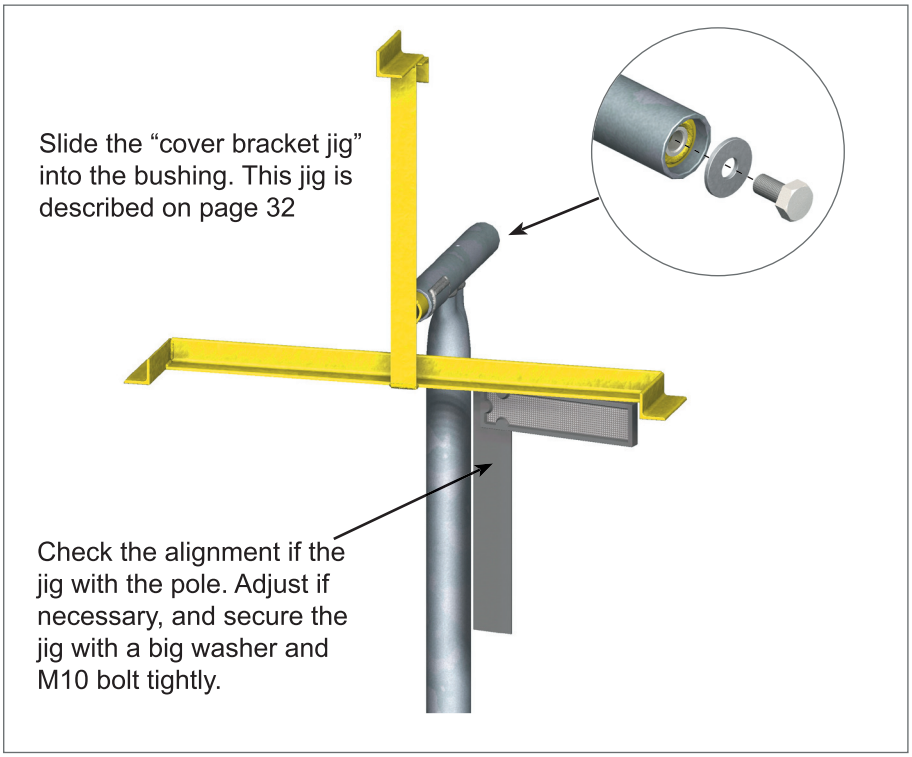
The cover bracket bend jig is described on page 31.

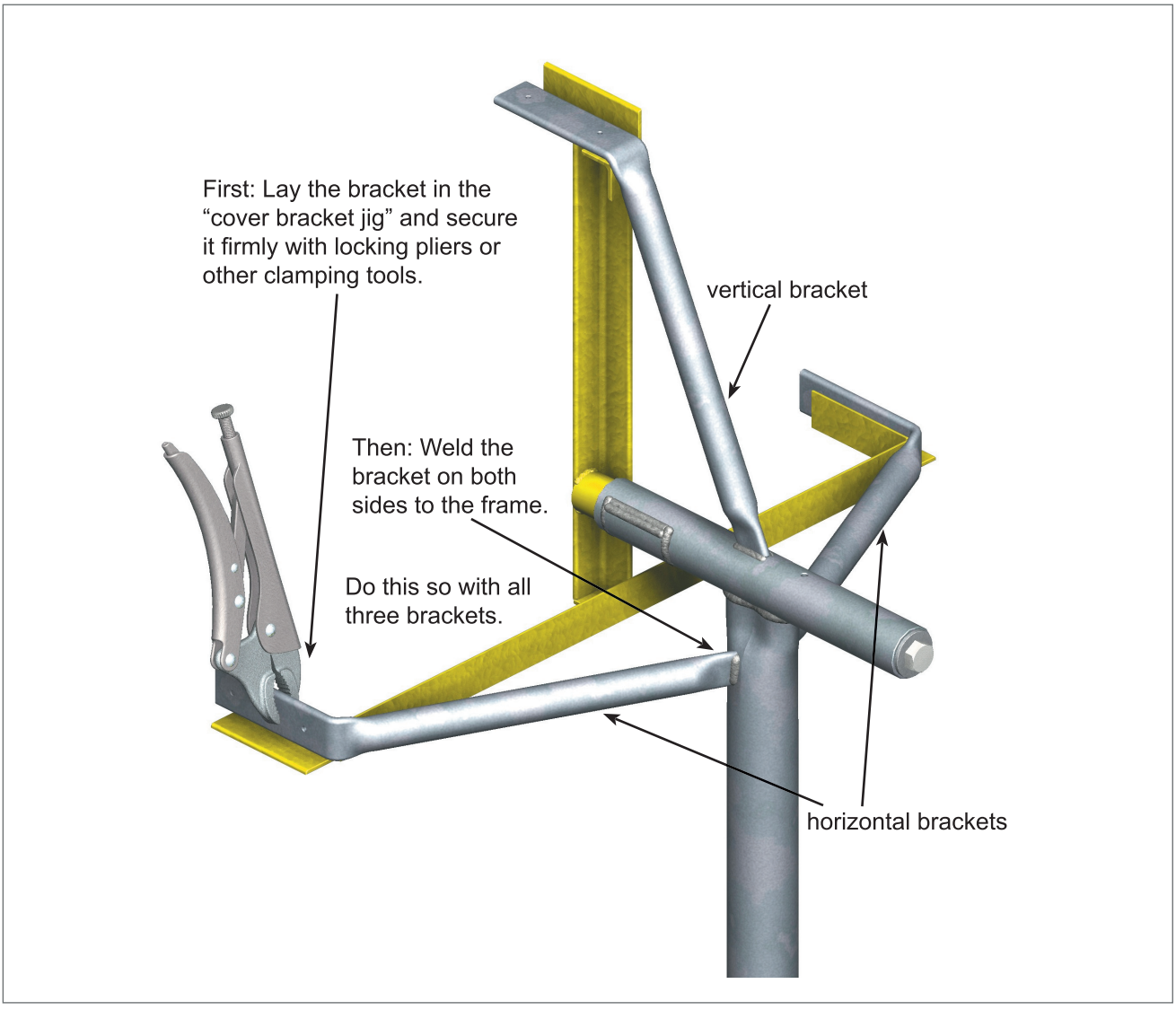
Horizontal cover bracket

Two of these brackets are needed.



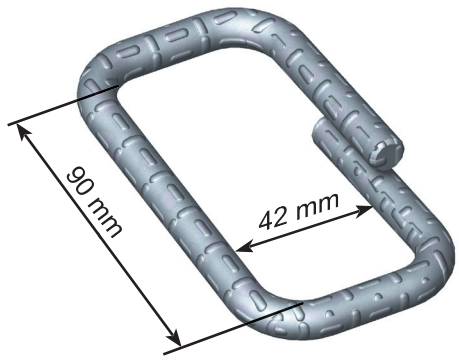
Welding the cover brackets

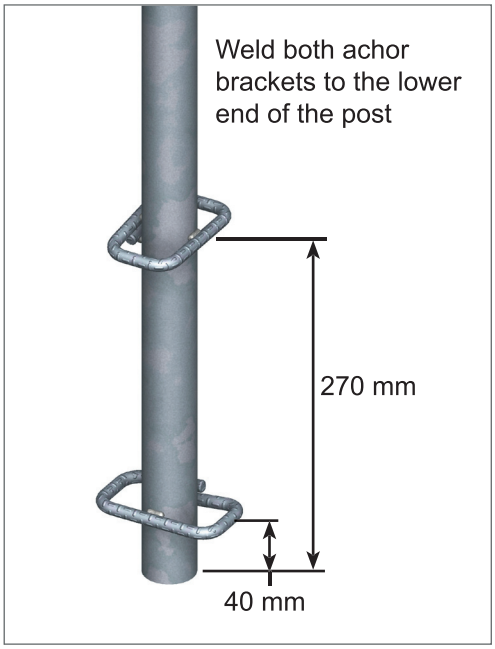




Anchor bracket

Two anchors are required, made of a 290 mm long Ø10 mm reinforcement bar.

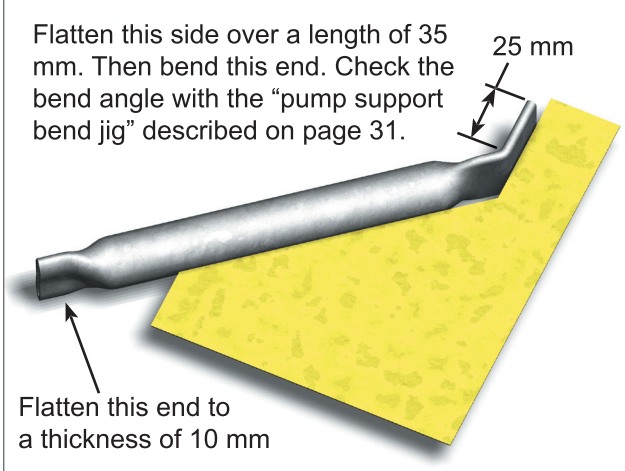


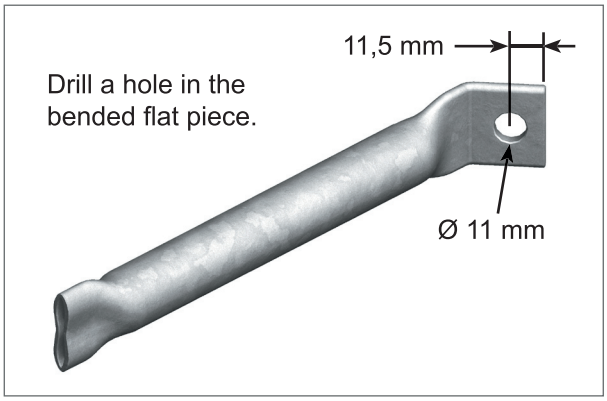


Pump support arm

The pump support arm is made of a 215 mm long 1/2" galvanised pipe.

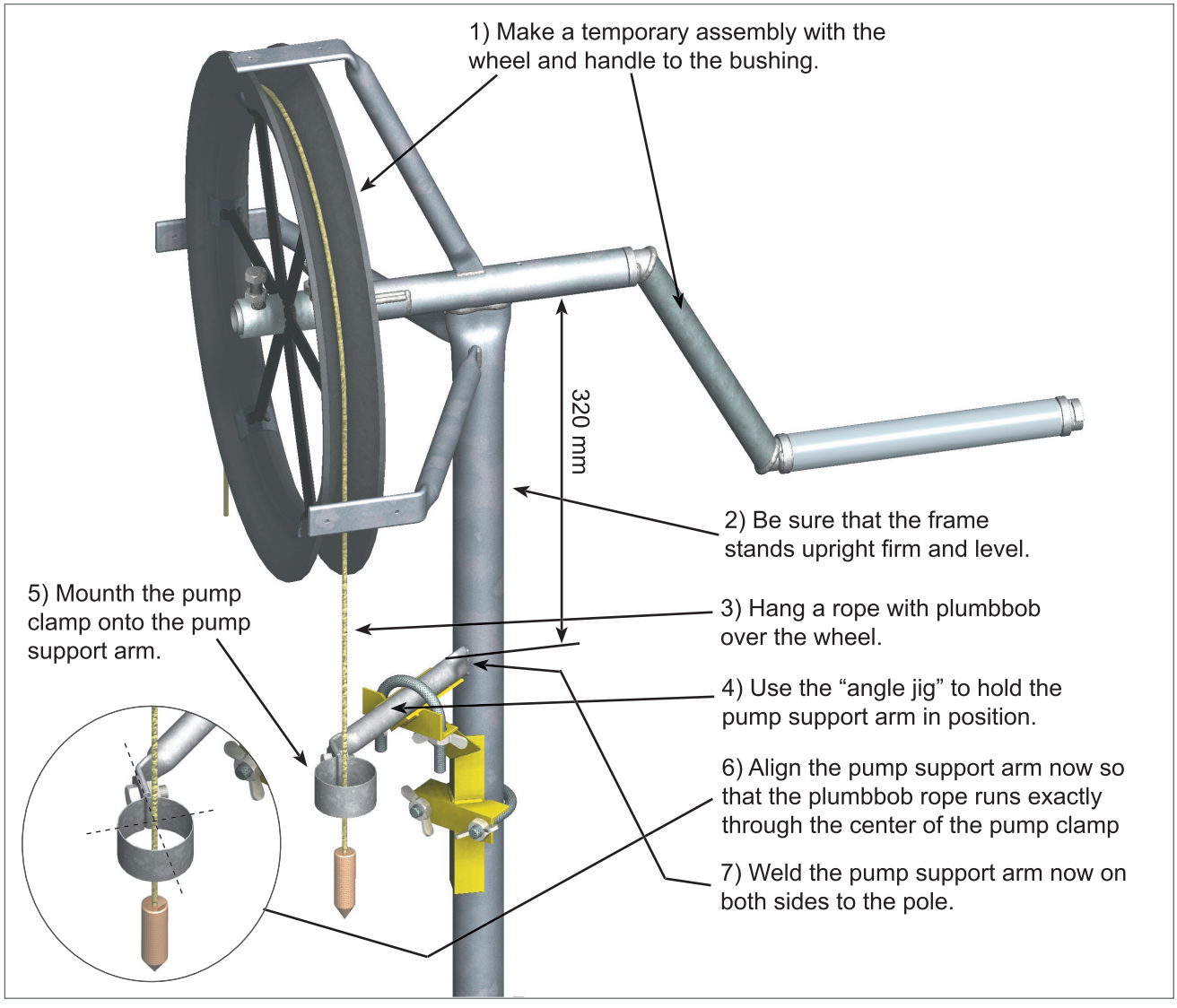
Flatten this side over a length of 35 mm. Then bend this end. Check the bend angle with the "pump support bend jig" described on page 31.





Weld a M10 nut on one side above the hole.

Mounting the pump support arm



Painting the frame

All the welding on the frame is now done. Clean the frame thoroughtly from dust and grease. Only the bare parts that not are protected by zinc have to be painted.

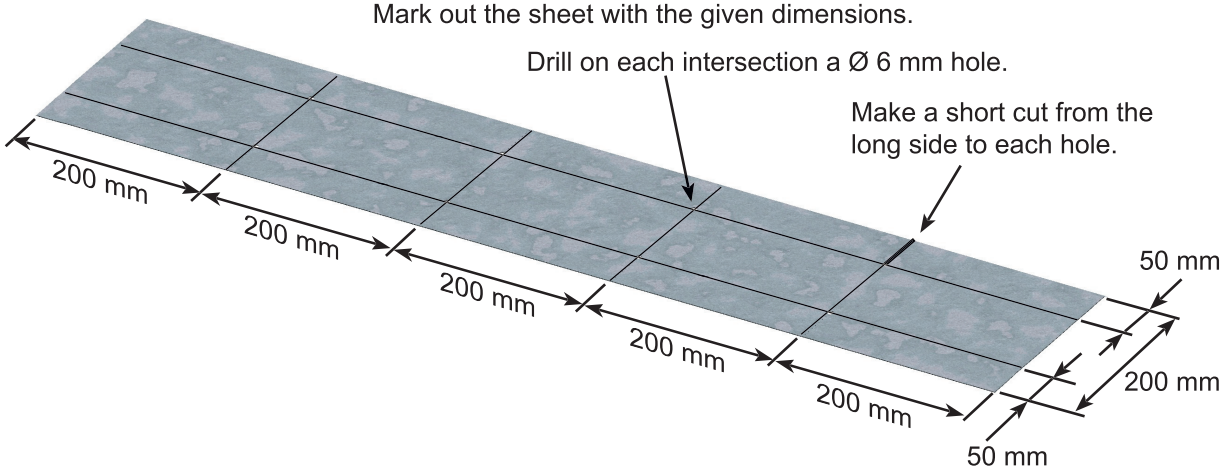
The wheel cover

The cover is made of 0,7 mm thick gavanized sheet 200 mm width and 1000 mm long.

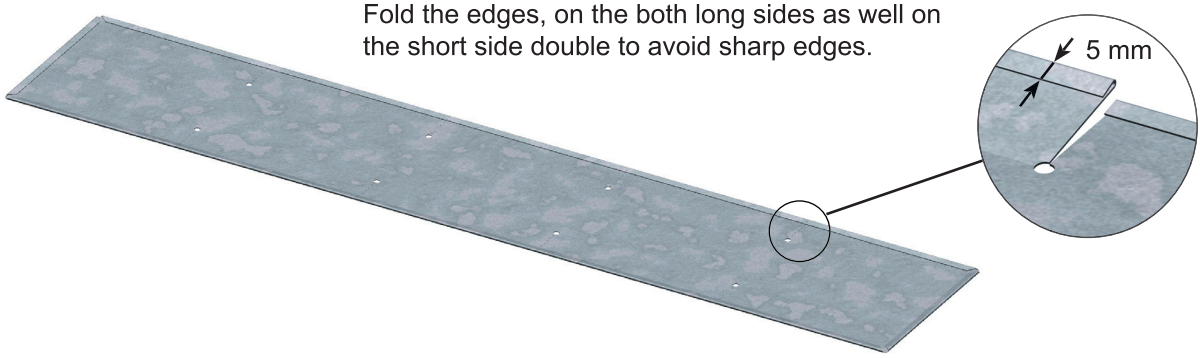
Mark out the sheet with the given dimensions.

Drill on each intersection a Ø 6 mm hole.

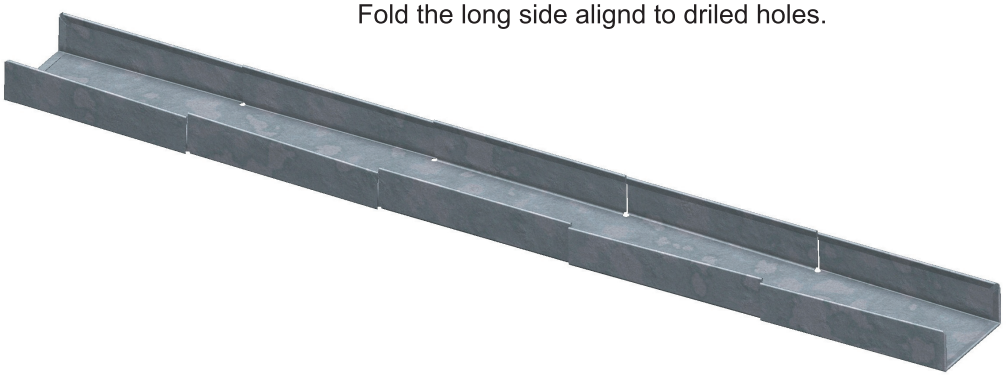
Make a short cut from the long side to each hole.



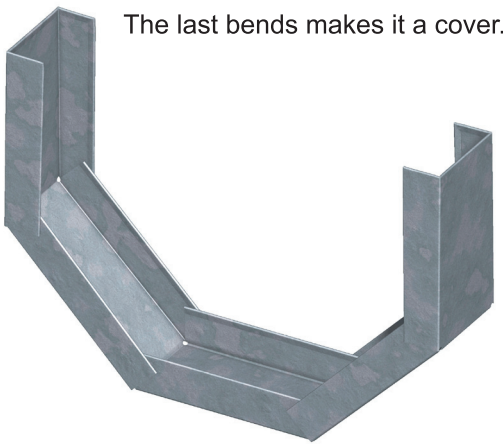
Fold the edges, on the both long sides as well on the short side double to avoid sharp edges.

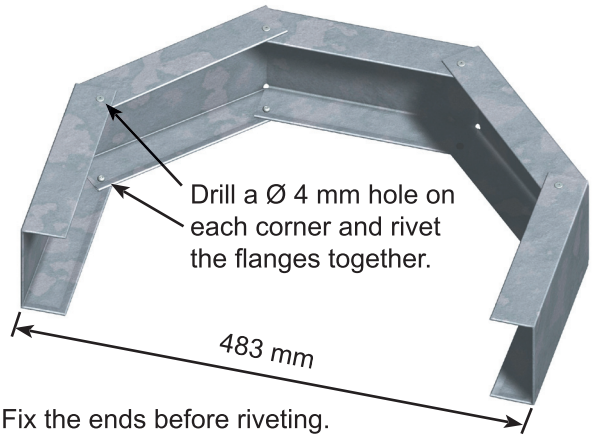


Fold the long side alignd to driled holes.



The last bends makes it a cover.

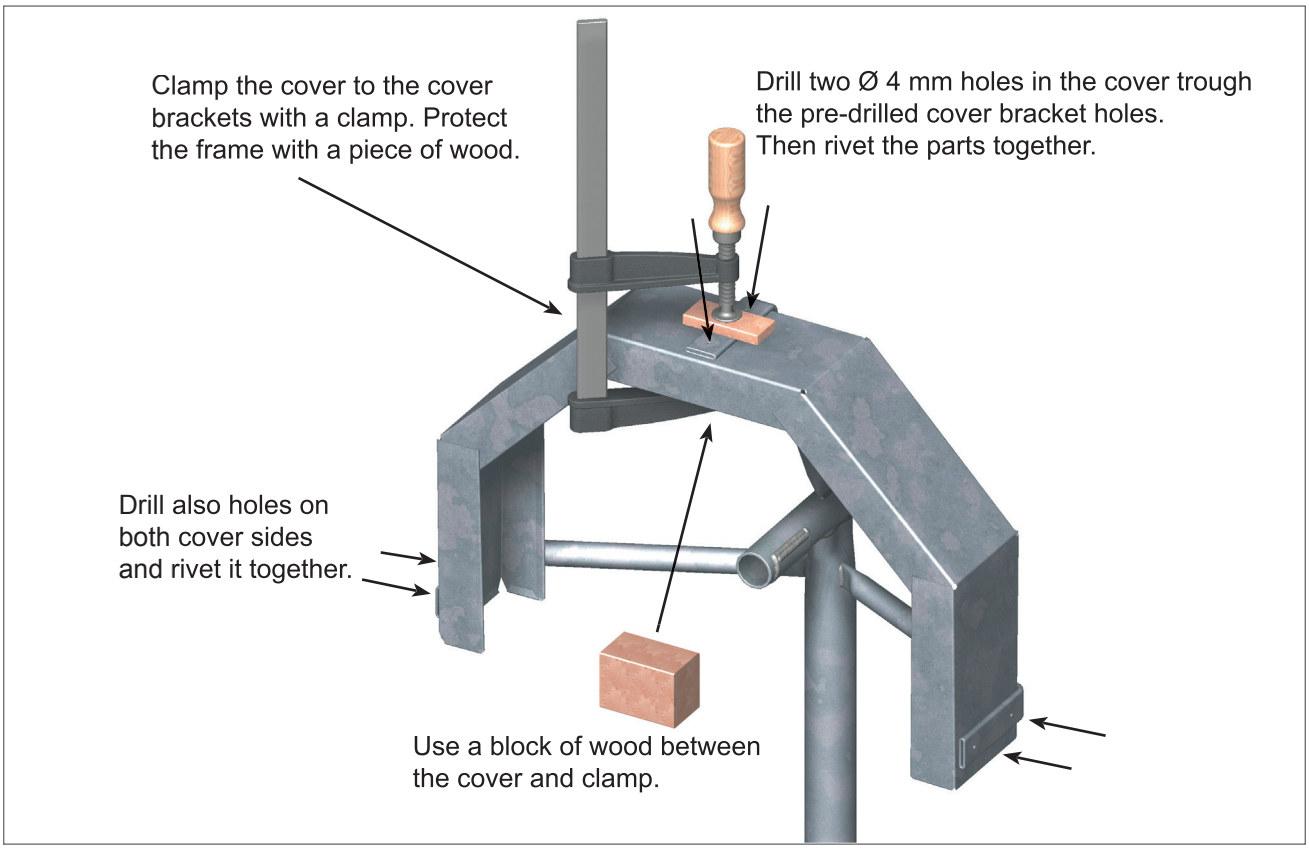




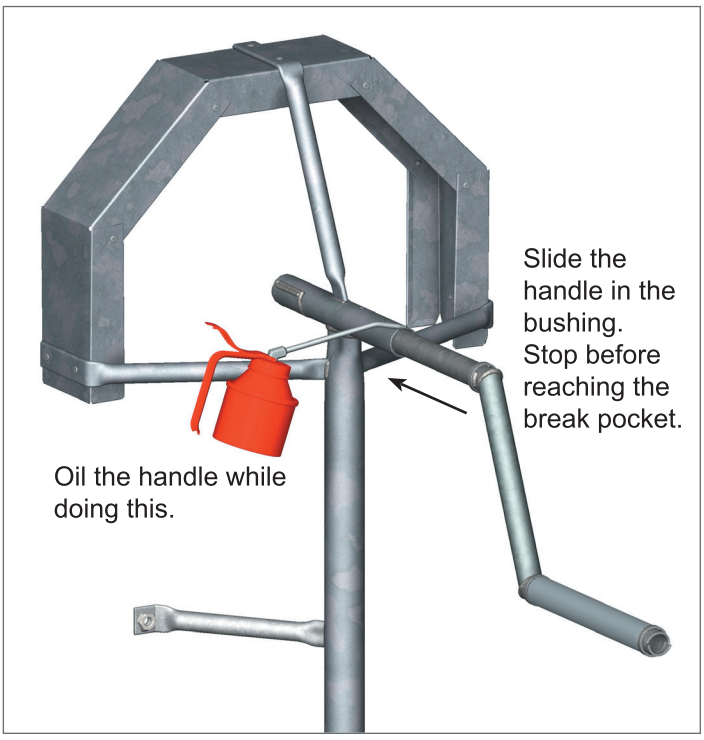
Fix the ends before riveting.

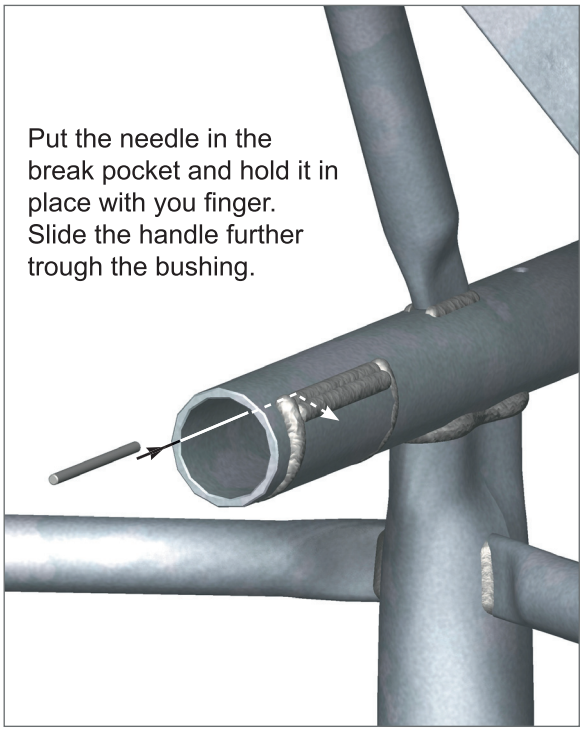
Frame assembly

Mounting the cover

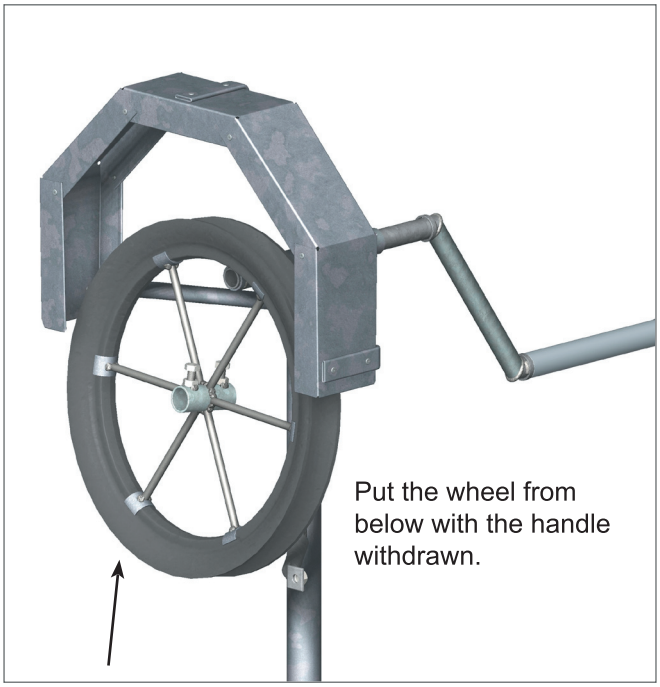


Mounting the handle

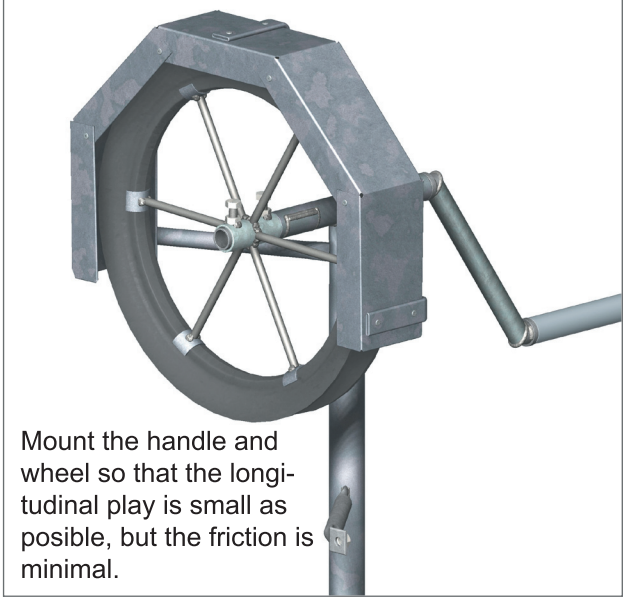




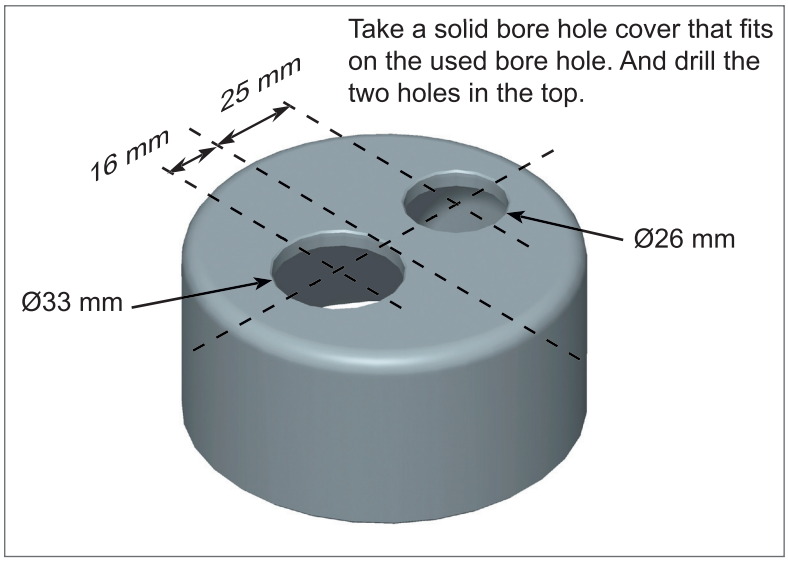
Wheel assembly



When the wheel is in position, slide the handle fully through. Tighten the wheel bolts.



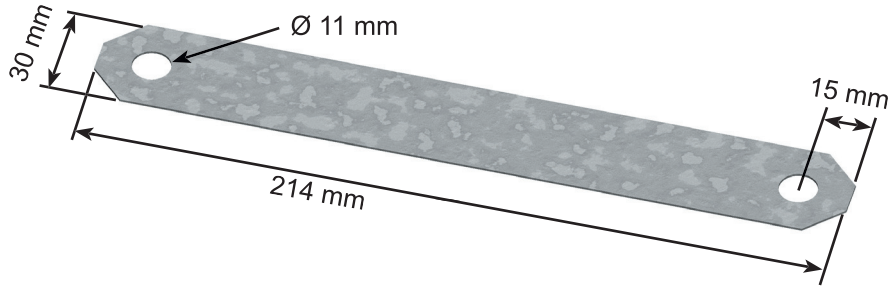
Bore hole cover



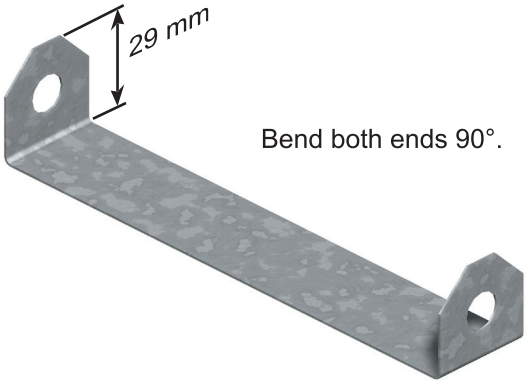
Given measurements are for a Ø25 mm rising main and a Ø32 mm return pipe.

Pump clamp

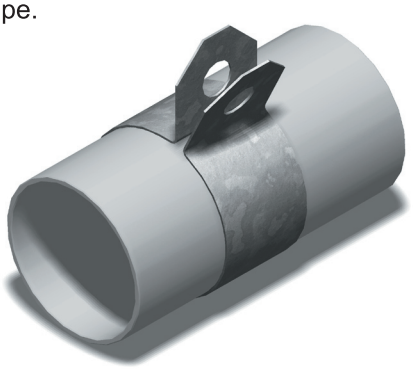
The pump clamp is made of galvanized sheet 0,7 mm thick



The given measurements are for a Ø40 mm return pipe. Adapt the measurements for other pipe diameters.

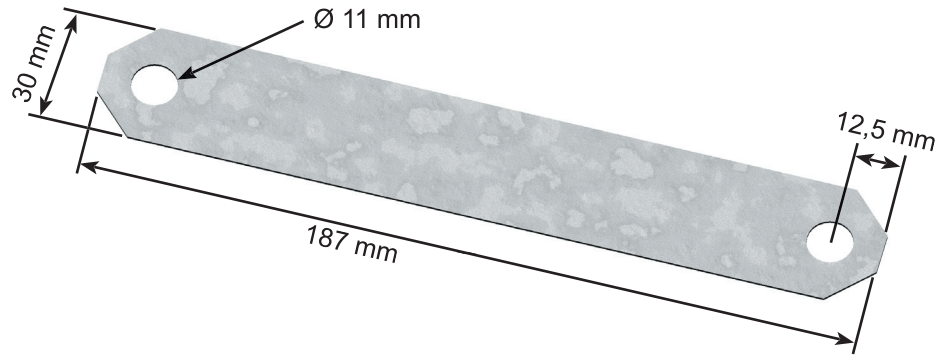


Bend the clamp around a piece of Ø 50 mm pipe.

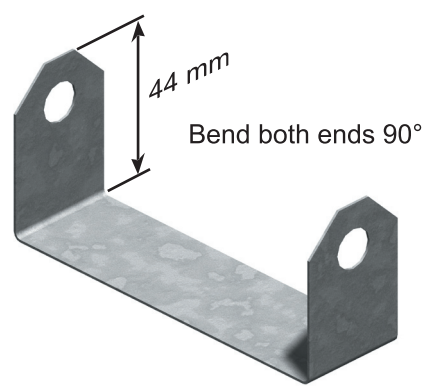


Return tube clamp

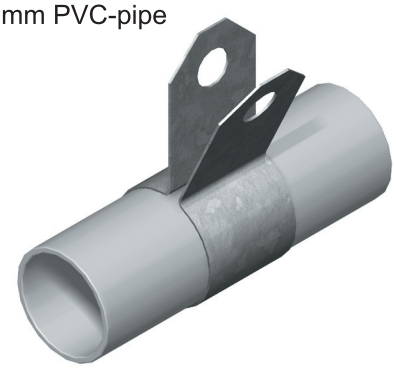
The return tube clamp is made of 0,7 mm thick galvanised sheet.



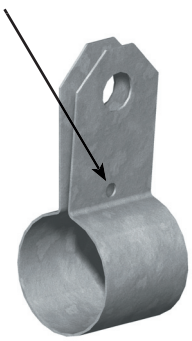
The given measurements are for a Ø32 mm return tube clamp. Adapt the measurements for other pipe diameters.



Bend the clamp around a 32 mm PVC-pipe

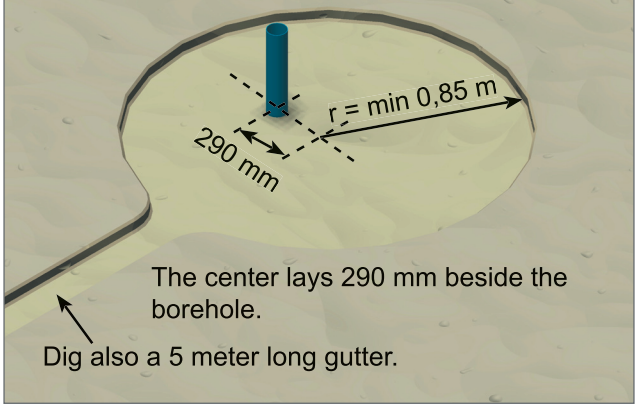


Drill a Ø 4mm hole close to the corner.



Frame installation

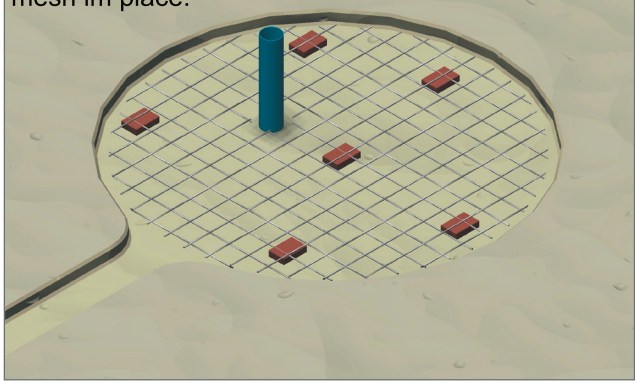
Dig a shallow 60 mm deep hole with a minimal diameter of 1,7 meter.



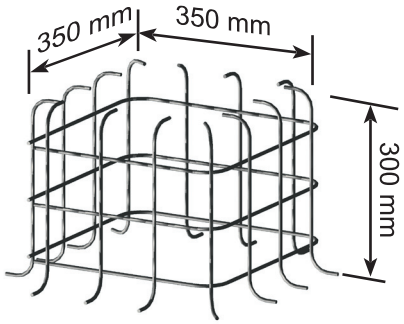
The center lays 290 mm beside the borehole.

Dig also a 5 meter long gutter.

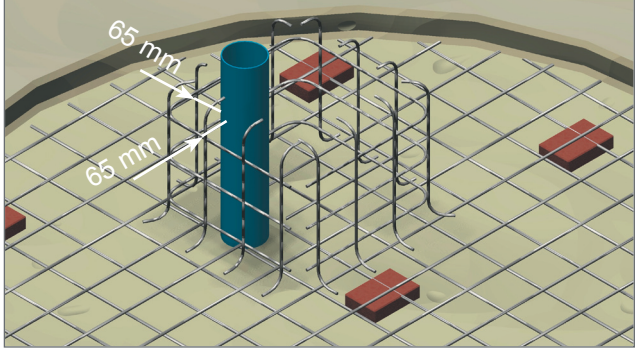
First lay plastic foil on the bottom. Then place small stones on the foil and then lay the reinforcement mesh im place.



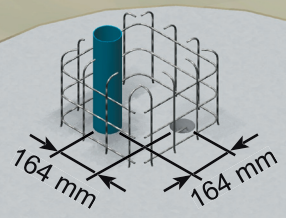
Make a reinforcement mesh cage 350 mm * 350 mm and 300 mm heigh.



Place the reinforcement mesh cage over the bore hole. Keep a distance of 65 mm between the bore hole case and the mesh cage.

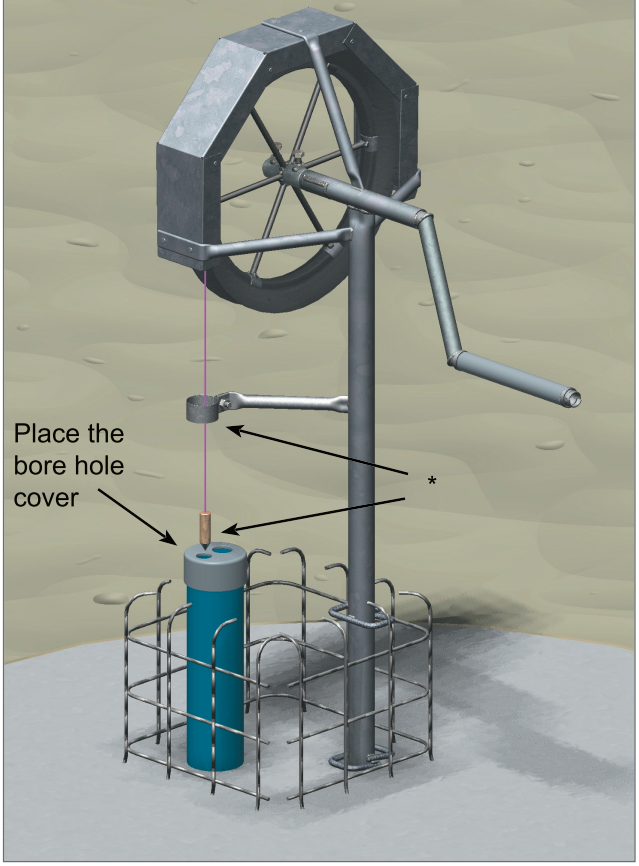


Pour a 60 mm thick concrete slab. Keep a 50 mm deep hole open for the pump frame.

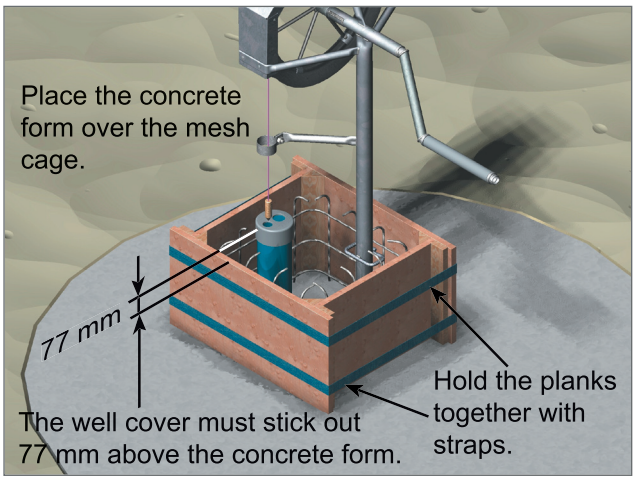


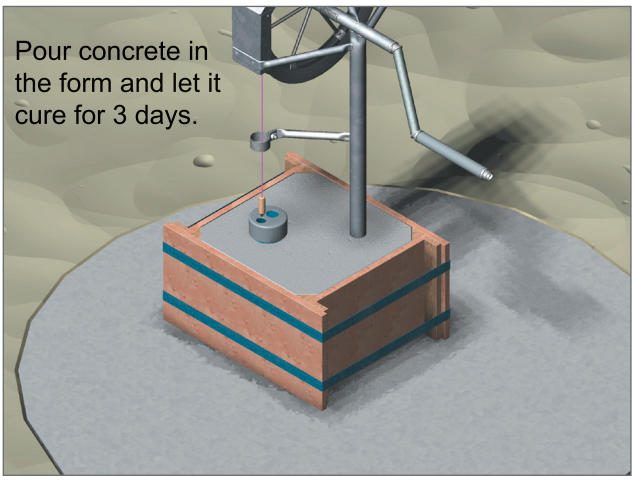
Let the concrete cure for 3 days.

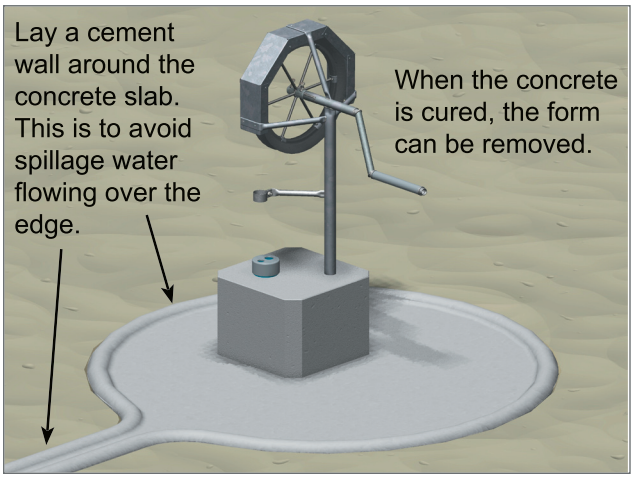
Place the frame and secure it with iron wire to the mesh cage.



*) When the pump is placed waterlevel the plumpbob must go though the pump support center and hangs above the small cover hole.


Place the concrete form over the mesh cage.
77 mm
The well cover must stick out 77 mm above the concrete form.
Hold the planks together with straps.

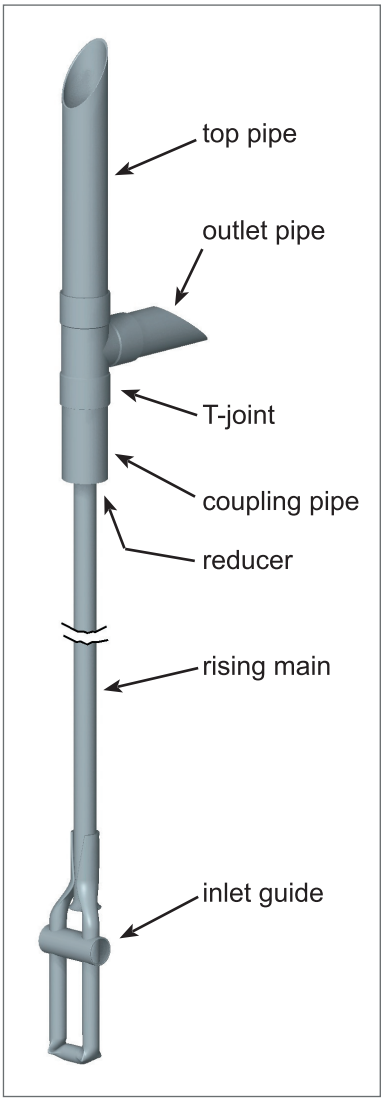

Pour concrete in the form and let it cure for 3 days.


Lay a cement wall around the concrete slab. This is to avoid spillage water flowing over the edge.
When the concrete is cured, the form can be removed.

The pump

(25 mm rising main example)

The pump is the actual part that lifts the water and is located mainly in the borehole or well. It consist of the PVC construction with the rising main, the inlet guide and the outlet construction. And secondary the rope with the pistons.

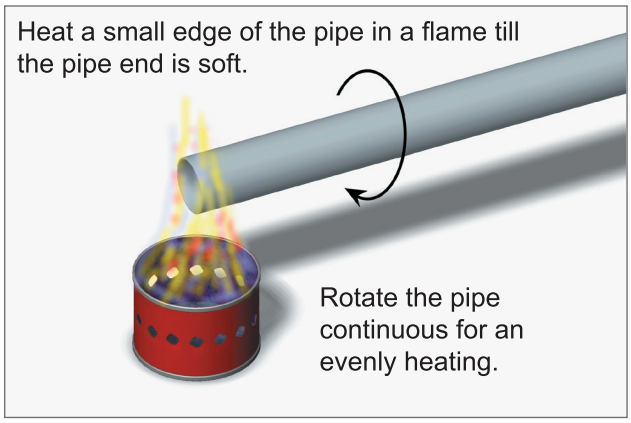


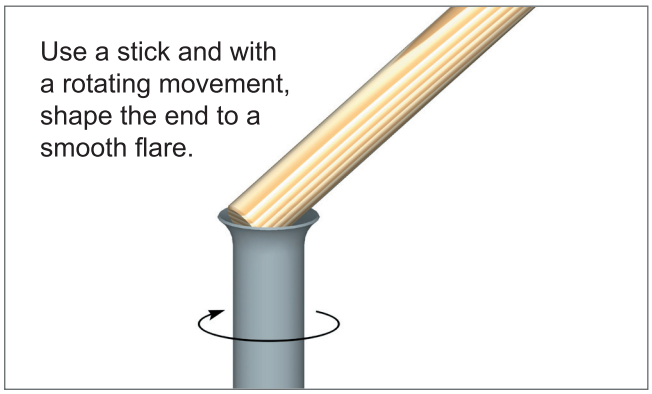
Rising main

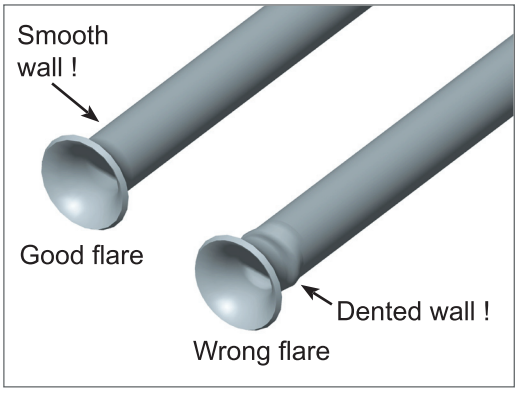
The diameter of the rising main depends of the water lifting height. Choose the tube diameter from the table under section “Pump capacity” on page 4.

Making a flare

The lower end of the rising main must have a flare so the pistons will easely slide in the pipe.

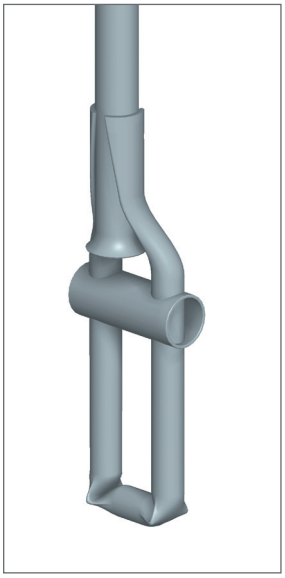






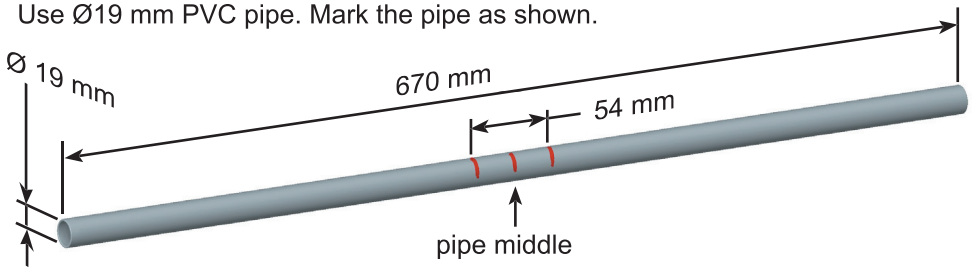
The inlet guide

The inlet guide ensures that the rope with the pistons smoothly enters the rising main. The given dimensions concern only the 25 mm rising main.



The inlet bracket

Use Ø19 mm PVC pipe. Mark the pipe as shown.



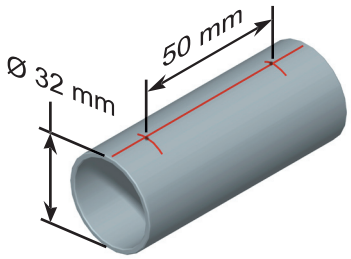
Nod the pipe at the marked places.

Warm the nod places a little bit, but don't soften them!

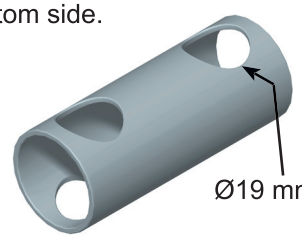
Rope guide

The length of rope guide must fit in the borehole diameter.

The rope guide is made of a Ø32 mm PVC pipe, ca. 80 mm long.

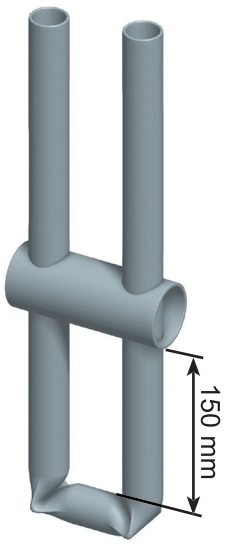


Make two holes at the marked places trough both, the top and bottom side.

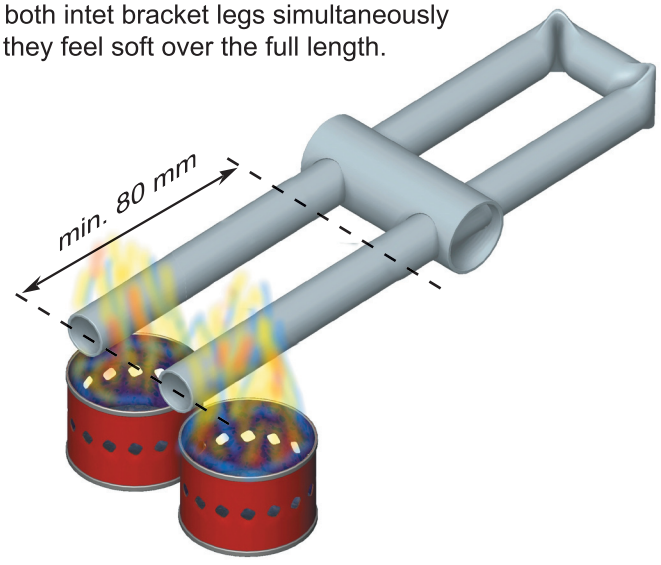


Inlet guide assembly

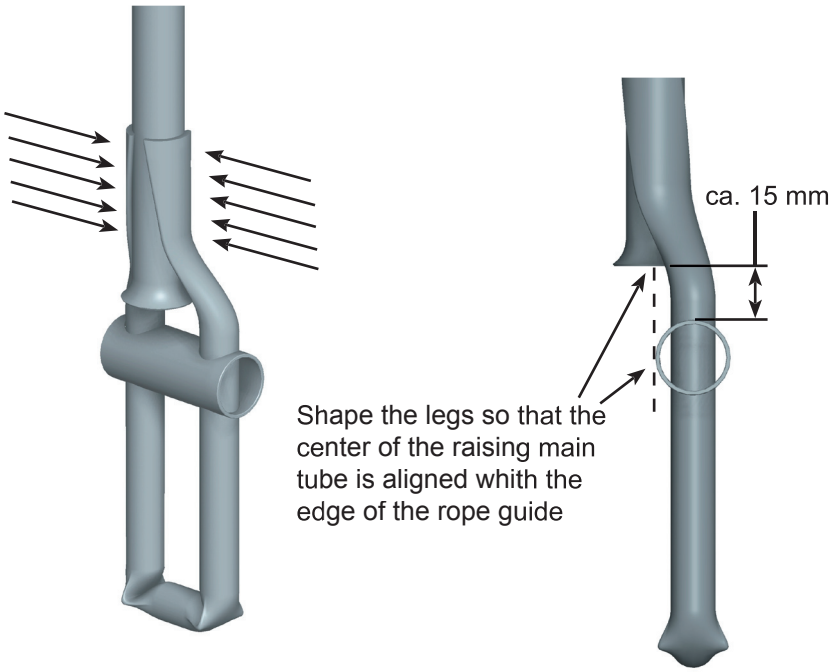
Slide the rope guide over the two inlet bracket legs.



Heat both intet bracket legs simultaneously untill they feel soft over the full length.



While the inlet guide brackets legs are still warm and soft sqeeze them to the flared rising main. Wear gloves for heat protection.

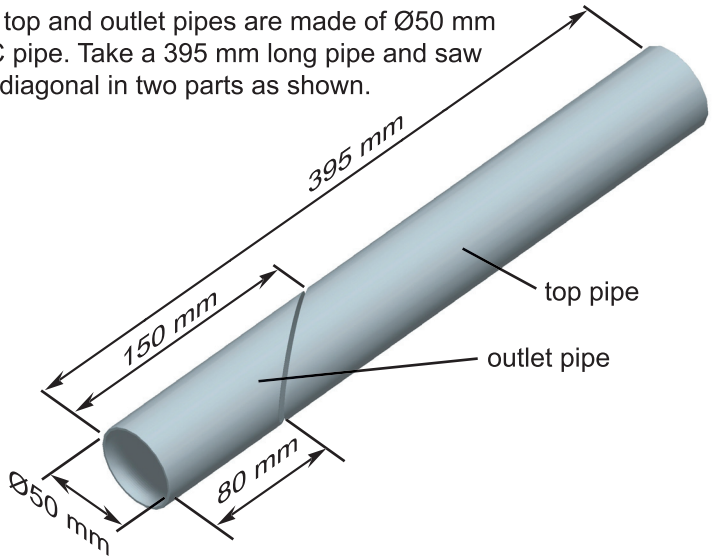


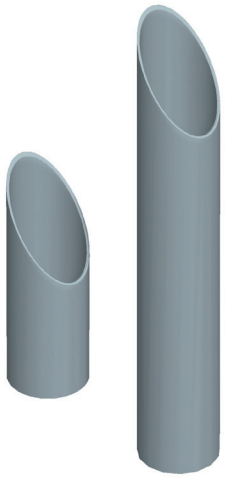
After the shaping of the inlet guide bracket legs, they can be glued to the raising main. Sand the adjoinig faces before.

Wrap rubber strips around the glued parts so there are pressed to each other firmly.

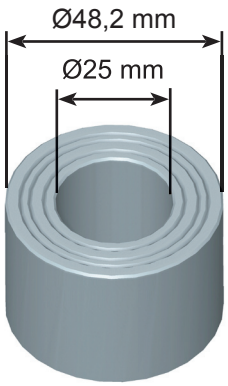
Top and outlet pipes

The top and outlet pipes are made of Ø50 mm PVC pipe. Take a 395 mm long pipe and saw this diagonal in two parts as shown.





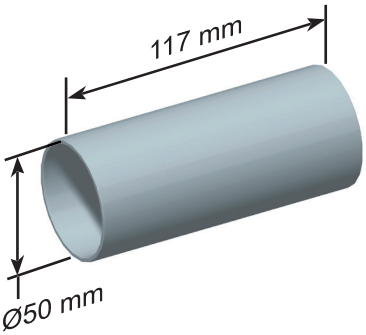
Reduction



To couple the Ø25 mm rising main to the Ø50 mm coupling tube, a reduction is needed. Assemble this from different pipe sizes.

Coupling pipe

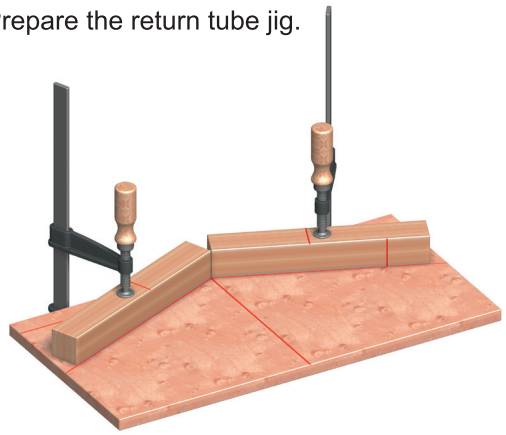
The coupling pipe is made of Ø50 mm, 117 mm long PVC pipe.



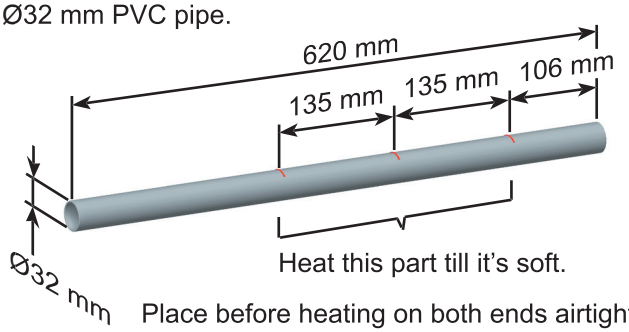
Return tube

The used return tube jig is described on page 33.

Prepare the return tube jig.

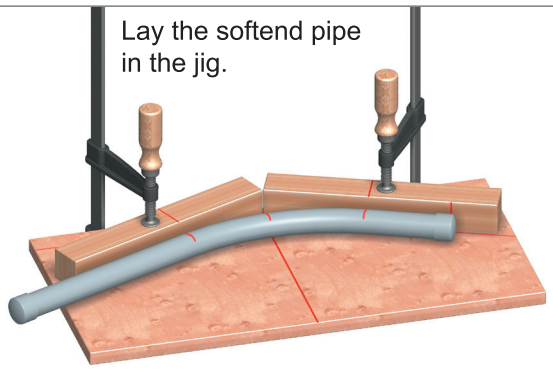


The return tube is made of a 620 mm long Ø32 mm PVC pipe.



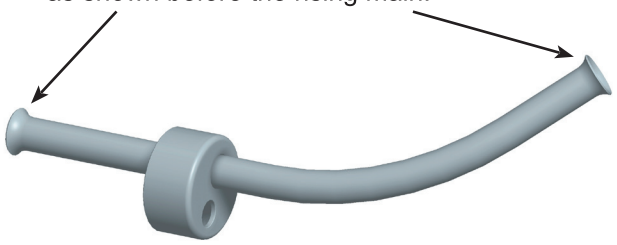
Place before heating on both ends airtight endcaps. The generated inner pressure by heating will prevent buckling of the pipe.

Lay the softend pipe in the jig.

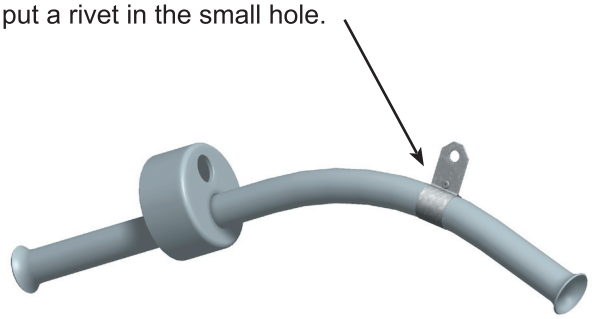


Cool the made bend with water.

Put the return pipe in the biggest hole of the bore hole cover. Now flare both ends as shown before the rising main.



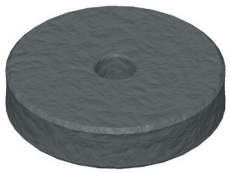
Put the return pipe clamp on the return pipe and put a rivet in the small hole.



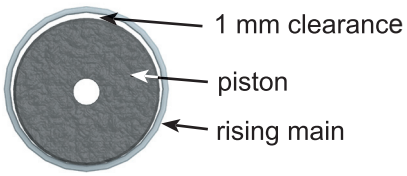
Pump installation

Pistons

The best pistons are the molded HDPE ones. They have the best wear resistance and the best fitting in the main raising pipe. But to make those pistons special equipment is needed. With more basic techniques pistons can be made from the remaining car tire material that is used for making the wheel.



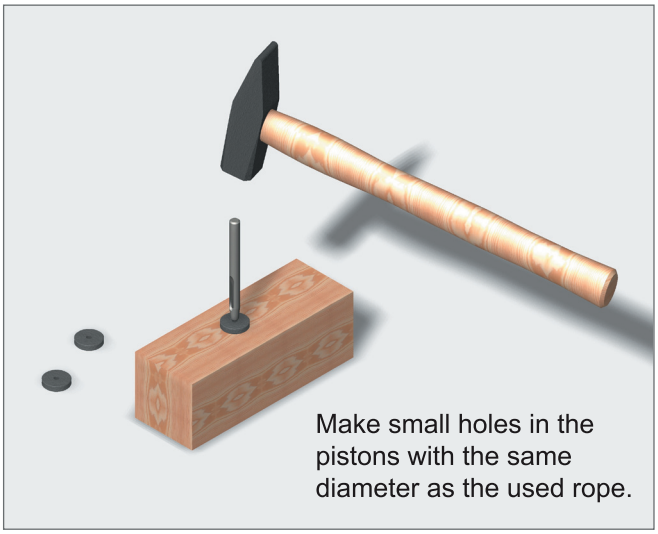
Piston made out car tire



It's important that the pistons can slide easily trough the rising main. Therefore the pistons must have a slightly smaller diameter than the inner diameter of the rising main. A clearance between 0,5 and 1 mm is sufficient.

Take a piece of wood that fits between the tire side walls and put it in between.

With a punch and a heavy hammer pistons are punched out off the tire side wall.



Make small holes in the pistons with the same diameter as the used rope.

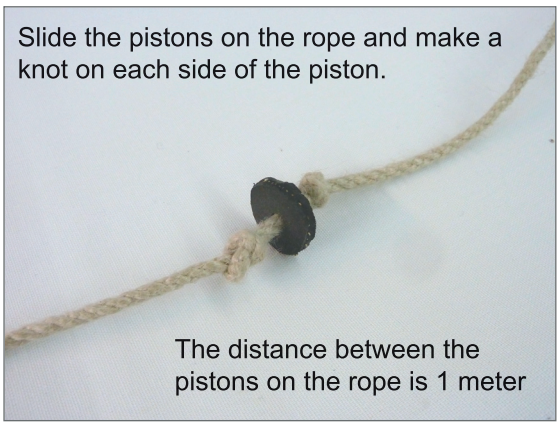
Rope

Use only plastic rope with a diameter of Ø 4 mm. Organic rope will decompose and therefore it won't last long and can pollute the water. The required length of the rope can be calculated as:

rope length [meters] = (well depth + 1) * 2,2

Mounting pistons on the rope

Slide the pistons on the rope and make a knot on each side of the piston.

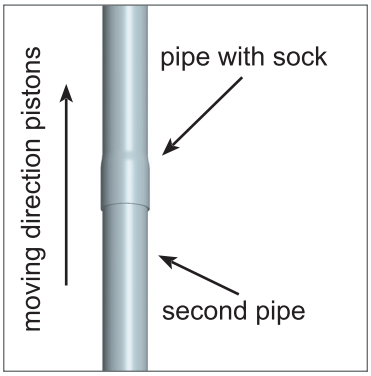


The distance between the pistons on the rope is 1 meter

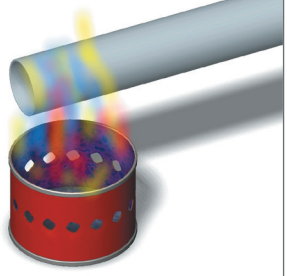
The rising main

The rising main including the inlet block must reach from the bottom of the well till the top of the bore hole casing. To obtain this rising main length, more PVC-pipes must be coupled together. This is done by making a sock on the bottom side of each extending pipe and glue them together.

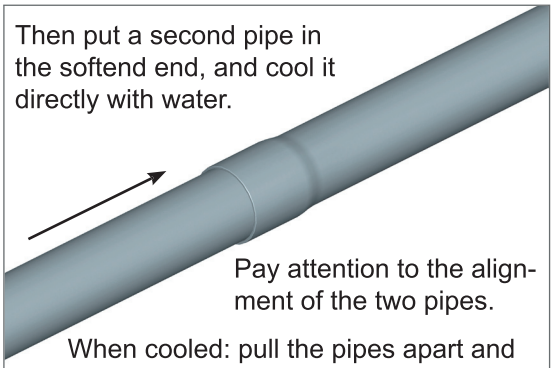
For a smooth sliding of the pistons though the pipes it's importend that the sok is made on the right side of the pipes as shown in the figure right.



To couple two PVC-pipes together gently heat one end till it softens.

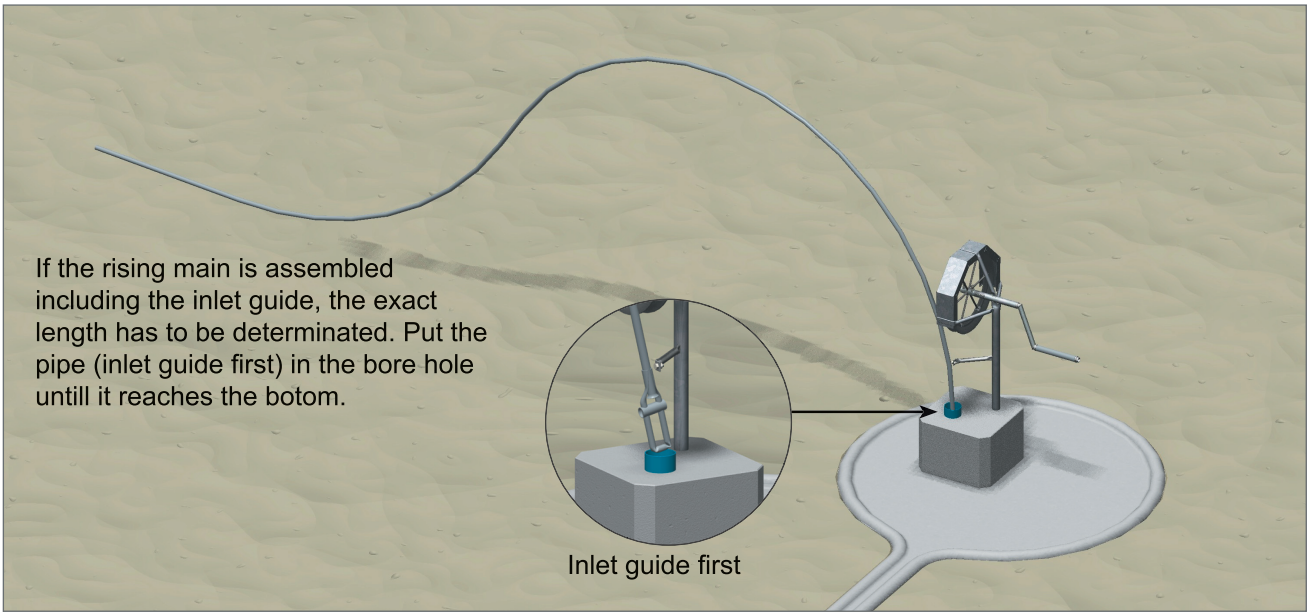


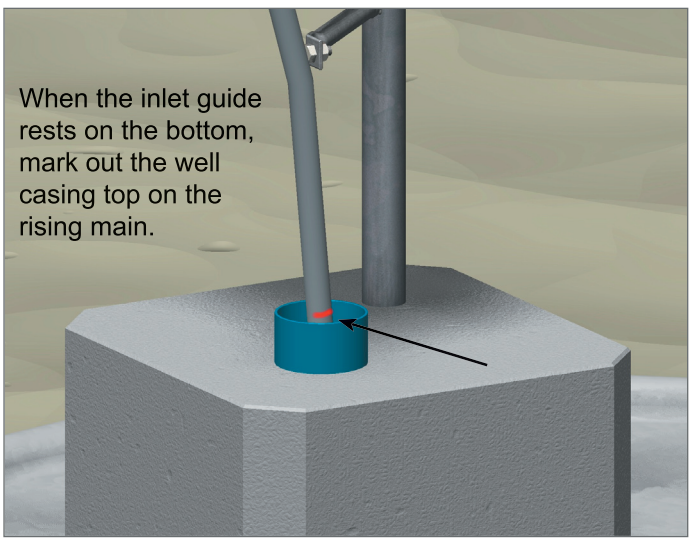
Then put a second pipe in the softend end, and cool it directly with water.



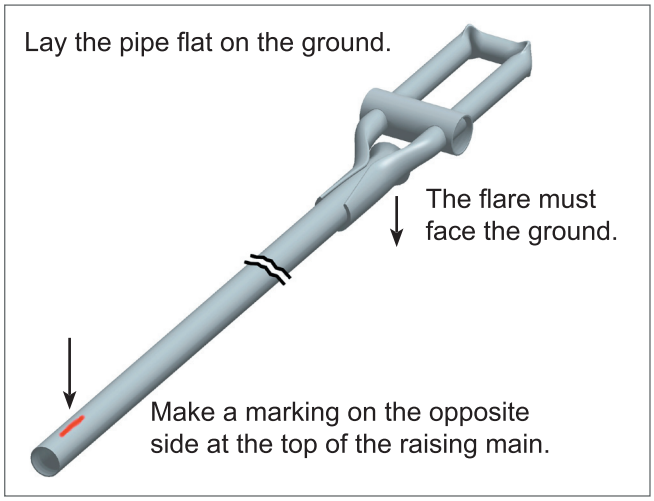
Pay attention to the alignment of the two pipes.

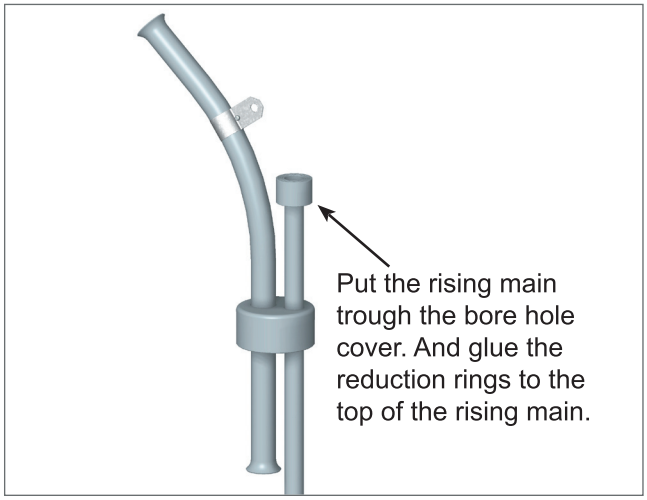
When cooled: pull the pipes apart and dry them. Now glue both pipes together.



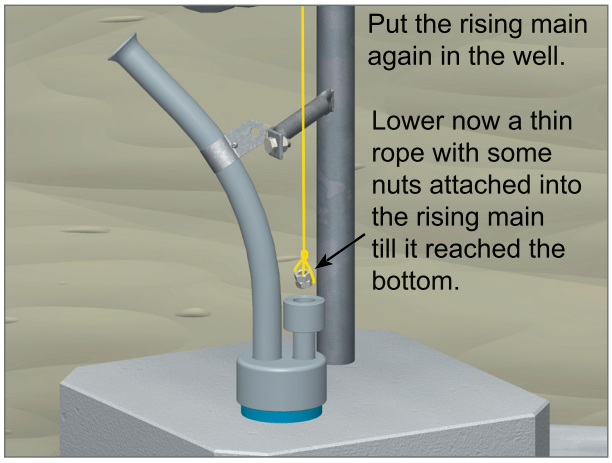


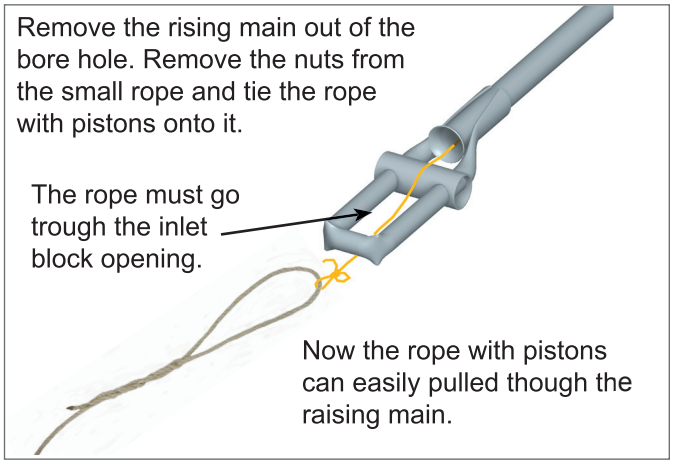
Now remove the rising main out of the bore hole and cut the pipe at the marked place.

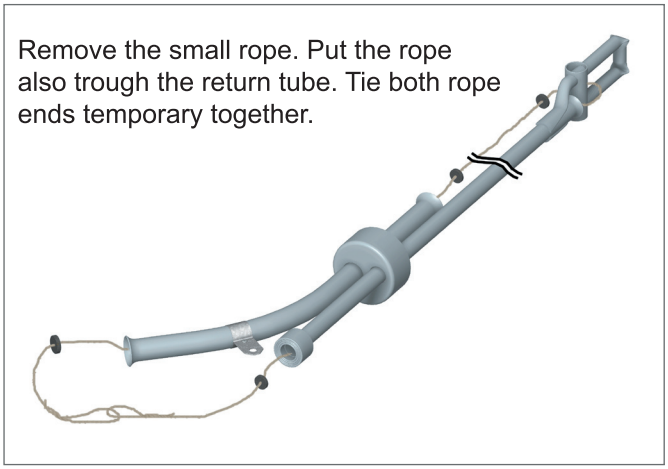


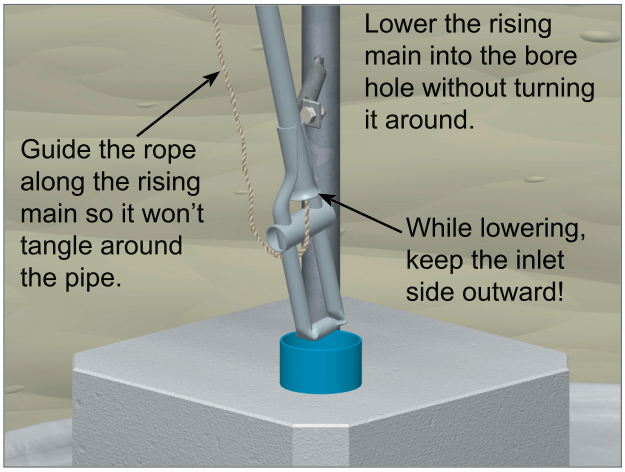


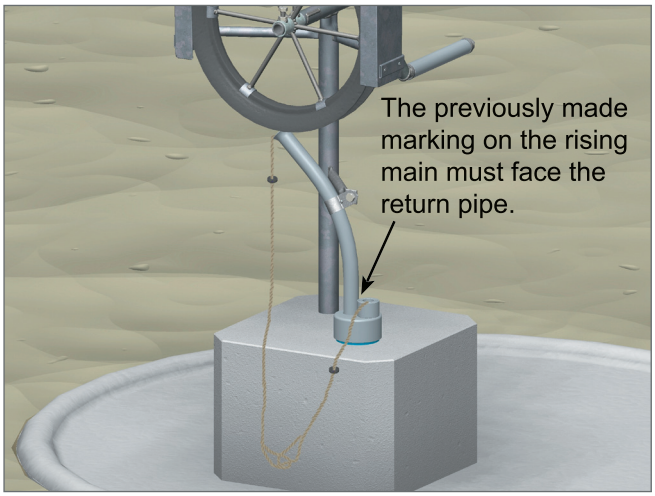
Rope installation

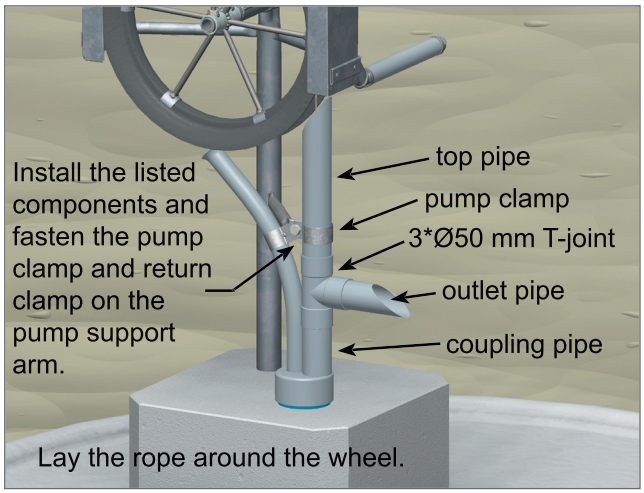






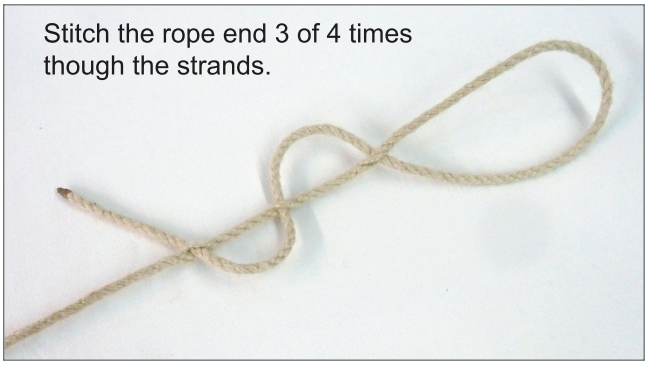


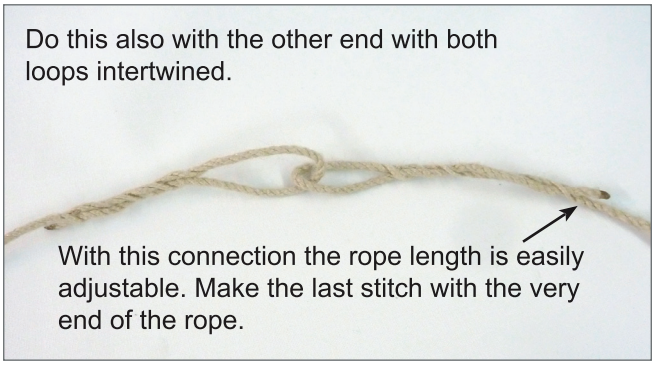




Rope coupling

Both rope ends are connected together with adjusteble loops.





Now adjust the rope length so that there is just a little slack. The photo on the left shows the right amound of slag.

Maintenance

For a long lifetime of the pump a regular maintenance is essential.

Lubricate the bearing every two weeks with a few drips of oil.

Check the faultless working of the braking mechanism. If necessary take the handle out of the bearing an clean the bearing inside, handle and locking needle.

When signs of wear on the rope appear: Check the strength of the rope and replace it when it’s too weak.

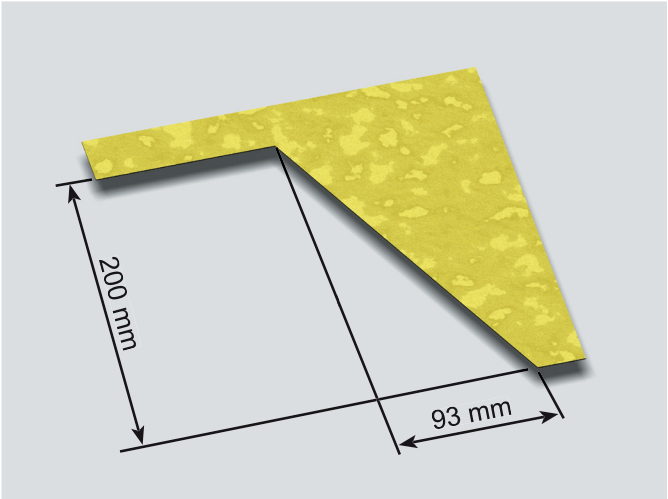
Jigs

However it is possible to make the pump whitout jigs, the use of jigs are recommendated for maintainig the right dimensions and to ease the building of the pump. This chapter discribes the necessary jigs.

Cover bracket bend jig

The cover bend jig is used for checking the bend angle from the horizontal and vertical cover brackets.

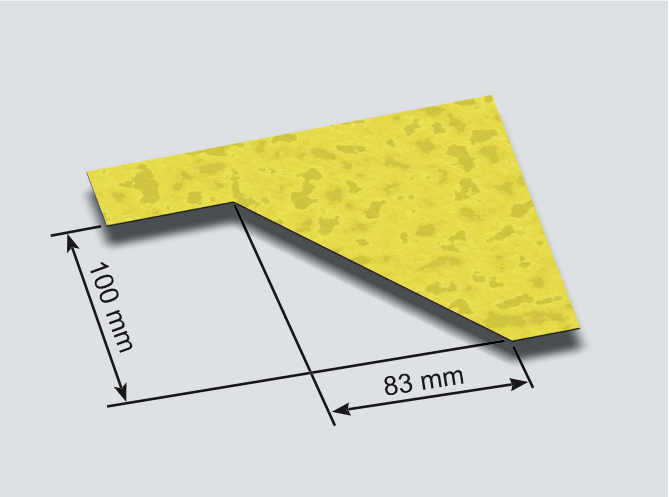
This jig can be made from (galvanised) sheet metal.



Pump support bend jig

The pump support bend jig will be used for checking the bend angle from the mounting lip and support arm.

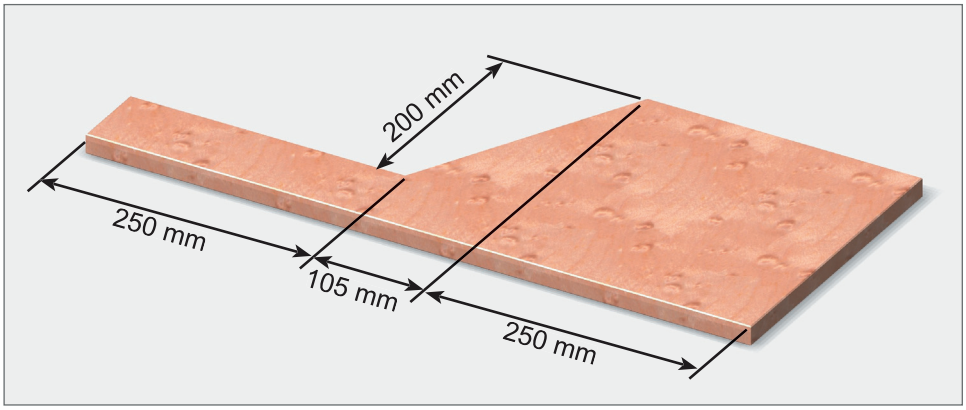
This jig is also made from (galvanised) sheet metal.



Handle jig

The handle jig is used for aligning the three handle pipes when they are welded.

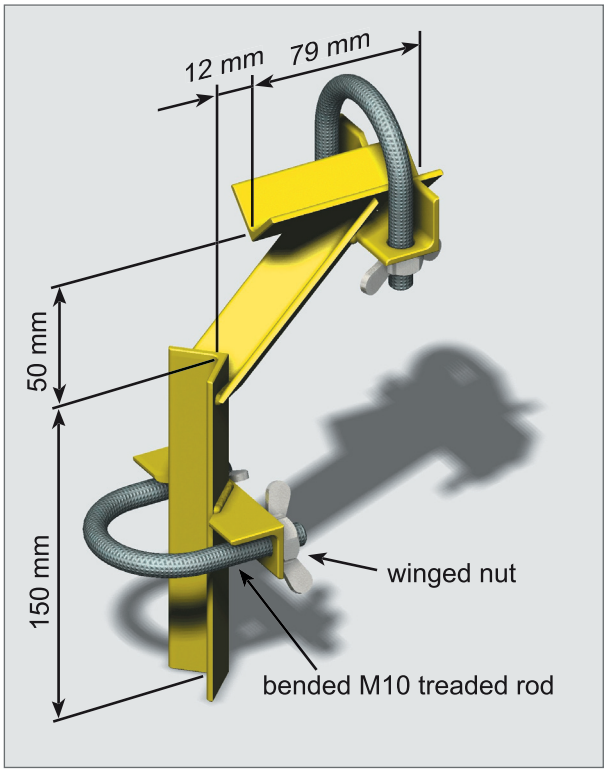
This jig is made from 18 mm plywood, ca. 605 mm * 270 mm.



Frame angle jig

The frame angle jig is used as a welding jig to place the bearing bush and pump support arm perpendicular on the frame pole.

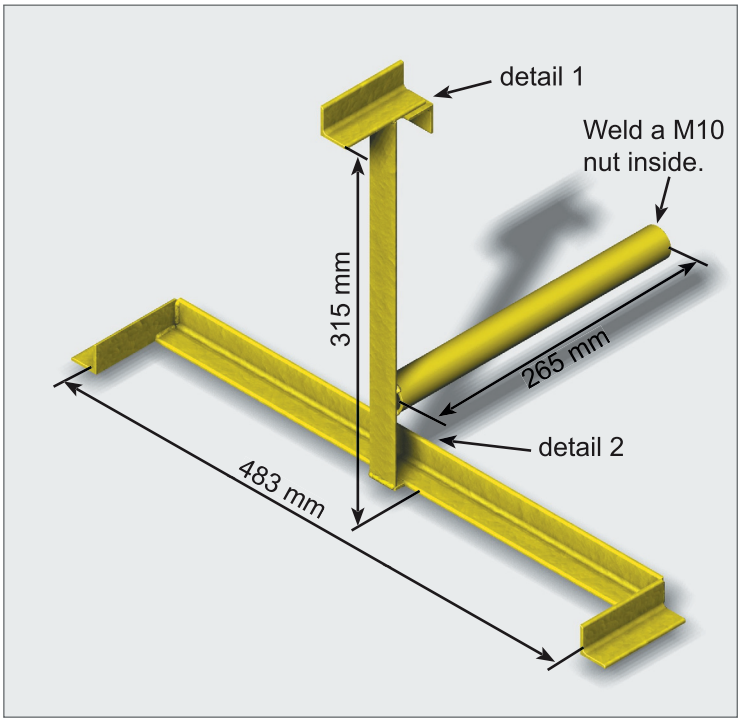
There are 5 pieces angle iron 25*25*3 used. For details see the drawing PTP2011/m3.

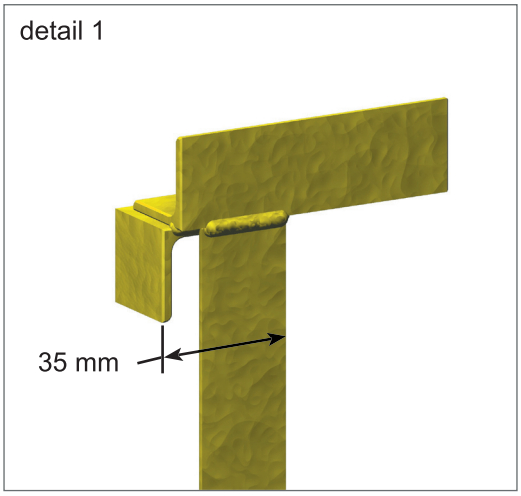


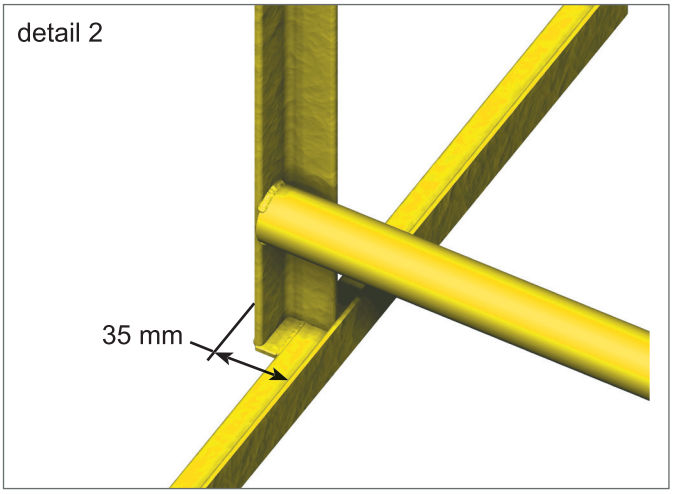
Cover bracket jig

To fixate the two horizontal and the vertical cover brackets for welding, the cover bracket jig is used.

The frame is made from 6 pieces angle iron 25*25*3 and a 3/4” pipe. The jig is drawn in more detail in drawing PTP2011/m4

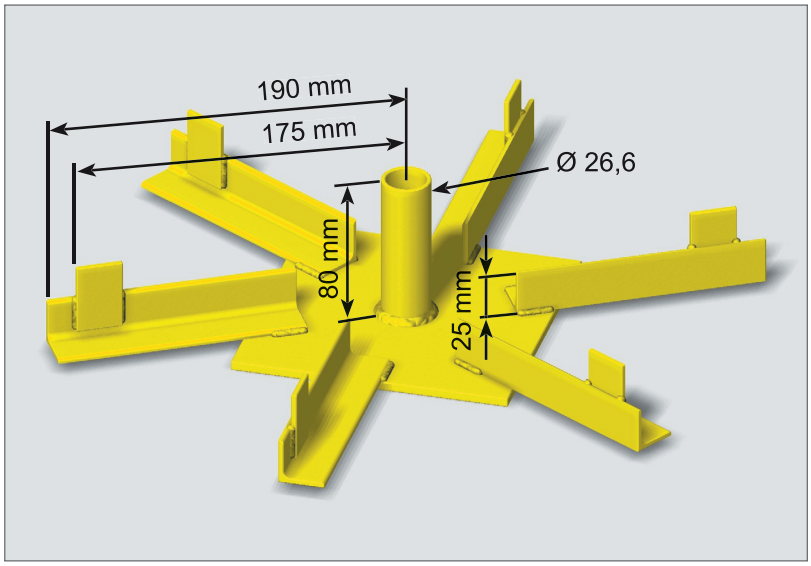






Wheel welding jig

The wheel welding jig is fixates and aligns the tire parts, the hub and the spokes. With this jig the parts can be welded together with ease.



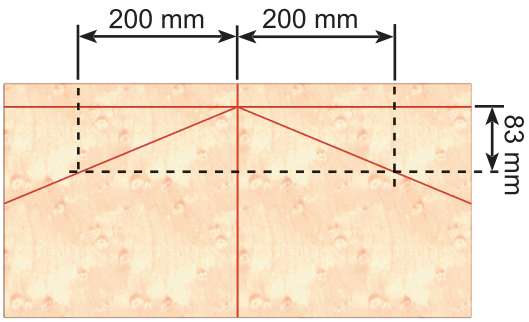
The base of the jig is a steel base plate ca 150 mm * 150 mm with a 3/4” pipe welded in the center. The six angle irons 25*25*3 are welded on the base plate evently spreded with a mutual angle of 60°. To hold the tire parts a small strip is welded on each angle iron. Details of this jig can be found in drawing PTP2011/m1.

Return tube jig

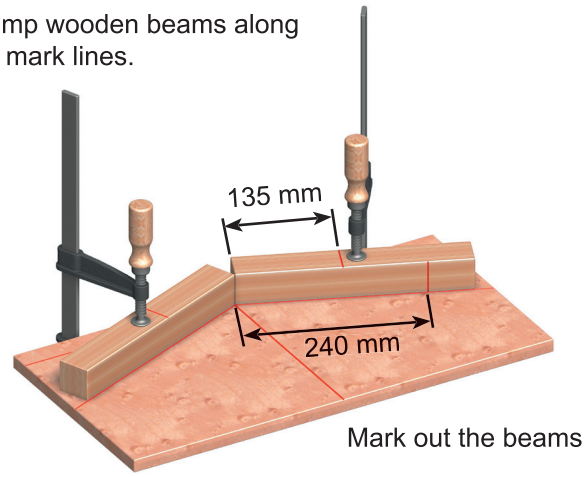
The pump return tube has to be bent under a specific angle of 134°. To ease the bending a jig is used.

This jig can be made of a ca. 300 mm * 600 mm, 18 mm thick plywood plate. Mark out the bord as shown. Clamp or nail two wooden beams on the bord aligned with the drawn lines.

Take a ca 600 mm * 300 mm big wooden bord. And mark this out as shown.



Clamp wooden beams along the mark lines.



Mark out the beams

Errata

To improve the given design the following instructions must be applied.

Orientation pump

page 21

Rotate the complete pump 180º with respect to the concrete slab so that the outlet pipe faces the opposite site of the waste water drainage. This is will improve the self cleaning of the concrete floor.

Concrete block

page 22

Apply a gentle slope on the top of the concrete block that anchored the pump frame. This prevents that water remains on the block. Also camfer the top edges.

Pump clamp

page 20

Make the pump clamp with thicker material, 3 mm instead of 0.7 mm sheet. The pump outlet is then less sensitive for bending out of alignment.