Soft Pipe Insertion Tool - SPIT, Version 3.0

By R. G. Sparber

I was talking with my friend Steve who came up with a much simpler solution assuming you have access to water that is just below boiling. Soak about 2" of the tubing in this water and it will slide in easily. Now, if you don't have access to very hot water, read on.

See a video of this tool being operated:
https://www.youtube.com/watch?v=lIEME2Q7WiQ

plus an X-ray view of the tool in a simulator:
https://www.youtube.com/watch?v=xpJZt-yiWO4

Here is a video showing how to do this task by hand:
https://www.youtube.com/watch?v=J1ozyeK_AXM

The guy in this video has a lot more strength than I posses! How much force is needed depends on the diameter of the tubing and its stiffness.

The Problem

Here in Phoenix, Arizona, when the irrigation springs a leak, the trees and shrubs quickly start to brown and the water bill can go through the roof. The challenge is to dig down to the leak, cut out the bad section of "soft pipe", add couplers[2], and install a new section. Of course, the repair doesn't last long on this 17 year old pipe because it bursts a few inches away a few months later. A better solution for me is to expose 5 feet on both sides of the failure and replace this run of soft pipe with

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[2] The key words are "710 Compression fitting".

"hard pipe" (½ inch PVC). Eventually I will have replaced all of my soft with hard pipe.

In the winter, I often expose more than 10 feet at a time. In the summer, the goal is to start at dawn, work quickly before it gets above 110°, and get in doors. The cost for me is digging the trench. What goes in there for the repair is minor as long as I don't have to dig it up again.

Many couplers exist that connect soft pipe to hard pipe. The most cost effective design is a compression sleeve. I paid $2.50 for a bag of 5[3]. The fancy couplers are over $4 each.

The big problem with these compression sleeves is pushing the soft pipe through it. There are three tricks that help: soap to lubricate and heat from the sun to soften the tube. Then rock the soft pipe back and forth while pushing. It helps, but for me it is not enough. Especially when I am working in a trench, it is very hard to get the leverage needed. Furthermore, it almost tears the skin off of my hands as I push on that soft pipe.

The Solution

Of course, the solution is to have a tool.

A search of the Internet plus a discussion with an irrigation specialist turned up no such tool. Not to worry, I'll just design and make one.

This prototype was built using a lathe and drill press. All fasteners came from my local Ace. Total material cost was under $15.

I spent time thinking about where this tool would be used. It will likely get covered in mud and will need to be hosed off. The fasteners are nickel plated steel. The rest is 6061 aluminum. With the pipe down in a hole, the user can operate the handles above ground.

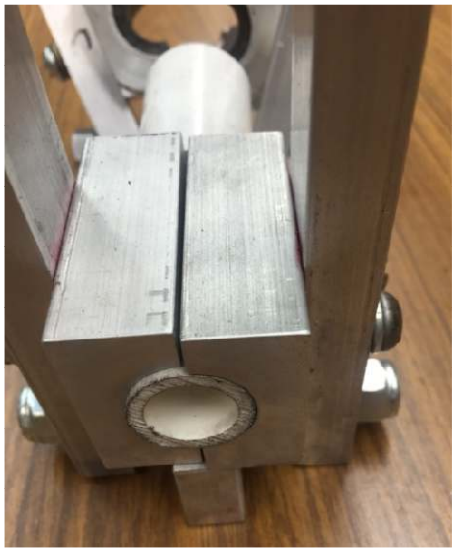
[3] I found them on line in quantity for less than 25 cents each: https://www.irrigationdirect.com/products/drip-irrigation-supplies/compression-fittings/710-od-blue-ring-compression-fittings

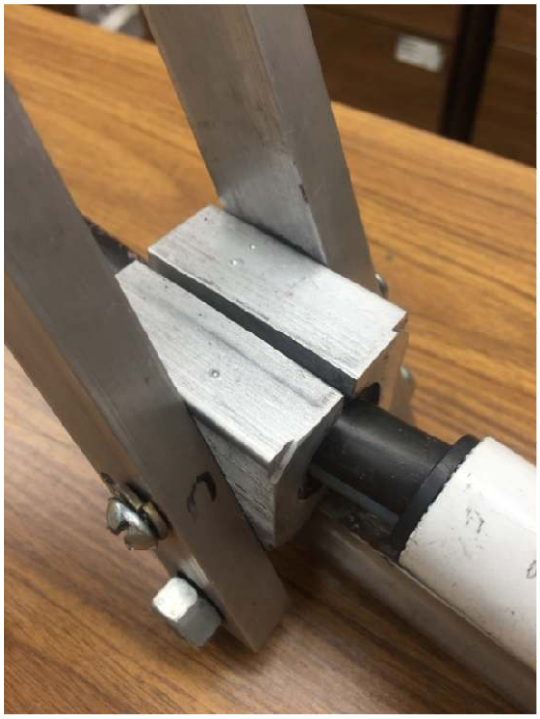
One deficiency of this design is how the pipes load. More on this after I show you how it works.

As you can tell by reading this article, I prefer to give the idea away rather than tangle with patents, marketing, and potential financial loss. All are welcome to risk their own money and hopefully profit.

In the load position, the two sets of jaws open to accept the soft and hard lines.

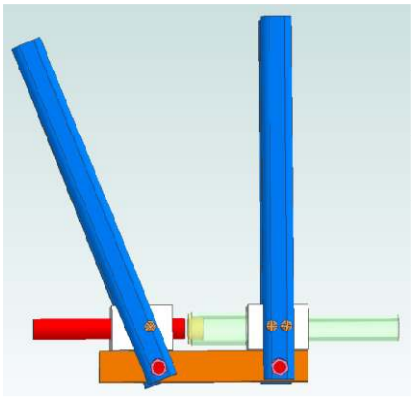
The soft pipe is placed inside the rubber lined jaws while the hard pipe rests in the unlined jaws. The coupler and compression sleeve have already been solvent welded to the PVC pipe. In this picture, the pipe was cut off.





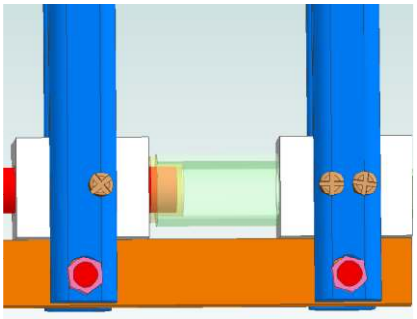
Closing each pair of arms secures the jaws around the pipes. The end of the soft pipe is touching the opening of the compression sleeve inside the PVC coupler.

Note that the pair of arms is at about a 45° angle.



The soft pipe jaws slide on the connecting bar. These jaws are free to pivot relative to their arms. This forces these jaws to stay in alignment with the hard pipe.

We are essentially trying to push a rope here. Any misalignment of the soft pipe as it is driven into its compression sleeve can cause buckling.



In one action, I push each pair of arms together while moving the pairs of arms towards each other. This rendering includes an x-ray view of the hard pipe and coupler. After the first stroke, the soft pipe is though the coupler by about one half inch.

When the pairs of arms are parallel, I open up the soft pipe arms, slide it back to 45°, close the arms, and repeat the action. This moves a total of one inch of soft pipe through the compression sleeve as required by the manufacturer.

The arms are spread open and the tool removed.

Here you see the tool has been placed in a trench. The hard pipe with coupler and collar rests in the right set of jaws. The soft pipe rests in the left set of jaws.

With my right hand squeezing the right pair of arms and my left hand squeezing the left pair of arms, I moved the arms together. No picture of that - ran out of hands.

Is was then a simple matter to open the jaws and slide the tool along the soft pipe to a place where I could remove it.

The soft pipe is now solidly connected to the hard pipe.

I bumped a nearby coupler and the soft pipe fell off. Note the compression in the pipe. It is very close to the end. The installer were supposed to push the soft pipe into the coupler about one inch. Well, I need to get it back in.

Although the tool was not designed for this coupler, maybe it can work. I did have to trim off the deformed end first.

The hard pipe jaws don't fit very well but it was good enough.

Success! The soft pipe is now in about an inch. I then pushed the soft pipe connected to the left arm of this T in about another half inch.

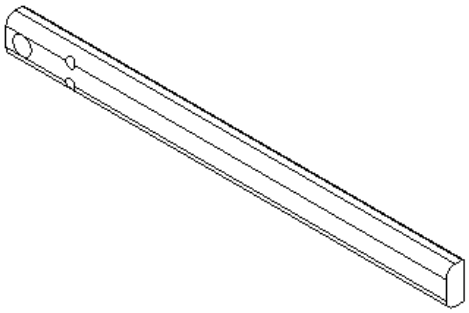
One obvious improvement to this tool is to have the pipes load from the other side of the pivot. Then the user could place this tool around the pipes similar to using a pliers.

This arrangement comes with two possible design choices.

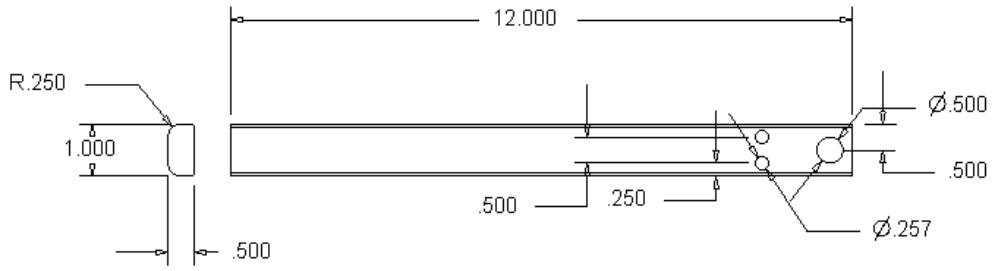
The simplest option is to keep the straight arms. This means the user must ***pull*** the arms apart while pushing the sets of arms together. That is very awkward.

The second option is to have a pivot joint similar to what is found in a pliers. This means that the arms cross over at the pivot. Not impossible to design and build, but would be more fabrication complexity. I'll leave this improvement to the readers.

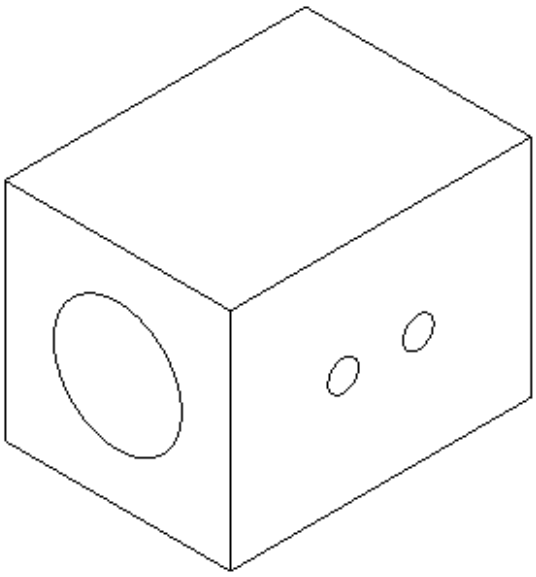
Shop Drawings



Arm
quantity (4) but see note
material 6061 Aluminum

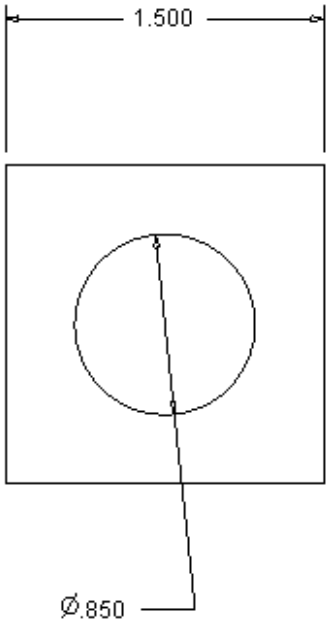


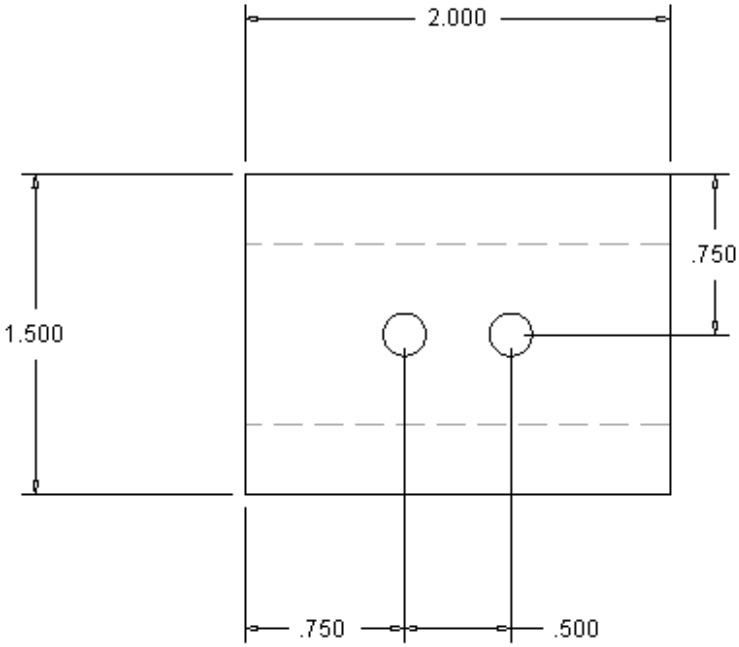
Make two arms as specified. Then make
one arm as specified but with only the top 0.257" hole.
The forth arm is with only the bottom 0.257" hole.



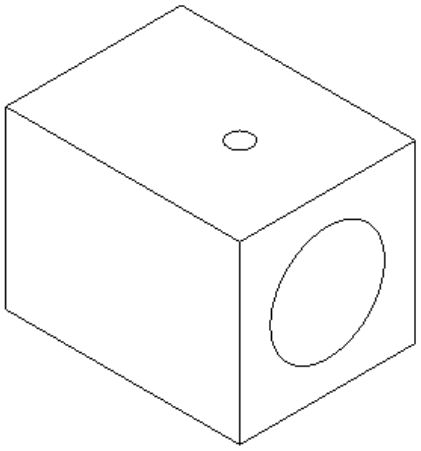
Hard Pipe Jaws
quantity (1)
material 6061 aluminum

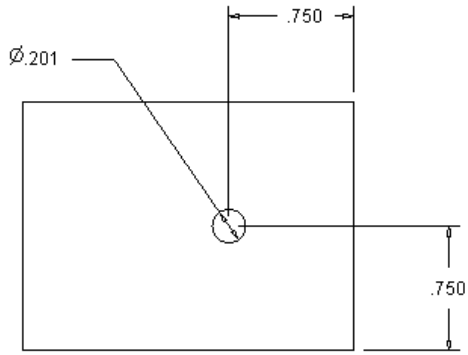
Drill and bore out.
Then saw in half with
2 adjacent holes on each
part. Tap each hole 1/4-20.



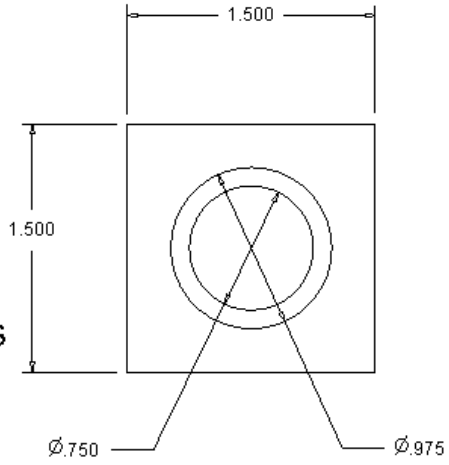


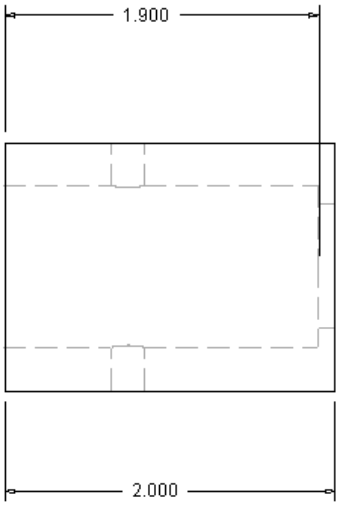
Soft Pipe Jaws
quantity (1)
material 6061 aluminum



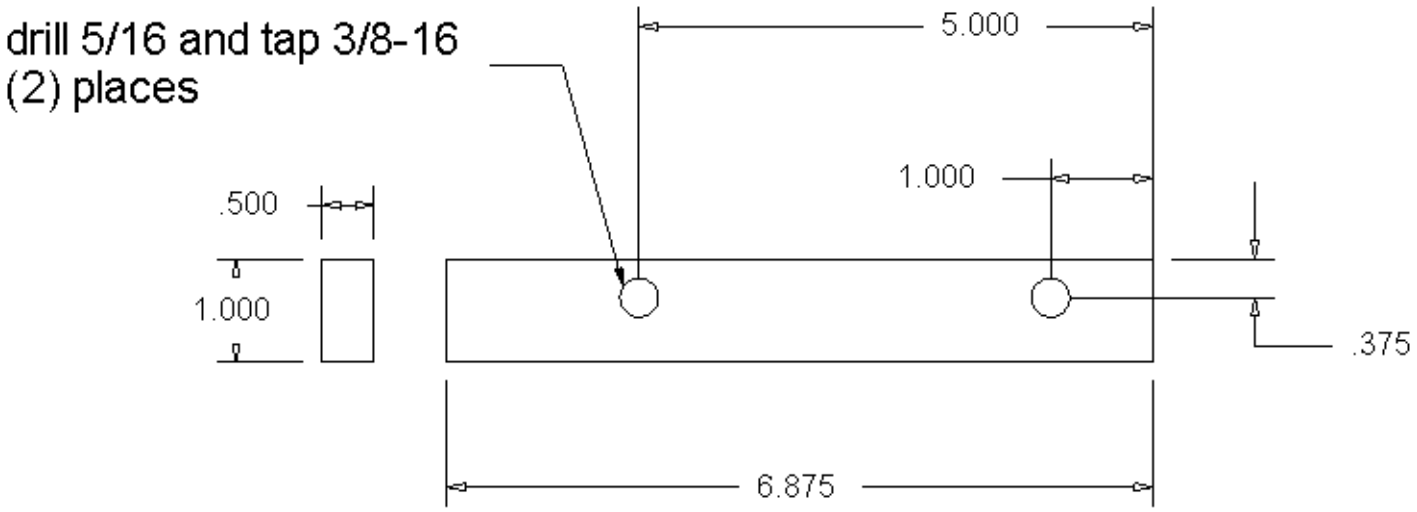


Drill and bore on lathe. Then saw in half such that one 0.201" hole is in each jaw. Tap these holes 1/4-20.

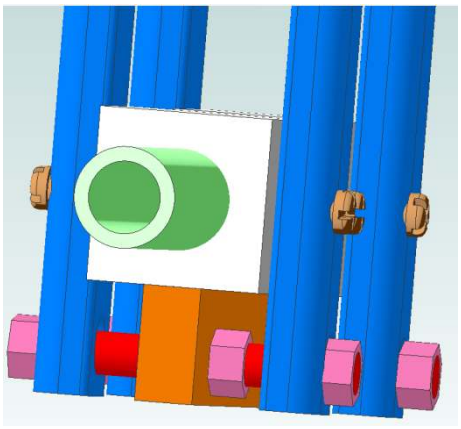




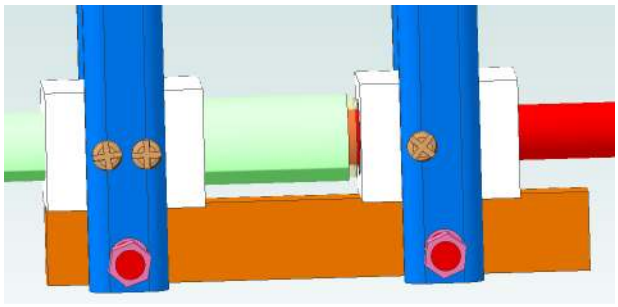
Linkage Bar
quantity (1)
material 6061 aluminum



The pivot rods are made from 3/8-16 threaded rod. Each one is 3 inches long. The rubber liner for the soft pipe jaws was selected by finding radiator hose that was a slip fit to the soft pipe. A length 2 inches long was cut axially. Dry fit the split hose to the jaws, trim as necessary, and then glue in place. I used Permatex Form-A-Gasket as my glue.



Thead the rod half way through the linkage bars and secure with a nut on one side. Attach the arms and put nylon lined locking nuts on the outside.



Attach the jaws with ¾" long ¼-20 screws. The soft jaw screws are Loctite'd in place such that the jaws can smoothly pivot. The PVC jaws use the same screws plus lock washers.

Coat the edge of the linkage bar under the soft pipe jaws with a little anti-seize grease. Optionally, the linkage bar could be made from a heavy plastic that is slippery.

I welcome your comments and questions.

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