

REQUIRED READING

If you are reading this, you have an interest in bending some tube. You may or may not have a bender already. I've pulled together as much applicable info as possible to give you sources for information to educate yourself and help with the sourcing of parts to convert the JD2 Model 3 manual bender to hydraulic power.

The starting point for understanding the concepts of bending tube and how to go about measuring for your creation can be found in "[Bending Tube 101](#)" by Rob Park on Pirate4x4.

The pictures provided are thumbnail images - click them to view 800 x 600 images. Please note - this is how I chose to convert my JD2 Model 3. There are many other ways to accomplish the same thing. Please see my disclaimer at the end of this article.

BENDER PARTS

To start off the process, I bought a [JD2 Model 3](#) Manual Bender with Degree Ring. Since the [Pro Tools Model 105](#) is a similar design, most of what applies to the JD2 conversion can be used on converting a Pro Tools 105. You will not be using the manual parts, so sell them off to someone. I got lucky and was approached early in the process to sell my parts.

TUBING DIES

I kind of lost my mind when buying dies and got 1", 1.25", 1.5", 1.75" and 2". I have visions of building all sorts of stuff (roof rack, bumpers, sliders, and misc. brackets/braces), so that has fueled my lunacy. After searching several message boards, it seemed to be the general consensus that using the smallest radius dies (lower "CLR" number) would result in the strongest bends and would offer more flexibility. CLR = CenterLine Radius. Seeing this stuff on the web and holding it in person is a huge difference. All this stuff is much larger than I imagined and very heavy. The shipping charges are justified - I feel sorry for the UPS guy that has been delivering these parts. The dies can take some time to receive, so plan ahead.



NOTCHER

What is a tubing bender without a notcher? I decided to invest in one with the ability to do off-center notches. I don't want an equipment limitation coming between me and design vision. If you don't want to buy a notcher, there are other methods including the chop saw and/or angle grinder. There is a nice article on chopsaw notching over on [OFN](#).



BENDING AIDS

There are a number of tools available to make bending tubing a bit easier and more accurate. The obvious tools are tape measures and marking instruments. For marking, I've found the Sharpie silver paint markers work quite well and are easy to see.

For measuring angles, there are many options. From simple magnetic gravity-based pointers to simple mechanical protractor-type angle finders. Some newer options that really simplify angle finding are digital angles and digital levels.



COMPUTER SOFTWARE

You really need to look no further than [2020 Software Solutions](#) for your tube bending software needs. Their Bend-Tech line of software assures you aren't wasting tube with mistakes and excess drops. Bend-Tech EZ 3D is exceptionally intuitive and makes performing complex multi-plane bends easy.

HYDRO CONVERSION

I'm converting this bender to hydro right off the bat. The beauty of a hydro setup is that the bender becomes an easily movable self contained piece of equipment instead of being fixed to the floor. I'm doing a "homebrew" hydro conversion based on the now-famous [Jay K's Homebrew Hydro Writeup](#). Some people who have done similar conversions opt for 12V pumps. While these might work OK, I didn't like the idea of having to use a battery, etc. So I used Jay's parts list for the pump, cylinder, fittings, hoses, etc. I later found that it is a good idea to wait on the fittings and hoses until you have everything attached to your bender stand where you want it. It will save you money in the long run.

To learn more about how hydraulics work, take a look at [How Stuff Works](#).

GETTING STARTED – PLANNING

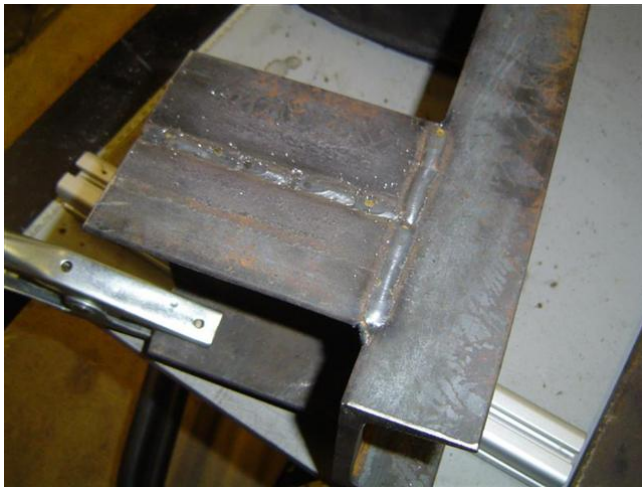
The process starts with the layout and calculation of the mounting location for the ram (bender has the 2" die mounted in this picture)

Pull the port plugs to aid in cycling the ram through it's range of motion. You want a slight angle between the operable bender arms and the ram. If you align the ram and bender arms, you run the risk of binding the bender and breaking components, not to mention putting yourself at risk. I mounted the stationary arms on the channel to help sort out the final location for the ram.



UPPER FRAMEWORK and BENDER/RAM MOUNTING

This picture shows pretty close to what I ended up with. The fixed end of the ram was moved even further to the left to assure there would be no binding.



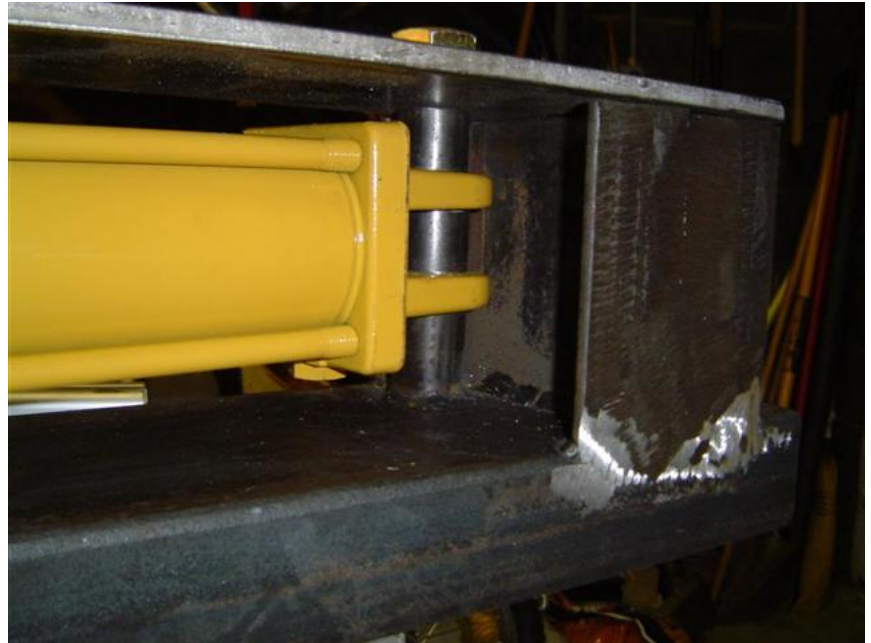
I wanted this stand to be very stout so I would not run into problems down the road. At the stationary end of the ram, I added some extensive beef. The end support is made from two sections of the ship channel, welded back to back.

Got the 3/8" top plate sized and drilled. Here's a test fit. I cut the top plate for clearance with a angle grinder and a nice thin wheel. Like hot knife through butter!



UPPER FRAMEWORK and BENDER/RAM MOUNTING (cont.)

I welded sleeves on the channel and top plate for the stationary ram mount. This received a 1" dia. bolt 7" long. Sharp drill bits, cutting fluid of some sort, and a drill press make the process of drilling through this thick steel less of a chore. I bought a Drill Doctor during this build up. A tip, step drills are not designed for drilling thick steel. When they break off, the hardened steel left in the hole from the bits make it nearly impossible to finish the hole. Ask me how I know... Here's a shot of the sleeves prior to welding.



LOWER FRAMEWORK and HYDRAULIC PUMP MOUNTING

I mapped out the leg angle on a table and marked everything up for trimming the leg tubes. I also made up plates to mount the casters. These are welded to the bottom of the legs.

I first welded the legs to a flat plate, then welded the assembly to the channel. This helped me keep everything straight and added strength to the leg mounting area. I positioned the upper assembly on my workbench for attaching the leg assemblies.



LOWER FRAMEWORK and HYDRAULIC PUMP MOUNTING (cont.)



First time sitting on the ground and after tacking the casters on (a lot easier than drilling all those holes). Just don't breathe those fumes! The shot to the right is the stand with the pump shelf installed. I originally planned to make another shelf underneath the pump shelf, but I like the idea of being able to stand in close to this thing if need be. I've decided to make the die storage kind of hang down from the shelf where I'll have round bar welded to it to slip in the dies and followers. This will also keep the weight nice and low to balance when I have a heavy stick I'm bending.



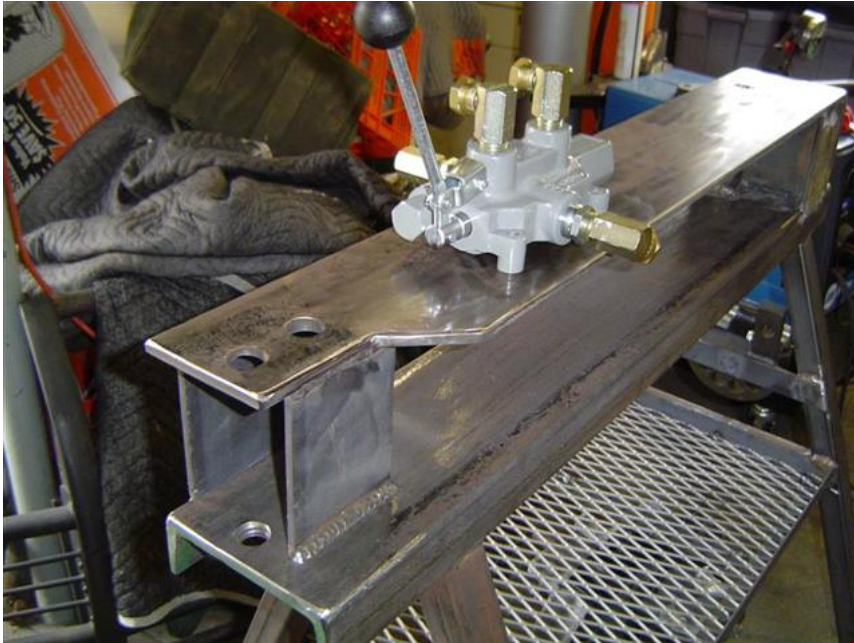
BENDING DIE STORAGE

This pic shows the square tube I used to mount the die storage. I welded stringers between the legs and then dropped a section toward the floor to support a bar that runs the length of the stand. This will give me adequate room for 4 dies and followers. I angled the round bar up so the dies don't fall off when maneuvering the bender around the shop/outside. I suspended the small 1" die on the fixed end of the stand. Note, I used scab plates on the end of the round bar since the square tube wasn't all that thick.



FINISHING THE UPPER FRAMEWORK

I welded the top plate to the rear "H" support and created a pocket out of 3/8" plate for the bender arms.



PAINING THE STAND

Ol' Twisty is blue now. Just a first coat. It received a couple more coats. I used Duplicolor engine paint over self etching primer. If I had it to do over, I'd probably chose a different type of paint. The engine paint doesn't seem to be all that durable. My MM210 is on the right - the color is pretty close.



FINAL ASSEMBLY

I figured out that one or two of the hoses I have are too short (I bought 4-24" per Jay K's instructions) based on where I wanted my valve. I wanted to have my valve near the bender arms and the power unit as far toward the opposite end as possible for counterbalance when bending heavy stuff. In fairness to Jay, he said the sizes may need to be adjusted - he was right. A couple of pics of everything mocked up in place.

I unplugged the ram and cycled it through the range of motion. It appears that I'll get between 110 and 120 degrees in 1 shot. Here's the bender at maximum extension.



The valve mounted in it's final position. I drilled and tapped the top plate 5/16-18 and used socket head bolts. I slipped a rubber washed under each mounting point also. Did a similar mount for the pump.



HYDRAULIC CONNECTIONS

Here's the valve with all the hoses hooked up. The valve used is a 4-way spring loaded control valve that returns to center. The two ports on the side connect to the pump, while the two ports on top connect to the ram. The pump ports get the 3/4" to 1/2" reducers and then 1/2" NPT 90° fittings. The ports for the ram only get the 1/2" NPT 90° fittings.

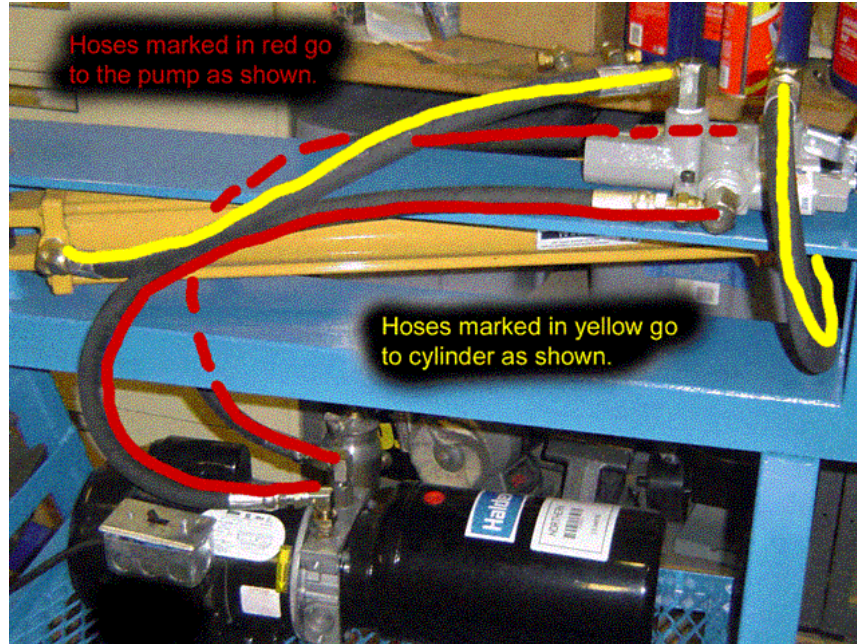


To reduce the stress on the hose connection, I used a 45° 1/2" O-Ring to 1/2" NPT fitting to connect to the 24" hose on the stationary end of the ram. The ram used is a 3" bore, 24" stroke double acting cylinder. The other end of the ram uses a 1/2" O-Ring to 1/2" NPT adapter to connect to the 24" hose.

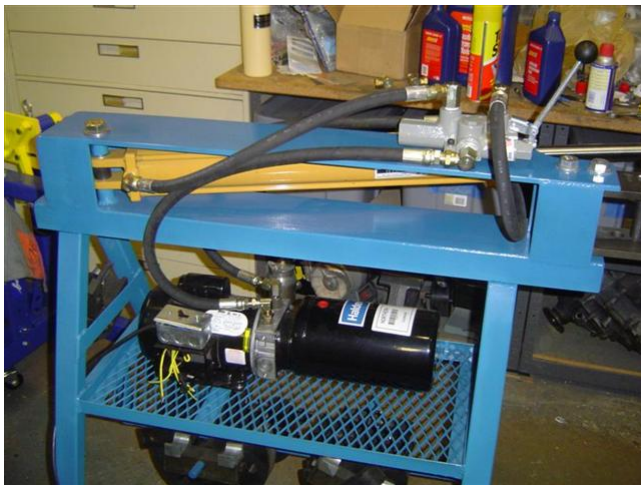


HYDRAULIC CONNECTIONS (cont.)

Here's the hose routing:



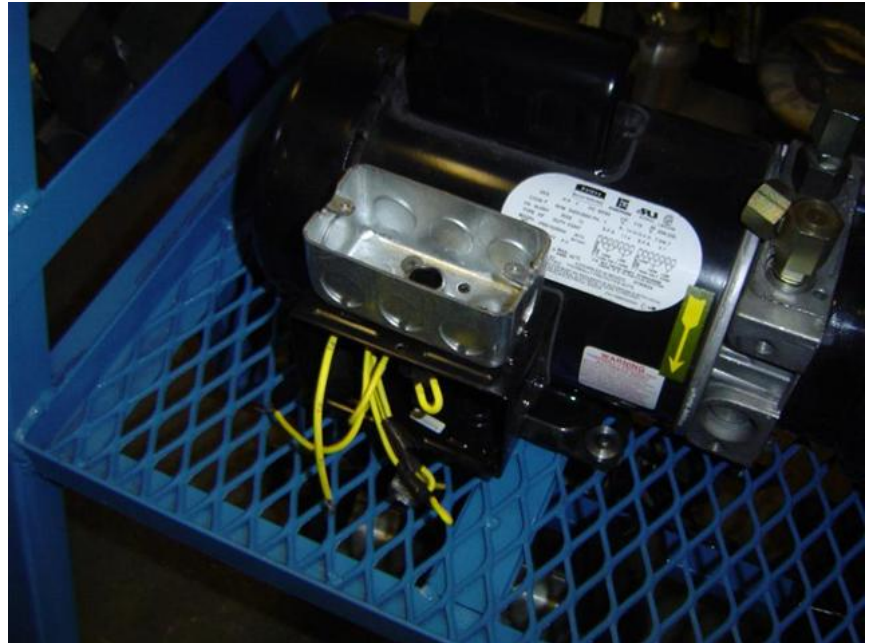
Here's a couple overall shots.



ELECTRICAL CONNECTIONS

A word to the wise: Do NOT trim the length of the wires coming out the motor (notice that they are all yellow), you run the risk of cutting the markings off of the wires. Ask me how I know...

I mounted a metal box to the junction box on the pump motor with a ferrule and two conduit locknuts. I ended up running a self-drilling screw through the boxes for good measure. As far as the wiring schematic (your guess is as good as mine):



To wire this pump for 110v operation:

P2, T3, T5 - all get connected together, wire nutted, and left alone.

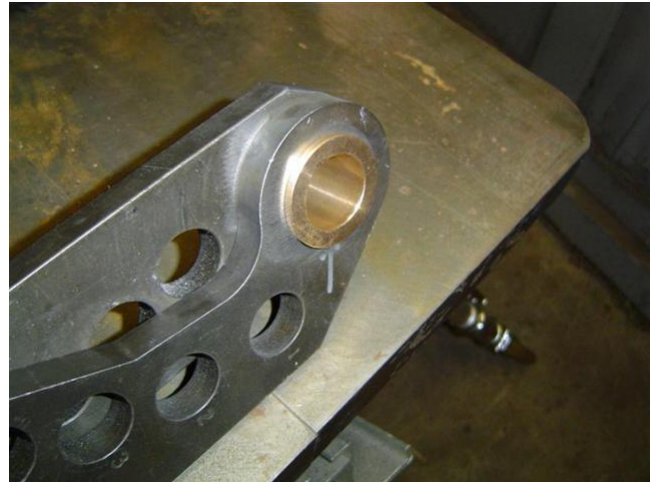
P1 - connects to white wire (neutral) from power supply.

T2, T4, T8 - all get connected together, wire nutted to the black wire (hot) from power supply.

Ground - from whip/pigtail gets wired to box/switch

BENDER ARM MODIFICATION

I've made a modification to the bender arms. Due to how difficult to it is to remove the center die pin, I've decided to drill out the die pivot hole in the arms (both the stationary and movable arms) for a 1 1/4" bushing. Think of how a pipe clamp works - plates dig in to the pipe so the clamp holds. This seems to be what is happening with the arms of the bender on the center die pin. Using a bronze bushing should eliminate most if not all of the binding I'm experiencing when trying to remove the pin. I didn't have a bit big enough to open the die hole up to 1 1/4", so I'm having a buddy (who has a metal shop) enlarge the holes for me. I needed to run my 1" drill bit down through the hole in the bushing. Seems to be a hair too tight to get the pin in.



Bushing Spec:

McMaster Carr - [P/N 7815K56](#)

Alloy 932 (SAE 660) BRNZ Flanged-Sleeve Bearing, For 1" Shaft Diameter, 1-1/4" Od, 1" Length

SPECIAL THANKS

I'd like to specifically thank the following for their help and inspiration:

Jay Kopycinski
"Guinea13" from Pirate.
"Jackalope" from OFN

DISCLAIMER

If you choose to reproduce my modifications, in whole or in part, you do so at your own risk. If you choose to follow any of my advice, you do so at your own risk. I assume no liability for use of the above material. All links included were done for convenience and do not indicate endorsement by any of the linked entities.

Cebby's JD2 Model 3 Hydro Conversion

Sept. 23, 2005



PARTS LIST

Hydraulic Components

- Hydraulic pump (Northern Tool part #105871) - 1 HP 115/230V, 1.5 gal reservoir, 1.25 gpm, max. 2000 psi
- (1) 4-way control valve (Northern Tool part #2010) - 1000 to 3000 psi relief valve, factory set at 1500 psi, 3/4" inlet/outlet, 1/2" working ports
- Hydraulic cylinder - Lion model 30TH24-150 (Northern Tool part #992031 for 3000 psi unit or #992010 for 2000 psi unit)

NOTE: Prince Cylinder model # SAE9224 (Northern Tool part #909224) in Jay K's writeup is no longer available from Northern as of 9/20/05

Hydraulic Hoses and Fittings (my setup differs from the parts below due to my utilization of custom hoses)

- (2) 1/2" x 24" 2-wire hydraulic hose (Northern Tool part #50124)
- (2) 1/2" x 36" 2-wire hydraulic hose (Northern Tool part #50136)
- (2) Reducer bushing 3/4" M-NPTF to 1/2" F-NPTF (Northern Tool part #50CSC128)
- (7) 90° 1/2" NPT elbow (Northern Tool part #50ARC008)
- Bushing/Standoff 3/8" O-Ring M to 3/8" O-Ring F (no Northern P/N exists)
- Swivel Adapter 3/8" O-Ring M to 1/2" NPT F (no Northern P/N exists)
- Swivel Adapter 1/2" O-Ring M to 1/2" NPT F (no Northern P/N exists)

Electrical Components

- Single electrical box (metal)
- Single switch plate (metal)
- Switch
- Appliance cord with molded 3 prong plug
- 1/2" Ferrule
- 1/2" conduit locknuts

JD2 Model 3 arms and die(s) or Pro Tools 105

Raw Steel

- 6" ship channel - 5' (main beam)
- 3/8" plate x 6" x 4' (top plate)
- 1 1/2" x 2" x 12' rectangular tube-1/8" wall (legs)
- 1/2" solid round bar (die storage)
- 1" square tube x 6'+/- (die storage)
- 1" angle x 9'+/- (pump shelf)
- 2' x 4' Expanded Steel (pump shelf - cut to size)
- 1" Bolts (5" and 7"), nuts, washers
- 1"+/- ID Pipe (sleeving for bolts)
- Misc. 1/8" plate for caster mounting.

Utilize drops as shown above in build up article. Misc. notes:

- Ship channel remaining - use for end support in "H" configuration - roughly 5 1/4" h.
- Top plate remaining - use for pocket around bender arms - roughly 5 1/4" h and leg assembly top plate.

Paint

- Self Etching Primer/Machine Paint of your choice