ATC TREADLE PUMP INSTRUCTION MANUAL

Drawings and Specifications

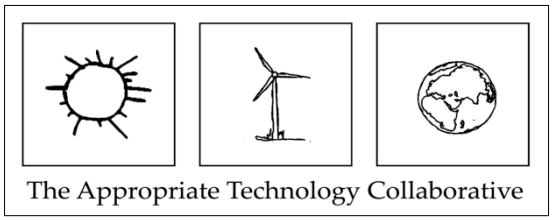


Table of Contents

Pump Assembly

Valve Box

Parts Needed

Part Number	Quantity	Picture	Name	Description (cm)
1	2		Sheet Steel	30.5x30.5x0.3 L x W x H
2	2		Flat Steel Bar Stock	30.5x3x0.6 L x W x H
3	2		Hose Fittings	1.5875 to 1.25 Diameter
4	2		Electrical Conduit Nut	1.25 Diameter
5	2		Garden Hose Seals	1.5875 Diameter

6	1		PTFE Tape or Plumbers Tape	1 Roll Any Size
7	4		Shoulder Bolts	7.62 x 1.25 x 0.9525 L x Thread Length x Diameter
8	4		Flat Washer	5 x 0.9525 OD x ID
9	2		Compression spring	Uncompressed Length: 4.13 Compressed Length: 2.54 Thickness of spring: 0.105 Inner Diameter: 1.11 Number of coils: 13

10	2		Compression spring	Uncompressed Length: 2.86 Compressed Length: 0.635 Thickness of spring: 0.055 Inner Diameter: 1.11 Number of coils: 8
11	1		Rubber sheet	10 x 10 x 0.3175 L x W x H
12	4		Nylock Nut	0.9525 Diameter
13	2		Angle Iron	5x5x.635 L x H x W

Manufacturing Steps

1. Begin by cutting the sheet metal squares into their respective sizes. This should be done using a large sheet metal shear press when possible for best results. If a shear is not available then and band saw or jig saw could be used as alternatives.

Figure 1. Shear Press

Figure 2. Band Saw

2. Take one of the 30.5cm x 30.5cm sheet metal pieces and mark it using a marker into two pieces each 15.25cm x 30.5cm using a square or straight edge. Then make a cut down this centerline using one of the methods discussed above. These will be on the top and bottom of the valve box

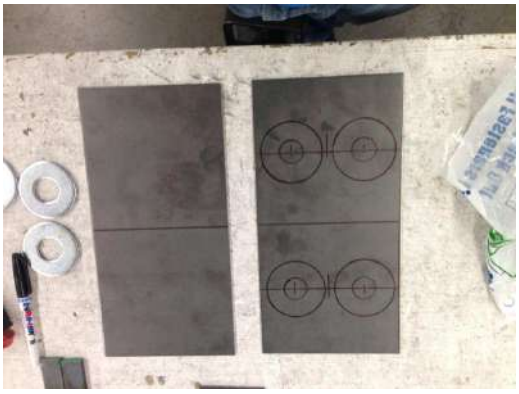


Figure 3. Sheet metal piece cut in half

3. Take the remaining piece of sheet metal and using the square or straight edge make 3 vertical lines on the sheet metal evenly spaced by 7.625cm. Then using a straight

edge mark one of the columns in half at a distance of 15.25cm. You can see this pictured below. This will make up the sides, center wall, and ends of the valve box.

Figure 4. Sheet metals for sides and ends

4. Next the three long pieces of sheet metal need to be trimmed to accommodate for the thickness of the ends during assembly. Each of the three long pieces need twice the thickness of the sheet metal trimmed off of them, approximately 0.61cm if using the recommended thickness from this report.

5. In addition to the sheet metal lengths the flat bar stock pieces need to be trimmed the same amount, twice the thickness of the sheet metal or 0.61cm. For the sheet metal it can be trimmed most accurately in a shear press if it is available. For the flat bar stock it needs to be trimmed on a band saw or drop saw.

Figure 6. Drop saw used for cutting flat bar stock

6. Use the template included printed to scale; with this all of the holes that need to be drilled into the top plate of the valve box can be drilled. Tape the long edge of the template flush to the long edge of the valve box. Tape the shorter end of the template flush with the left edge of the plate if you are looking down at the plate.

7. Using a punch and a hammer transfer all of the holes from the template onto the plate that will be used as the top of the valve box. The finished hole pattern is shown in the figure below

Figure 7. Finished hole pattern after being drilled

8. All (4) of the center holes will be a 10mm drill bit along with the 12 holes at the top half of the hole pattern designated for the outtake valves. The 10 holes at the bottom of the screen for intake valves are drilled using a 12mm bit. These holes should be drilled on a drill press when possible if not a hand drill will work if the sheet steel is clamped firmly to the workbench.

9. The next holes to be drilled are for the garden hose fittings. These will go in each of the ends of the valve box and should be on opposite sides from one another. An example of this can be seen in the figure below.

Figure 8. Garden hose fittings

10. The fitting should be installed centered (3.8cm from the left edge) in the chamber it is leading to and slightly above (1.9cm from the top of the valve box) where the flat bar stock is to be installed. The hole for this fitting should be drilled using a 13mm drill bit.

11. Now that the raw material is all cut to size and all of the holes have been drilled to this point the welding can begin. Using a metal inert gas welder (MIG), or whatever kind of welding is available begin with the top of the valve box and one end of the valve box.

12. Place a water tight weld along the inside edge of the two pieces of sheet metal as illustrated by the red line in the figure below. The end of the valve box should sit inside the edge of the top of the valve box in order for the other pieces to fit together

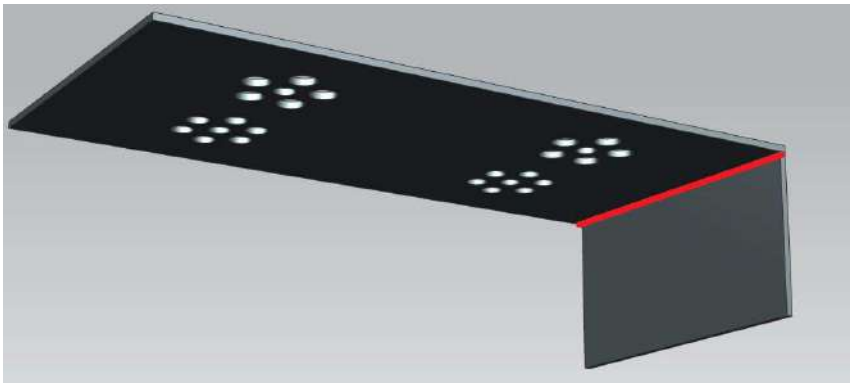


Figure 9. One Side and top of valve box welded together

13. Next place the chamber wall in the center of the top plate of the valve box and perpendicular to the end of the valve box. Then make a water-tight welded along the red lines shown in the figure below. It is important that pieces are clamped together and welded as square as possible in order to insure a good fit. Also weld the same intersections on the opposite side of the valve box.

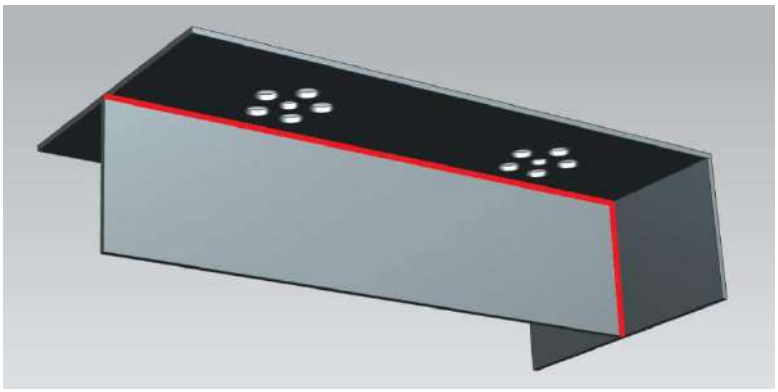


Figure 10. Top, end, and chamber sections of valve box

14. The second end piece will be welded on next; it is shown in the following picture. Make sure the same weld is also made on the opposite side and that all welds are water-tight.

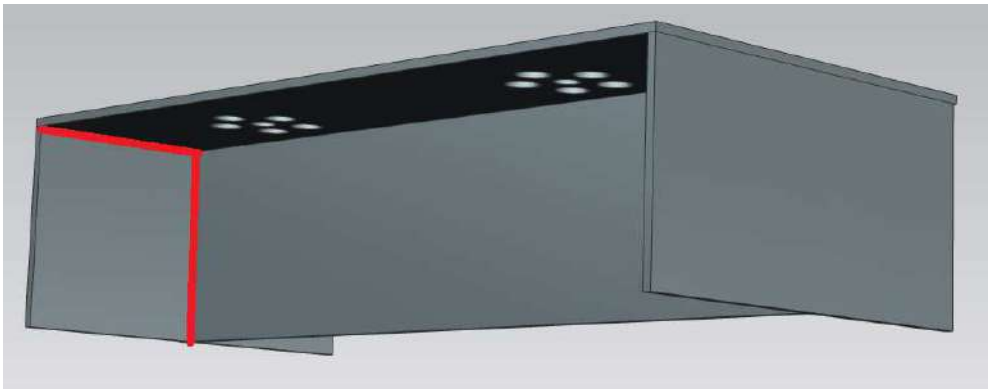


Figure 11. Second end section of the valve box

15. The next part that needs to be welded to the valve box is the bottom. It can be seen in the picture below the highlighted red areas need to be welded in both sides of the valve box

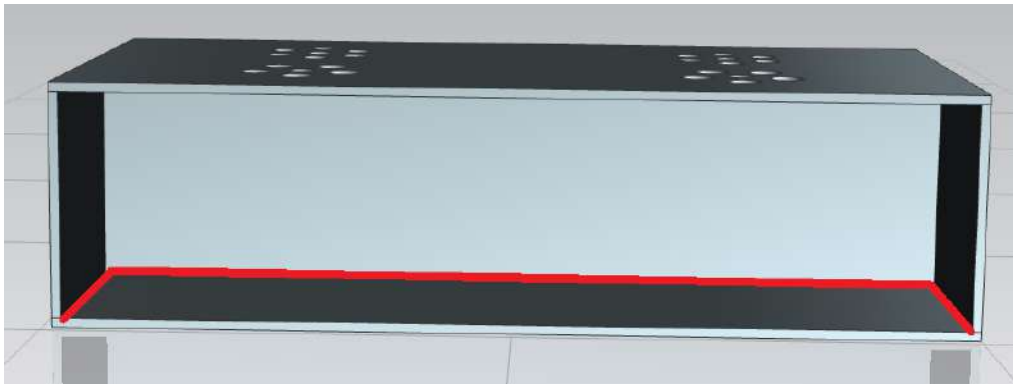


Figure 12. Bottom section of valve box

16. Following the bottom section is the flat steel bar stock. These are welded in to each water chamber so that there are centered top to bottom and left to right in each chamber. 3.8cm from the left side as the ends is facing you, and 3.8 cm down from the top as the end is facing you. Make sure these are welded on both sides in both chambers all the way around.

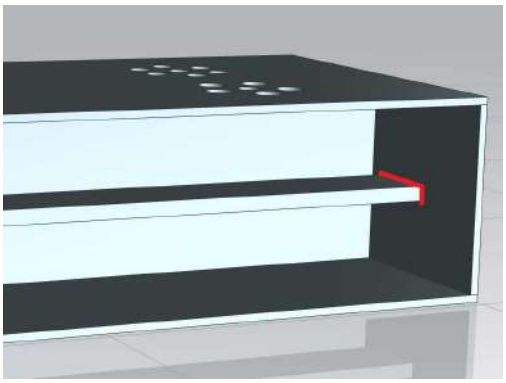


Figure 13. Flat bar stock welded into the valve box

17. Two through holes 10mm diameter must be drilled in the flat steel bar stock using the four center holes in the top of the valve box as guides to keep the two holes square to each other. The shoulder bolts for the check valves must pass through these holes without binding. An illustration of this is shown in the next figure.

Figure 14. Intake valves installed

18. After drilling the four holes in the bar stock use the 5cm washers as stencils to cut out four thin rubber seals from the piece of thin rubber. Use the shoulder bolt to place a hole in the center of the thin rubber by pushing it through by hand.

19. In order to create the inlet spring loaded check valves insert the shoulder bolt first through the washer, then through a single thin rubber seal. Take this assembly and push it through the center hole surrounded by the five 12mm holes and also through the holes in the flat steel bar stock. Once the bottom of the shoulder bolt is through the bar stock put the spring detailed as part 10 in parts list above on the shoulder bolt followed by the nylock nut. The inlet check valves are now installed.

Figure 15. Outtake valves installed

20. To install the outtake valves place the shoulder bolts through the top of the valve box in the two remaining center holes. When the bolts are through the top of the box but not yet through the bar stock place the thin rubber seals on the bolts and follow them with the washers and the remaining springs. Now push the shoulder bolt through the flat steel bar stock and attach the nylock nut on the bottom of the shoulder bolt. The outtake valves are now installed and can be seen in the image above.

21. The final internal component of the valve box is the garden hose fittings. Place the garden hose seals around the 1.25cm diameter side of the fitting. Stick the 1.25cm diameter end into the pre-drilled hole so that the seal sits flush with the outside of the valve box. Now thread the electrical conduit nut onto the back of the garden hose fitting as shown below. Also pictured below is a profile view of how the garden hose fitting should look once installed

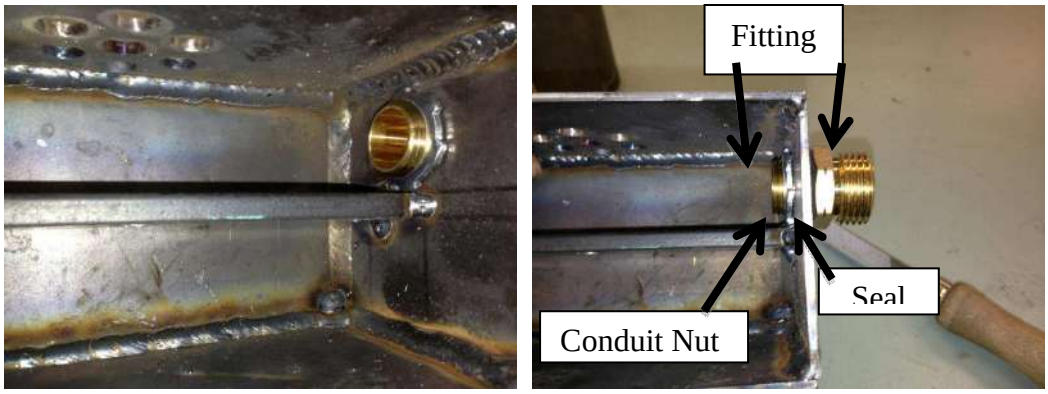


Figure 16. Garden hose fittings installation

22. The next step is to weld the box closed by adding the two sides to the box and welding in the areas indicated below by red lines. This should be done using a minimal heat with the welder because there are so many rubber pieces touching the metal valve box that overheating them could cause them to melt.

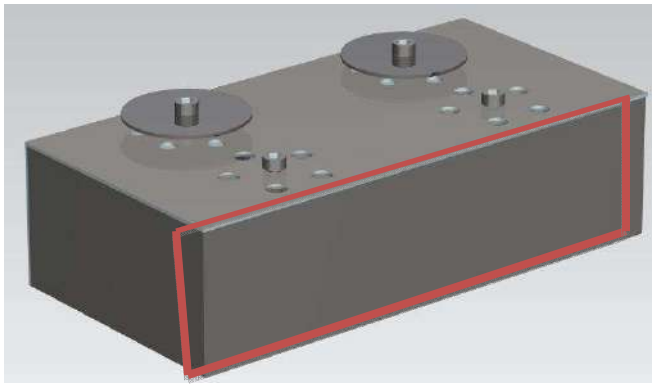


Figure 17. Sealed Valve Box

23. Finally the angle iron pieces must be added to one side of the valve box so that it can be mounted to a frame.

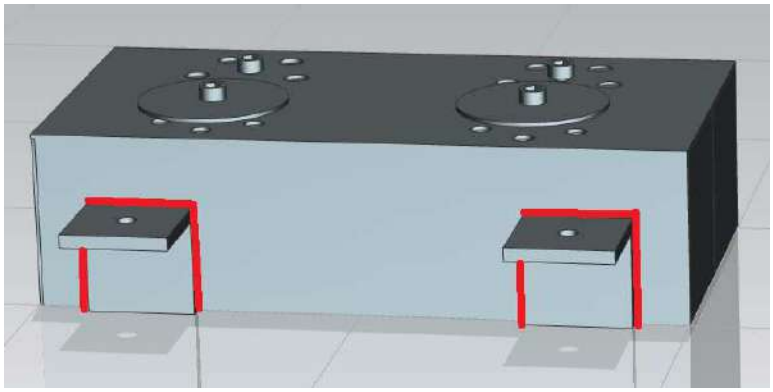


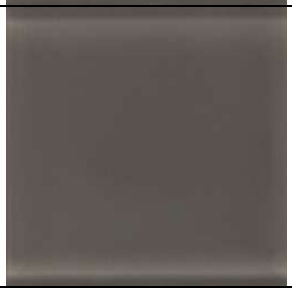
Figure 18. Valve box with mounting angles installed

24. These angles are welded to the valve box where the red lines show. The angles are described in the parts list and are 5cm wide. The flange without a hole in it must be cut by 1.25cm to sit flush with the frame design mentioned in this manual. Other frame designs may require a different size and mounting position. They are 2.5cm in from each side and the bottom part of the angle sits flush with the bottom of the valve box.

25. PTFE tape can now be placed on the threads of the garden hose fittings to help prevent leaks when a pressurized hose is attached to the inlet and outlet fittings.

Cylinders

Parts Needed

Part Number	Quantity	Picture	Name	Description (cm)
14	2		Sheet Steel	16.5x76.34x0.3 L x W x H
15	1		Sheet steel	8x3x0.3 L x W x H

OR

Part Number	Quantity	Picture	Name	Description (cm)
16	2		Sheet Pipe	13 x16.5 OD x H
17	1		Steel U-Channel	3x3x2.5 L x W x H

Manufacturing Steps

1. The cylinders are made using a metal inert gas welder and a steel press roller. A picture of a MIG welder was shown in a previous section, but a steel press roller is shown for the first time below

Figure 19. Sheet Press Roller

2. Take one piece of the sheet steel at a time and feed it through the manual roller until the sheet can be welded into a cylinder with an inner diameter of exactly 12.15cm. This is *one of the most important steps* to creating functional pump housing. If the inner diameter is not exactly round with a radius of 12.15cm the seals and pistons will not function to their full capacity.

3. Another option for manufacturing the cylinders is available if a lathe and the proper tooling are available for the lathe. A boring bar and a lathe can be used to bore out a 13cm outer diameter steel pipe down to the proper inner diameter. This process is pictured below. While machining is often timely and expensive it yields better results.

Figure 20. Use of a lather to bore out a steel pipe for cylinders

4. After both cylinders are manufactured using one of the two process they can then be centered over the valves on top of the valve box so that they can be marked up to have a U-channel cut into them that is 2.5 cm deep by 3.0 cm wide and 3.0 cm long.

5. This U-channel can be bent to shape on a sheet metal bender or a similar sized u-channel can be purchased when available

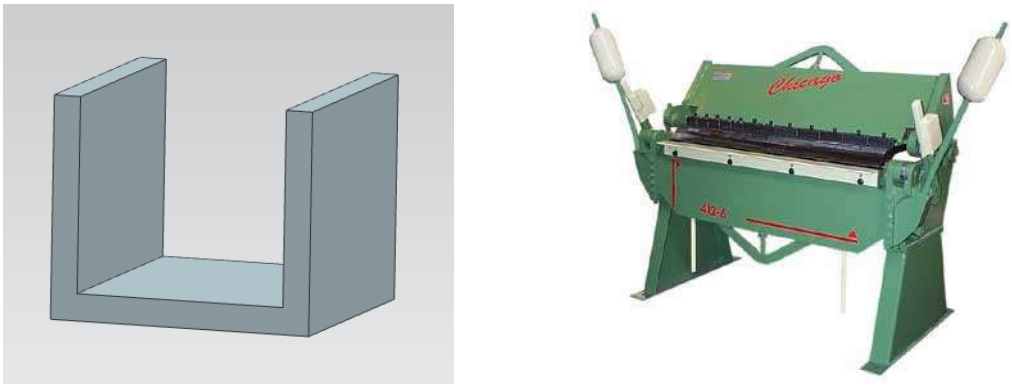


Figure x. U-Channel and sheet metal bender

6. Once the U-channel is constructed or purchased and the cylinders are manufactured the U-channel can be set on top of the cylinders while they are in position on top of the valve box. This can be used to mark where the U-channel will be cut into the individual cylinders. This is shown in the figure below.

Figure 21. Cylinder with U-channel cut out of it

7. This channel can be cut using a pneumatic or electric cut-off wheel, plasma cutter, or even a hack saw whichever is easiest and most readily available.

Figure 22. Cut-off wheel and plasma cutter

8. Next weld one of the cylinders to the valve box as shown in the image below with the U-channel cut out facing towards where the other cylinder will go.

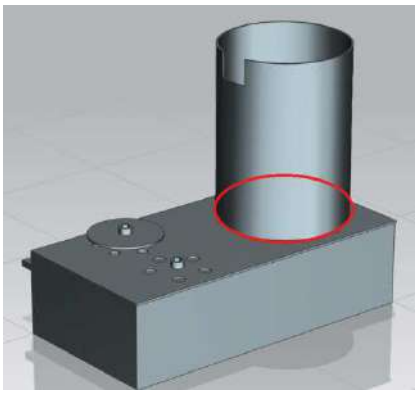


Figure 32. Valve box with one cylinder

9. Now weld the U-channel into the first cylinder **(DO NOT overlap into the cylinder! If sharp corners from the U-channel overlap into the cylinder, they could damage the seals.)** Figure 24 shows where to weld the U-Channel to the cylinder.

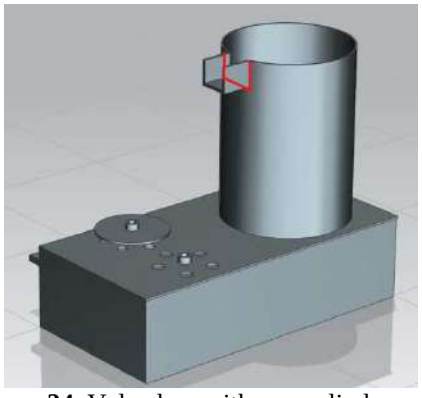


Figure 24. Valve box with one cylinder and U-channel

10. The final step is to weld the second cylinder to the valve box and the U-Channel exactly like the first cylinder, it is shown again here in the image below.

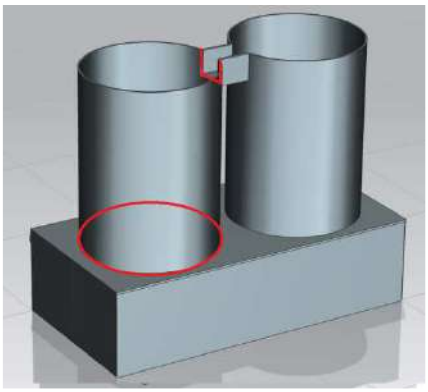


Figure 25. Last welding on valve box and cylinders

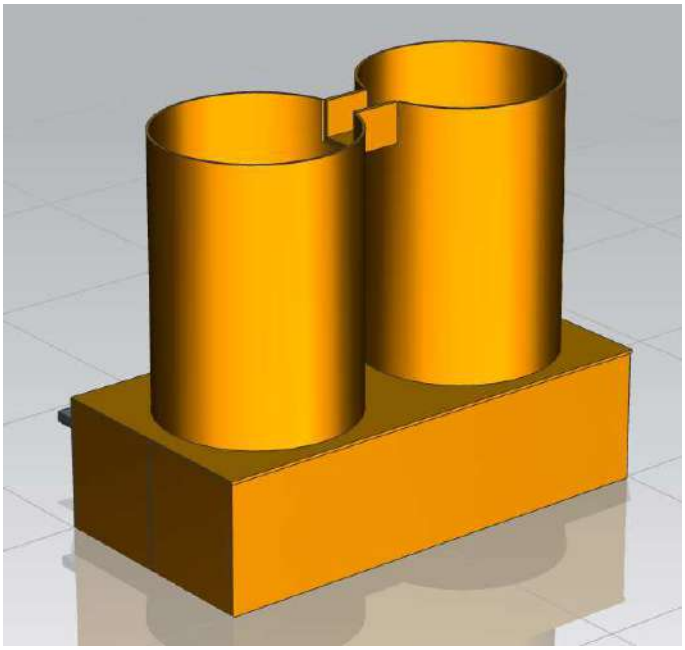
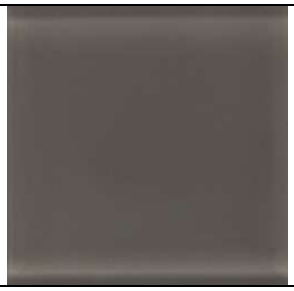


Figure 26. Final Valve Box and Cylinders

Pistons

Parts Needed

Part Number	Quantity	Picture	Name	Description (cm)
18	1		Flat Steel Bar-Stock	75x30x0.6 L x W x H
19	1		Steel Round-Stock	125x0.6 L x Diameter
20	1		Rubber Sheet*	5x5x.3175 L x W x H
21	4		M3.5 Nut	---

22	4		M3.5 Bolt	.6x.35 L x Diameter
23	4		M3.5 Flat Washer	---
24	2		Sheet Steel	13x13x.30 L x W x H

*Bike Tire Tube could be substituted for this item

Manufacturing Steps

Circular Plates

1. Take the 2 Sheet Steel pieces (#24) and measure out a circle 11.5 cm in diameter on each. This can be done using a compass. Set the compass distance to half of the diameter and rotate it about a center point.

Figure 27. Compass

2. Rough cut each piece around the circle shape. This can be done with a shear, a band saw, or a hacksaw. Upon completion of this step, the sheet steel pieces should look like Figure 28.

Figure 28. Left to Right: Manual Shear, bandsaw, hacksaw

Figure 29. Rough Cut Circles

3. Take the rough-cut circles and use a sander to achieve the desired circular shape. A dremel or file could also be used for this operation. After this step is over, the circular plates should look like Figure 30.

Figure 30. Left to Right: Sander, Dremel, File

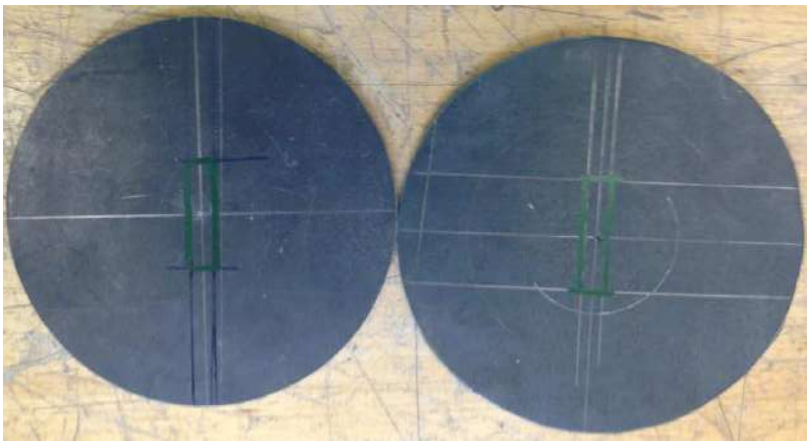


Figure 31. Finished Circular Plates

4. Finally, the edges of the circular plates should be smoothed out using a file. Figure 32 shows edge of the plates before and after filing.

Figure 32. Left side is rough before filing. Right side is smooth after filing.

5. Drill three holes in each circular plate 3.5 mm in diameter.

Piston Shaft

1. Cut the flat steel bar-stock (#18) into the following lengths:

    - Length 1: Two 136 mm pieces
    - Length 2: Two 50 mm pieces
    - Length 3: Two 116 mm pieces
    - Length 4: Two 40 mm pieces

    Figure 33 below shows one set of lengths.

Figure 33. Piston shaft components for 1 piston

Securing Rod

1. Begin with steel round stock (#19) and cut into four 30 cm long pieces.

2. Take each piece and bend it into an “S” shape pictured in Figure 34. The primary bends should be at 9 cm in and 18 cm in, both at 45 degrees. The secondary bends should be made to bring the end legs to 5 cm in length. Trim and file as necessary.

Figure 34. Bent Securing Rod

3. The finished securing rods should be able to fit, centered, on a piston plate with room on all sides.

Figure 35. Positioning of securing rod on circular plate

Piston Assembly

The securing rods, circular plates, and piston shaft pieces are now ready to be assembled. This assembly will be accomplished though welding. The following details the process of welding one piston. The process is identical for both pistons.

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Side 1

1. Weld Length 1 to the absolute center of the circular plate so that it stands vertically.
2. On one of the .6 cm sides, weld Length 2 vertically, leaving 10 cm exposed above.
3. On the opposite side of Length 1, weld Length 3 Vertically, leaving 70 cm exposed.
4. Leaving a 6 mm gap beneath it, weld the securing rod to the long face of Length 1, centering it relative to the circular plate.

Figure 36. Welded Side 1

Side 2

1. Take Length 4 and weld to the center of the plate.
2. Weld the Securing rod on top of Length 4, centering it relative to the circular plate.

Figure 37. Welded Side 2

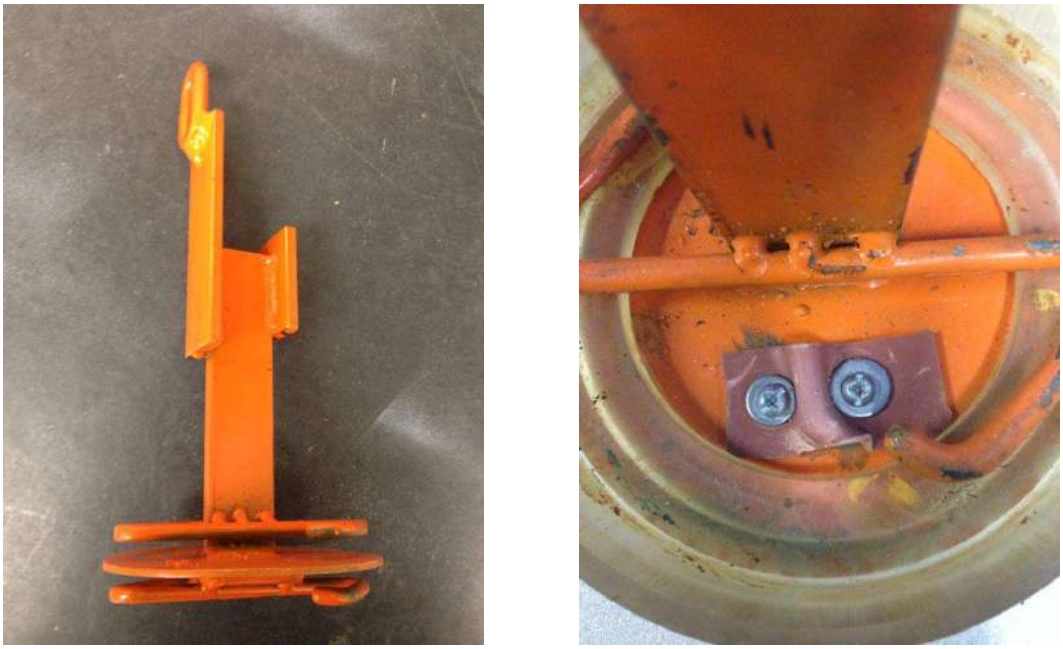

Figure 37. Complete Piston Assembly

Seals

Manufacturing Steps

Seals are to be injection molded out of a polyurethane rubber. The finished seals should look like the seals pictured in Figure 38. Four seals are required for one treadle pump.

See Appendix for a drawing of the mold used to injection mold the seals.

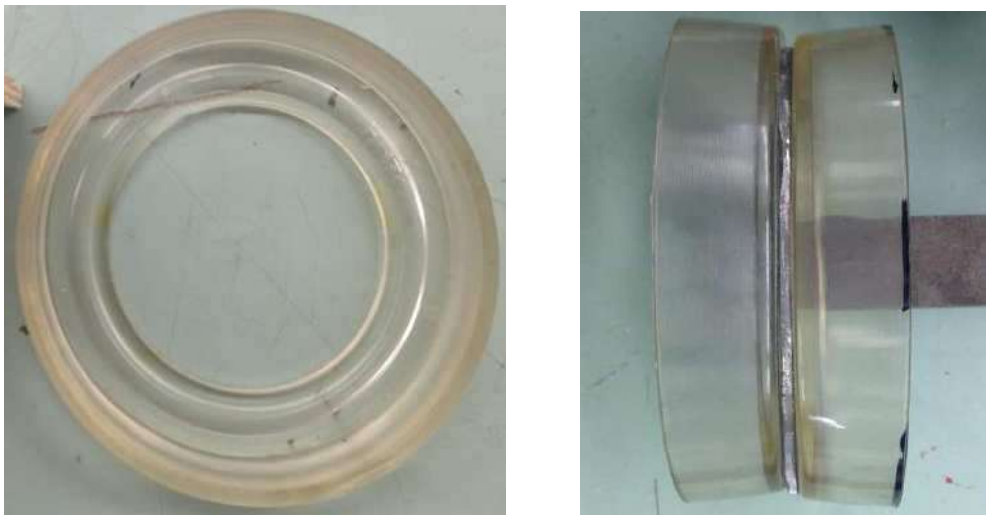

Figure 38. Injection molded seals

Figure 39. Seals with piston assembly

Frame Assembly

Parts Needed

Part Number	Quantity	Picture	Name	Description

1	2		Base Long	Lumber 32” x 3.5” x 1.5” L x W x H
2	1		Base Short	Lumber 16” x 3.5” x 1.5” L x W x H
3	2		Base Cross Middle and Front	Lumber 18” x 3.5” x 1.5” L x W x H
4	2		Treadle Step	Lumber 14.5” x 3.5” x 1.5” L x W x H
5	1		Pump Support	Lumber 18” x 6.25” x 0.75” L x W x H
6	2		Pump Spacer	Lumber 2” x 1.5” x 0.75” L x W x H
7	19		Wood Frame Fasteners	Wood Screws 2” Length
8	1		Base Cross Rear	Lumber 18” x 3.5” x 3.5” L x W x H
9	2		Support Front	Lumber 12” x 3.5” x 3.5” L x W x H

10	1		Support Center	Lumber 18” x 3.5” x 3.5” L x W x H
11	1		Rocker Arm	Lumber 6.25” x 3.5” x 3.5” L x W x H
12	9		Vertical Wood Member Fastener	Lag Screw 3/8" Diameter, 6" Long Shaft OD, Length
13	11		Lag Screw Washer	Washer 7/16”, 1” ID, OD
14	2		Chain Anchor	Eye Hook 3/8” x 3” Shaft OD, Shaft Length ¾”, 1.5” Hoop ID, OD
15	2		Chain-Piston Link	Quick Link 5/16”, 3” Shaft Diameter, Overall Length
16	1		Treadle Pivot Bar	Steel Round Rod 5/8”, 19” OD, Length
17	1		Rocker Arm Pivot Bar	Steel Round Rod 5/8”, 9” OD, Length

18	4		Treadle Knuckles	Steel Square Tube 2 x 1 x 1 x .1875 L x W x H x Thickness
19	2		Treadle Arm	Steel Square Tube 38 x 1 x 1 x 0.1875 L x W x H x Thickness
20	2		Treadle-Piston Pivot	Steel Angle Iron 1 x 1 x 1 x .25 L x W x H x Thickness
21	6		Treadle Bushing	Hex Nuts 5/8 Inner Diameter
22	4		Treadle to Step Fastener	U-Bolt ¼”, 3”, 2-1/8” OD, Length, Width
23	2		Pump Spacer Bolt	Hex Bolt 3/8 in.-16 x 2-1/2 in. OD, Length
24	2		Pump Spacer Nut	Hex Nuts 3/8 in.-16

Manufacturing Steps

1. **Material Gathering:** Begin by cutting all raw materials to the specified dimensions as labeled in the parts list. A majority of these cuts are for wood components, however a few metal cuts will be required. The most efficient and safest means to make these cuts is through the use of a drop saw. If a drop saw is unavailable the use of a handsaw or hacksaw is sufficient. Additional tools needed to construct this frame include adjustable wrench, the capability of welding steel, a drill and1/8", 3/8", and 5/8" drill bits with a Phillips head for fastening screws.

Figure 2. Drop saw used for cutting required materials to specified dimensions

2. **Base Frame:** Once all cuts have been made begin to lay the components out as shown in figure 3.

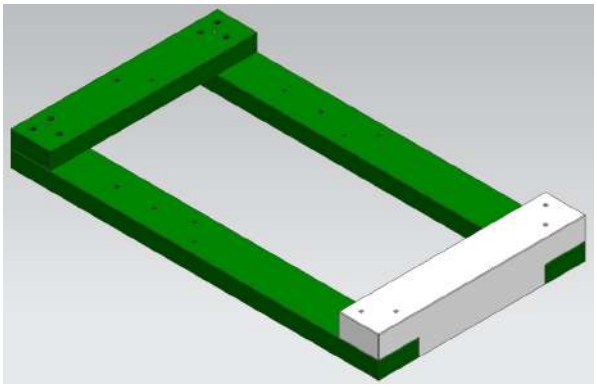

Figure 3. Rectangular base is constructed

The white component in figure 3 is part number 8 from the parts list. This part requires additional cutting to fit into the rest of the assembly. Using a band saw or handsaw, remove a 3.5" x 3.5" x 1.5" section from both ends of the 4x4. This is demonstrated in figure 4.

Figure 4. Side view of 4x4 post material removal

To ensure the rest of frame is constructed correctly it is suggested that clamps (figure 5) and a triangle (figure 6) is used to place the boards at a 90-degree angle to one another.

Figure 5. C-Clamp

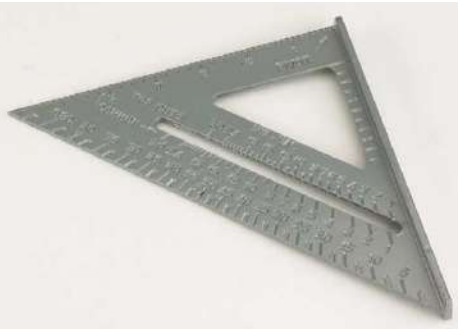

Figure 6. Triangle

Once boards are placed at 90-degree angles clamp, predrill and use part #7: wood screws to secure the boards into place.

3. Now that the base is secured in a square assembly, additional components can be added to the frame's base. This includes parts 3 and 5. As shown in figure 7 these boards span the center of the frame. As represented by the white arrow the back edge of Part 3(ii) is located 16 inches from the front edge of Part 3(i). Using the triangle and C-Clamp predrill and secure Part 3(ii) into place using wood screws.

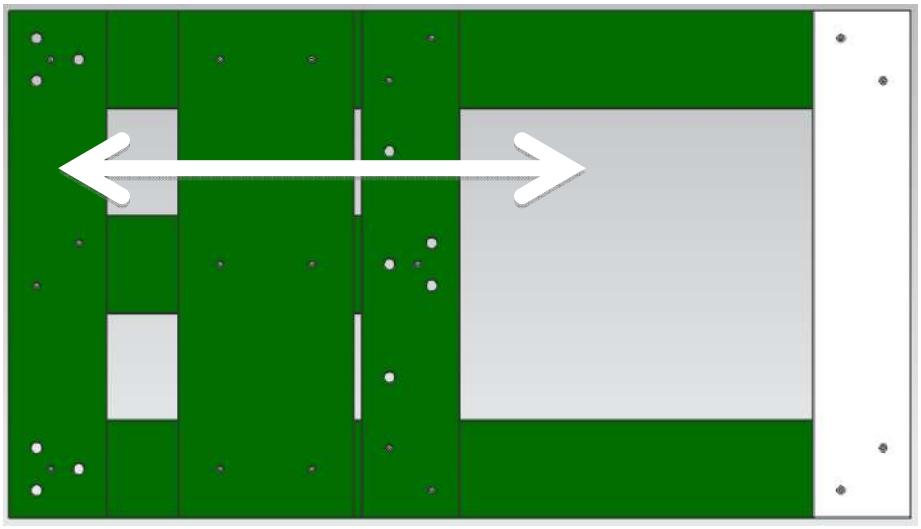

Figure 7. Placement of Base Cross Boards

Once Part 3(ii) is secured in place the placement of Part 5 can be determined. The front edge of Part 3(ii) has a gap of 0.25 inches from the back edge of Part 5. This gap allows for water to flow off the pump support and helps in the reduction of dry rot over time.

4. With these two boards secured in place, flip the base over and expose the bottom of the frame. As shown in figure 8 there is one more supportive board to be added to the assembly. This board, part 2 is centered between the two longer boards, part 1(i) and 1(ii). Predrill and fasten this board into its respective location.

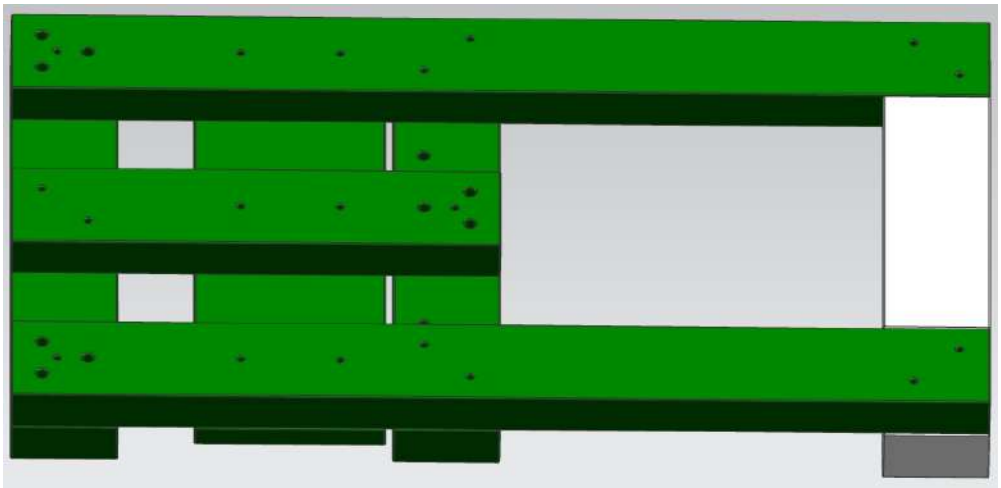

Figure 8. Underside of Frame

5. Figures 7, 8 and 9 show the suggested placement of wood screws in the frames assembly; all 19 wood screws should now be depleted into the construction of the frame.

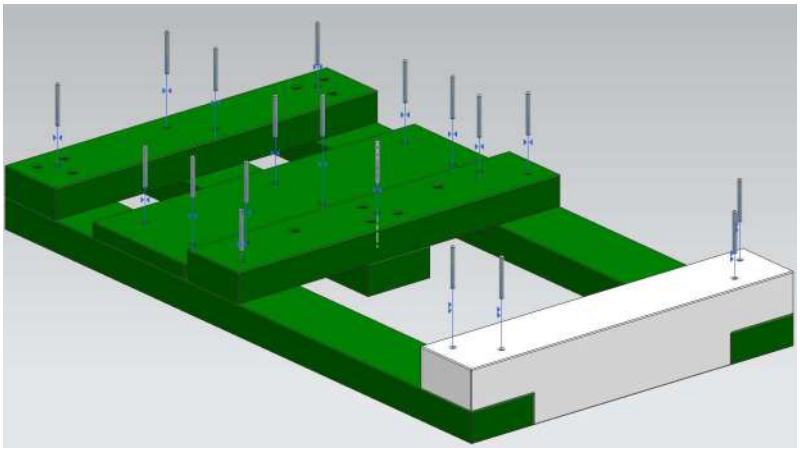

Figure 9. The placement of all wood screws in one view

6. **Treadles:** To begin treadle construction, obtain both part 19(i) and 19(ii). Cut 45 degree angled cuts one at a time at the specified lengths of figure 10. The easiest means of creating an accurate cut is to a miter box cut at the 45-degree angle or the use of an adjustable angle drop saw. The blue lines on figure 10 represent the 45-degree cuts creating 90-degree joints that are welded to create the ergonomic drop for this design.

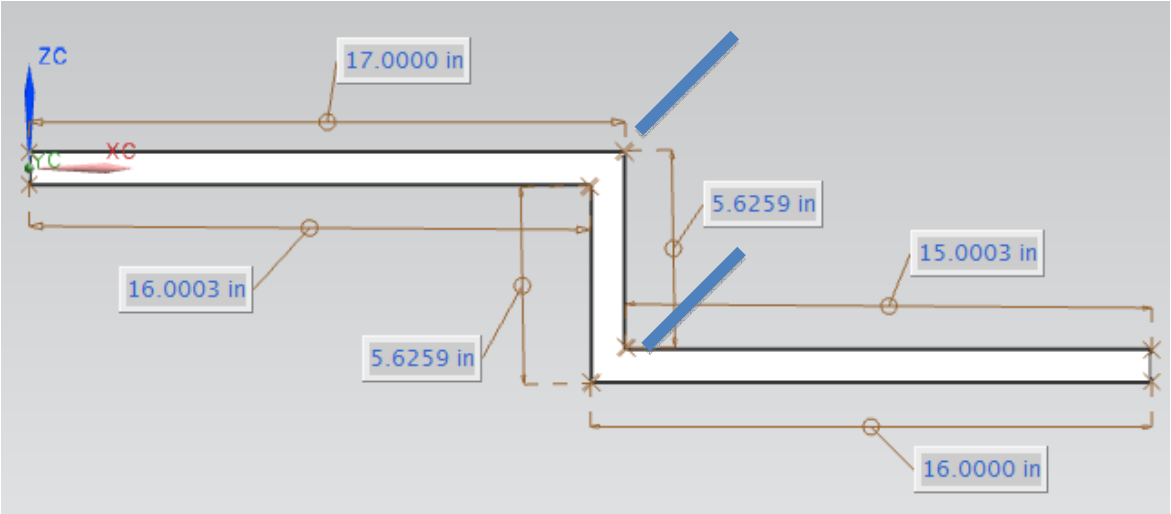

Figure 10. Treadle Arm diagram showing initial cuts and final assembly

Once both treadles have been welded it is time to weld the previously cut treadle knuckles or part 18 to the longest end of the treadles. This is the left end of figure 10. The finished product of this is shown in Figure 11.

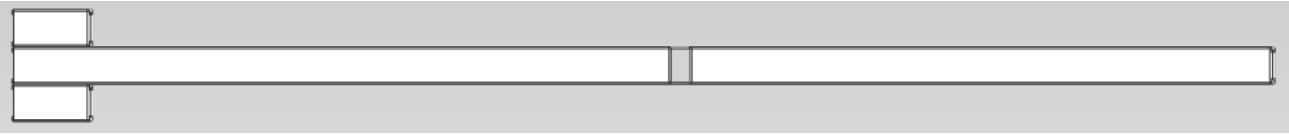

Figure 11. Above view of final treadle knuckle position after weld

The treadle's bushings, part 21, are then welded to the knuckles. The best technique to insure a uniform rotation point across the knuckle is to run the treadle pivot bar, or part 16, through the three nuts of each treadle before welding takes place. These nuts should be spaced out as far as possible between the three knuckles of each treadle. Figure 12 shows the orientation of these bushing in respect to the entire treadle while figure 13 shows the final placement of the bushing on the knuckles after they have been welded to the underside of the treadle.

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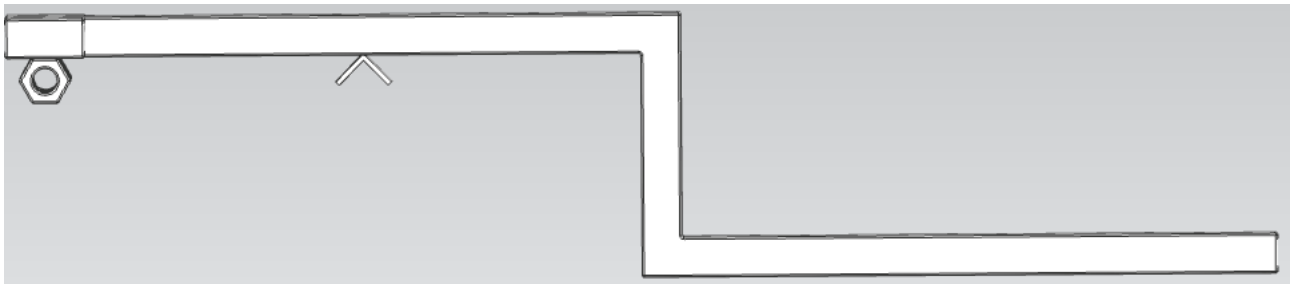

Figure 12. The side profile of the welded treadle components

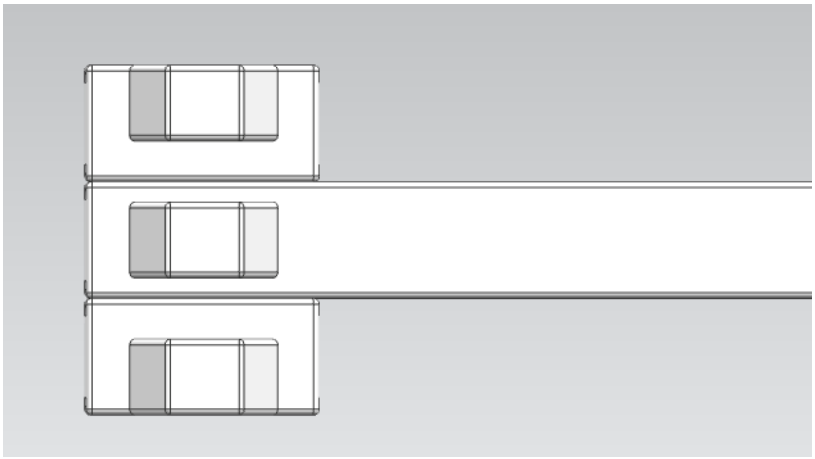

Figure 13. Centered 5/8" nuts acting as the treadle's bushing

The final weld required to complete the treadles is the treadle-piston pivot or part 20(i) and 20(ii). Weld the piece of angle iron 8 inches from the center of the treadle's bushing. This will ensure the treadles interact correctly with the treadle pump's pistons. A visual representation of this is shown in figure 12.

The operator's step plate is the final addition needed to complete the treadle assembly. This piece of wood or part 4(i) and 4(ii) is attached through the use of fasteners. Using figure 14 below, predrill the required holes for the U-Bolts, or part 22, to attach the wood steps to the treadles.

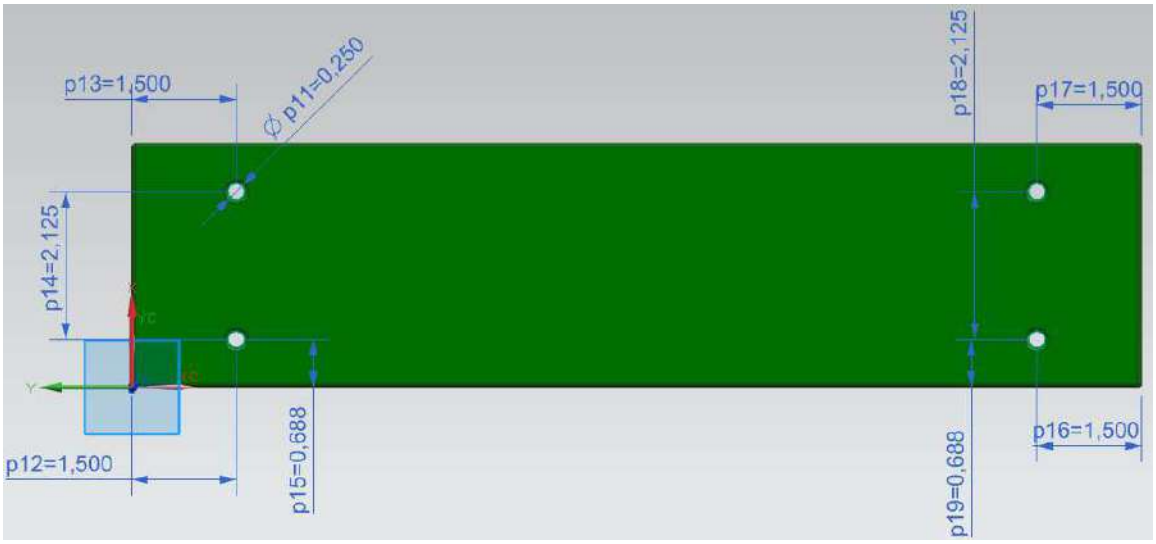

Figure 14. Hole location for Parts 4(i) and 4(ii)

Place the U-Bolts into the newly drilled holes and loosely tighten the nuts to allow for the treadle step to slide over the end of the treadles. The treadle steps are in proper location once the end of the board is flush with the end of the treadles. Once in the proper location tighten down the U-Bolts to securely hold the treadle steps in place. This final assembly can be referenced by figure 15.

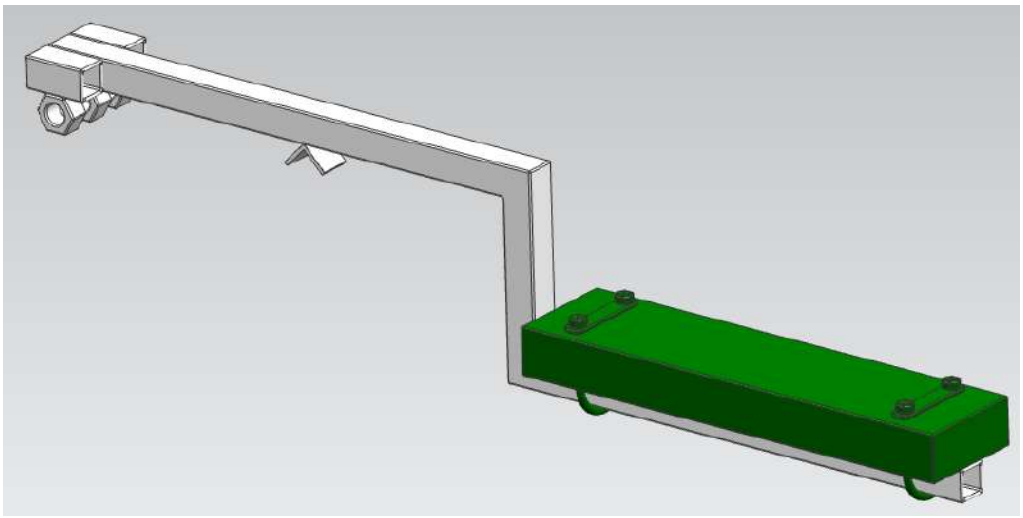

Figure 15. Final Treadle Assembly with Treadle Step in Place

7. **Rocker Arm and Treadle Mounts:** The next step is to prepare part 9(i), 9(ii) and 10. These parts need a single 5/8" diameter hole drilled through the center of each support. The location of this hole is shown in figure 16 for part 9(i) and 9(ii). Part 10's hole location is shown in figure 17.

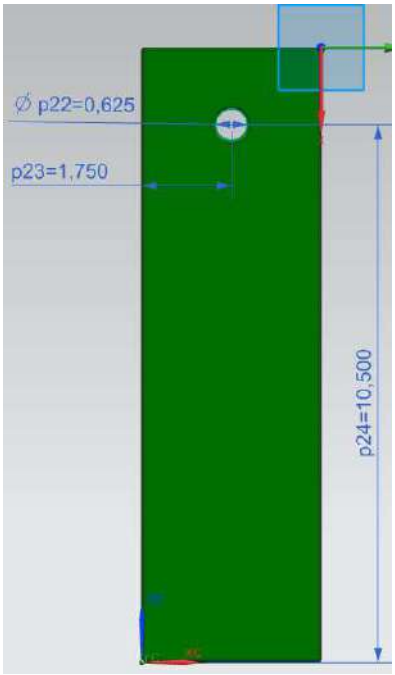

Figure 16. Part 9(i) and (ii) Hole Location

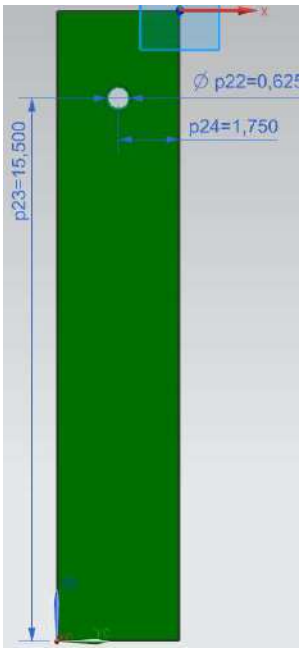

Figure 17. Part 10 Hole Location

Beginning with parts 9(i) and 9(ii), locate where the 3/8" predrilled holes will be for the front support 4x4s. The suggested hole pattern to be drilled into the base is illustrated by figure 18 below.

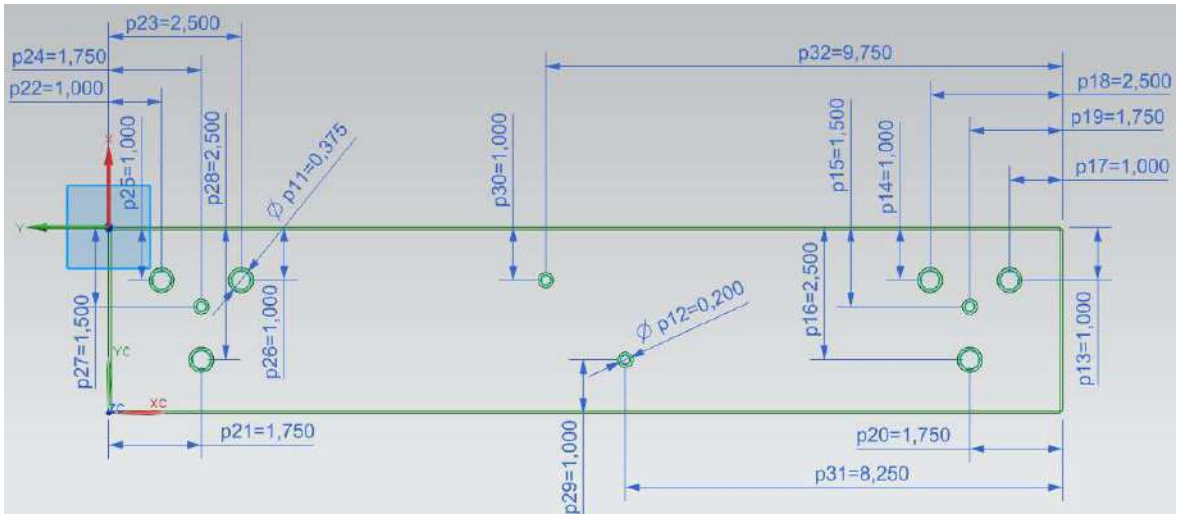

Figure 18. Front Support hole pattern (Part 3(i)) (Note: Top on the figure is the forward direction on the frame)

Holes also need to be created for part 10; the center mounted rocker arm support. The pump spacer holes can also be drilled at this point. Figure 19 shows the suggested location for these predrilled holes.

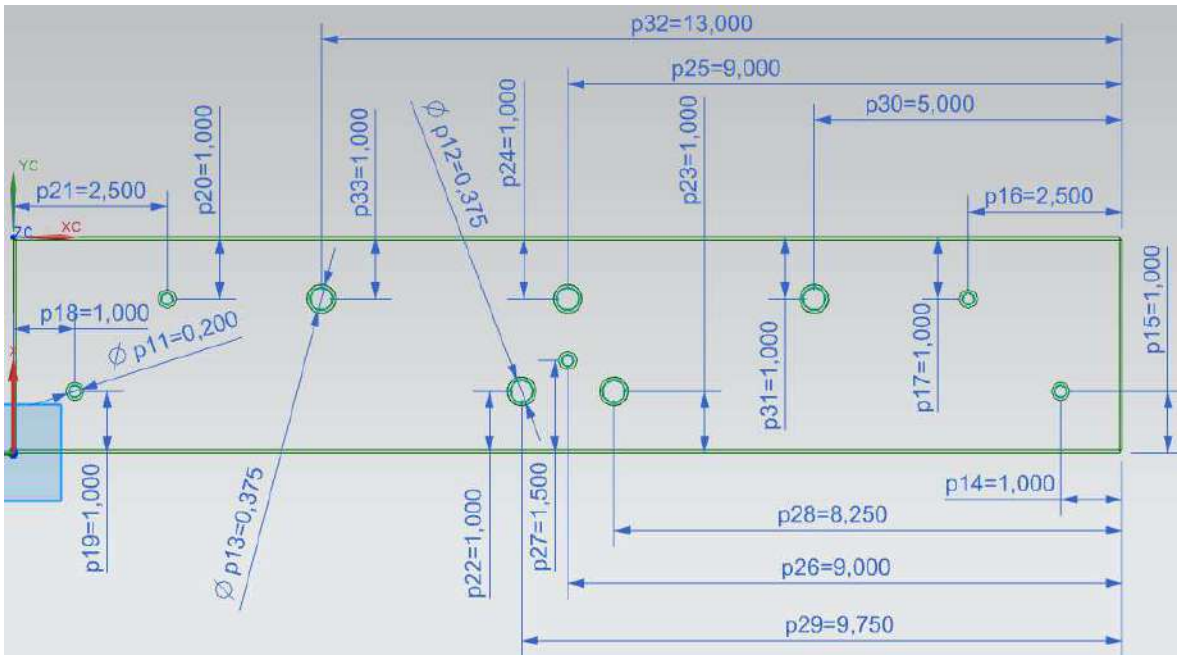

Figure 19. Rocker Arm Support Hole Pattern (Part 3ii) (Note: Top of the figure is the forward direction on the frame)

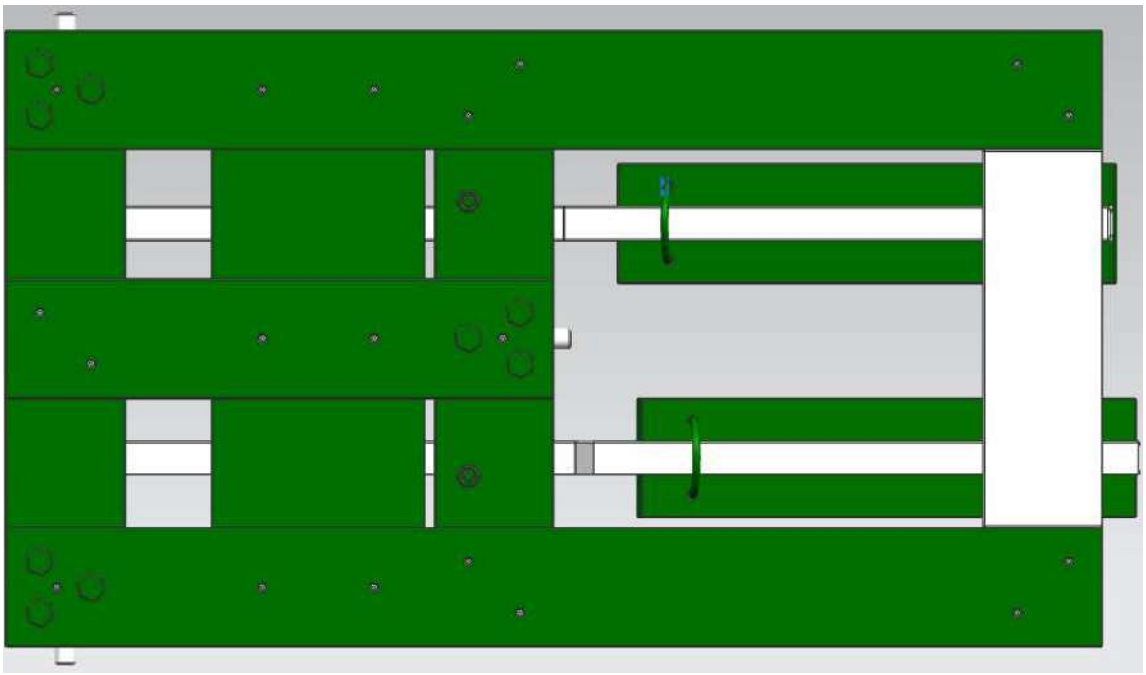

Figure 20. Shows the intended direction of the predrilled holes from a bottom view of the frame

With these holes predrilled into the frame, mirror the same bolt pattern onto the 4x4's such that the front support's 5/8" hole is parallel to the front of the frame, thus aligning with one another. Repeat this for the rocker arm support, however make sure the 5/8" hole is perpendicular to the front of the frame. Before the rocker arm 4x4 is bolted to the frame it would be beneficial to place the Rocker Arm Pivot Bar into the 5/8" hole with a majority of the bar (part 17) cantilevered towards the front of the frame. Depending on the drill bit used this may require the use of a hammer or weighted mallet.

Once these holes have been predrilled into the 4x4's place a washer (part 12) onto each lag screw (part 13) and loosely tighten the 4x4s onto the frame's base. Before the front supports are tightened down all the way, feed the treadle pivot bar (part 16) through part 9(i). Before the bar is through part 9(ii) slide the previously completed treadles onto the treadle pivot bar. Once this is complete and the treadle pivot bar is through part 9(ii) fasten the lag screws the rest of the way on the underside of the pump frame. Make sure this pulls the 4x4s tight against the frame's base. Cotter Pins may need to be installed on each side of the treadle pivot bar to maintain the correct position between the front 4x4 supports during pump operation. Complete the same activity for the rocker arm support and check to see if cotter pins are needed to keep the cantilevered rod in place. The treadle pump should now resemble figure 21.

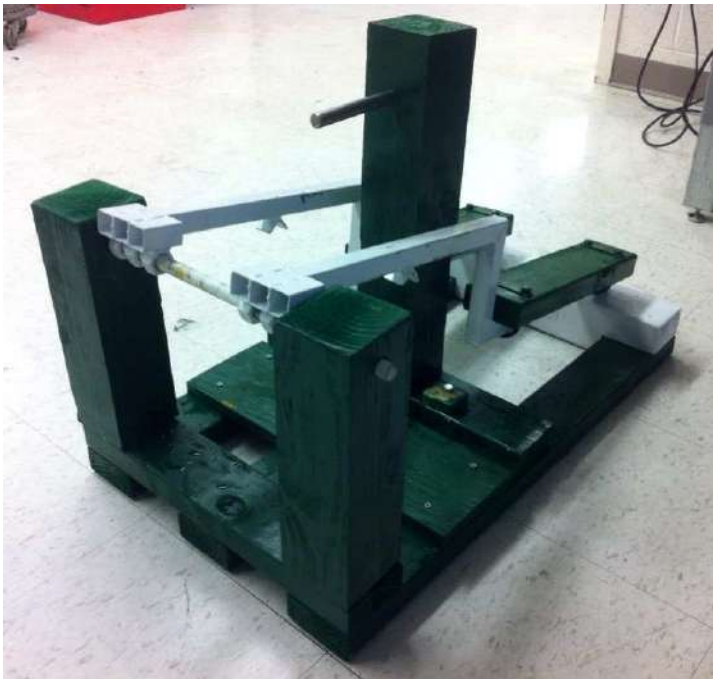

Figure 21. Progress Check for pump frame construction

8. **Rocker Arm Construction:** The only remaining component left to construct is the rocker arm. Three holes need to be drilled into part 11, the rocker arm. Figure 22 and 23 shows the overall layout of the holes on the rocker, with figure 24 and 25 showing the specific hole location dimensions.

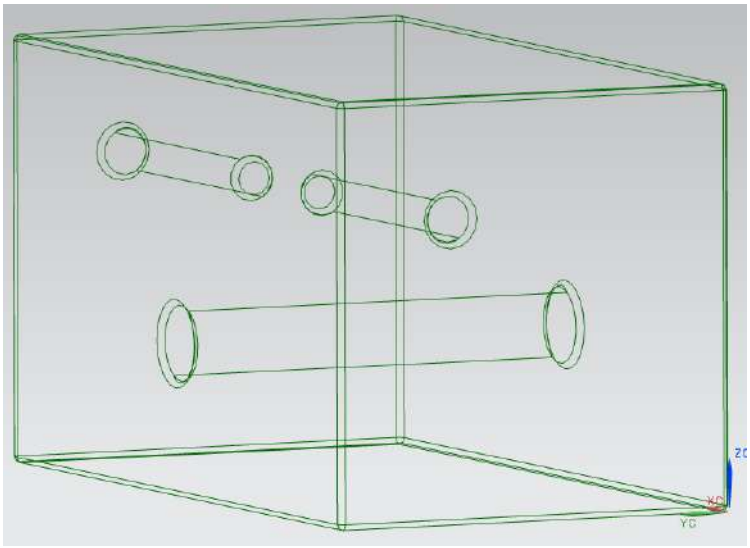

Figure 22 shows the computer model of hole pattern

Figure 23. Shows the physical

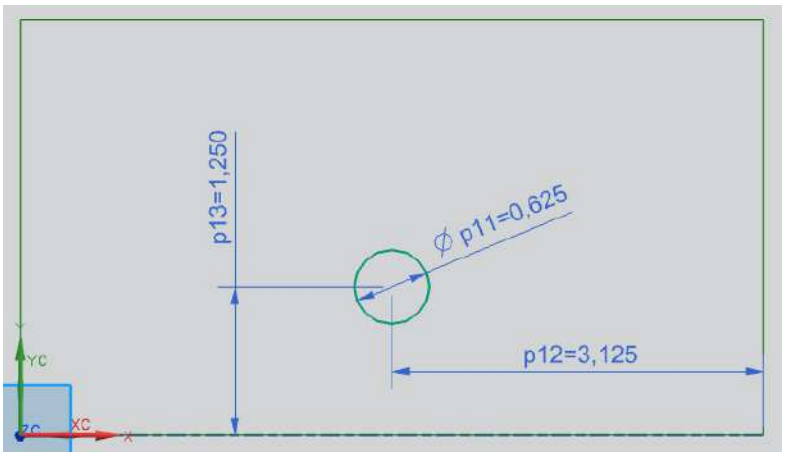

Figure 24. The front 5/8" diameter through body hole

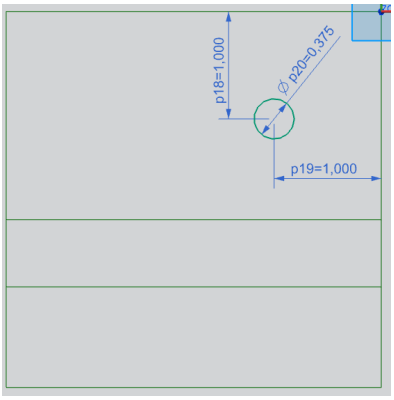

Figure 25. Side 3/8" diameter 3" depth hole, design will require a symmetrical hole on the other side

Once the three holes have been drilled the hardware can be added to create the rocker arm assembly. Using an adjustable wrench slowly twist part 14(i) into one side and part 14(ii) into the other side of the rocker arm. These should be twisted in till the hook of the bolt is pushing into the block in an upright position. To this attach part 15(i) and 15(ii) to their respective sides. Slip the rocker arm onto the cantilevered Rocker Arm Pivot. The basic frame design is now complete and should resemble figure 26.

Figure 26. Pump Frames complete construction

9. **Final Product:** With an ATC Treadle Pump Valve Box and Housing you can now finish the Treadle Pump. Using the quick link attach the pistons to the rocker arm. Slip part 6(i) and 6(ii), the pump spacers, into position and secure the pump to the treadle frame using the pump spacer bolt (part 23), nut (part 24) and the two remaining washers not yet used (part13). The final assembly is shown in figure 27.

Figure 27. Fully constructed ATC Treadle Pump

Congratulations you now have an operational treadle pump!