

Instructions for Building a Small Benchtop 20-Ton Hydraulic Press for The Jeweler and Metalsmith

Last Revised: August 4th, 2019

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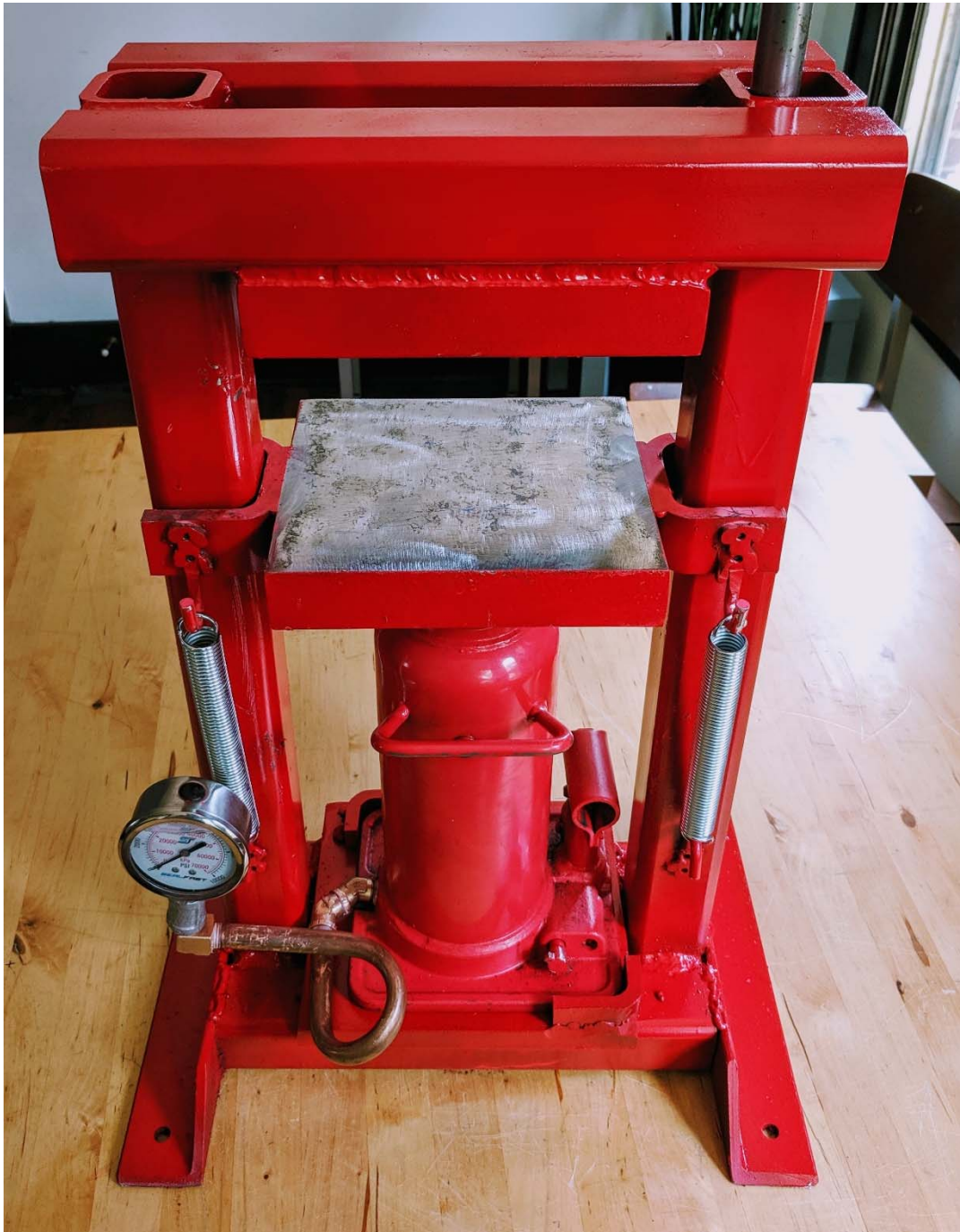


Figure 1: This 20-Ton Hydraulic Press Design with Paint and Springs

Introduction

This is a design for a small benchtop 20-Ton hydraulic press designed for the jeweler and metalsmith. It is my attempt at documenting what turned out to be a very good design



Figure 3: A 12-Ton press frame based on a very similar design to this one

that took cues mostly from what I saw that worked well, and what could be improved upon. You might also use this a starting point and improve on this design yourself too. It is one that can be fabricated easily with commercially available steel. It is my hope that this document may help others to build one too.

It is a modified version of some specifications forwarded to me from J.J. Masuda at *Wayne State University*¹. J.J. kindly sent some numbers for the cuts of the steel that appeared to accommodate a 12-Ton bottle jack.



Figure 2: Press from *Metalsmith Magazine*



Figure 5: Threaded rod press by Robin Casady

There are some plans for a threaded-rod model designed by Robin Casady in the 1993 book *Hydraulic Die Forming for Jewelers and Metalsmiths* by Susan Kingsley². There is also an old image of a custom press from *Metalsmith* magazine.

There are several presses commercially available. To start with, there is the 20-Ton *Bonny Doon*³ press that retails for about \$945, which works very well from reports. There used to be a manufacturer of a "*Dakota Bulldog*"⁴ press that looks to be more like my design, but the company no longer sells them. There is a 12-ton hydraulic press



Figure 4: 12-Ton Etsy "Shark Bite" press by seller called @Grafix

¹ <http://wayne.edu>

² 1993 *Hydraulic Die Forming for Jewelers and Metalsmiths* by Susan Kingsley - ISBN: 9780963583208

³ <https://www.riogrande.com/product/bonny-doon-classic-20-ton-manual-press-and-ram/110501>

⁴ <http://www.dakotabulldog.com/>

maker on Etsy⁵, who is selling a decent-looking one called the “Shark Bite” for ~\$800. Also, there is the Potter USA⁶ press, which also looks very nice too. The Potter presses start at \$1,170.

For those that are looking to build one from scratch or are looking to save some money or improve on a design you have seen, you can make this one for about \$300 - \$500 or less if you are willing to spend the time and effort.



Figure 7: 20-Ton “Dakota Bulldog” press no longer being manufactured

My modified hydraulic press design can accommodate any commercially available 20-ton bottle jack and is slightly taller (23”) and wider (12” total with a 7” wide platen) to allow a broader range of materials. It is a bit heftier than some of the designs that I found. It weighs in at ~108 lbs. with the bottle jack, so it is moderately heavy, but it is fairly compact, can be mounted in a small workspace on a table and can be moved by 1-2 people relatively easily.



Figure 6: Potter USA Press

Note: A lot of the success (or failure) of this design revolves around making really solid welds for the crucial rectangular stress/pressure frame. The rest of the design is not rocket science, but the rectangular stress/pressure frame welds are critical to making it hold up to the 20-ton bottle jack at full pressure.

List of Materials

1. 2” hot-rolled steel square tube, rounded edges with ¼” wall – for the main stress/pressure frame
 - a. Qty 4: 12” long – horizontal supports of frame
 - b. Qty 2: 23” long – vertical supports of frame
2. Qty 2: 6” x 7” x 1 ½” steel plate – For both the welded top plate and moving/floating pressure plate/platen
3. Qty 2: 2” x 2” angle iron, ¼” thickness – 12” long each – for bench legs

⁵ <https://www.etsy.com/listing/53026113/hydraulic-press-for-jewelry-making-metal>

⁶ <https://www.potterusa.com/>

4. Qty 1: approximately 7" x 7" x 1/2" – steel plate for bottle jack base plate. Size is not very important but needs to be 8" or less wide to fit within the pressure frame and probably 1/2" thick or more.
5. 3" hot-rolled steel square tube, rounded edges with 3/8" walls – approximately 4":
 - a. Qty 2: 3" square tube with 3/8" walls, cut in 1 1/2" pieces, rounded edges – for floating pressure platen "C" guides
 - b. Qty 1: 3" square tube with 3/8" walls, but to 1/2" to 3/4" – for creating guides for the bottle jack on the base plate
6. 20-Ton Hydraulic Bottle Jack – Note: Any 20-Ton jack will do, but if you want one with a gauge, the only one I have found is the Japanese Norco jack that has a gauge port, and it retails for around \$200. You can find jacks without gauge ports for between \$30-\$50.
7. 3/4" Steel Rod x 2 feet – to replace the thin short rods that come with bottle jack to raise the hydraulic cylinder.
8. Qty 4: Springs – To retract bottle jack after extended and pressure released (optional)
9. Qty 8: Rope Hooks – To hold springs to retract bottle jack (optional)

Tools Needed

1. **Angle grinder** with ~80 grit sanding discs
2. **MIG welder** for tack welding stress frame in preparation for better MIG/TIG welding. Everything else except the rectangular stress frame can be welded with a regular 120v home MIG with average or minimal welding skills.
3. High-amperage **TIG/MIG welder** (or friend, family, school or business that owns one) – for welding the stress/pressure frame
4. **Steel cutting bandsaw** – The small spring/gravity home shop models will work well

Step 1: Cutting and Tack Welding the Stress Frame



Figure 8: Tack Welded Frames

The stress frame is the primary rectangular frame that will endure all the pressure from the bottle jack bearing down on the work. Here we are intending to create the basic shape and secure the form, but not do the final welds necessary to attach the legs, base plate, etc.

Clean all surfaces that will be welded. Tack weld the 2" square tubes for the rectangular stress/pressure frame together using a convenient welder, making sure to lightly tack the tubing from multiple sides and angles. Be sure to use a right-angle tool to make sure the stress/pressure frame is plumb, and lengths are even and square. Use clamps to make sure there is not any bowing during the welding process.

Tack weld the top 1 1/2" steel plate directly in the middle of one of

the ends. At this point top and bottom are irrelevant. However, the plate you are securing now will become the top plate.

Step 2: TIG Weld the Stress Frame

I chose to ask my brother and skilled welder Patrick to do this part. He has a giant high-power TIG welder and a lot of experience welding. TIGs can have more control over temperature and can create a stronger weld if they have a high enough maximum wattage. You could probably use a MIG welder with this ¼" thick steel, but it would likely need to be a higher watt model, one with more than a home 120v

version to have a deep enough weld. Be sure to weld around all the seams that are exposed.



Figure 9: TIG Wlded Stress/Pressure Frame



Figure 10: Top view pressure/stress frame



Figure 11: TIG Welded Fixed Top Platen of Stress/Pressure Frame

Step 3: Attach/Weld Angle Iron Legs

Now that the stress/pressure frame is solid, everything else can be done via simple/minimal welding techniques without the worry about it breaking under stress. Drill $3/8$ " or larger holes in the 2" angle iron for mounting bolts and weld them to the main stress/pressure frame. Be sure to use the angle grinder to grind down the welds on the bottom and sides of the frame so that the press can sit flush on the table where it will be mounted, and the angle iron will sit flush against the edges.



Figure 12: Sanding frame to sit flat and flush with table and angle iron

Step 4: Attach/Weld Steel Base Plate for Hydraulic Press

Attach the ~6-8" wide steel base plate to the frame that the bottle jack will be sitting on. It is not important that this plate is welded as securely as the stress frame, it just needs to be welded. It can be pretty much any width less than or equal to 8" wide and more than 6". Some bottle jack bases might hang over the front end of the plate if it is less than 7" deep. A good size is 7" x 7" x ½".



Figure 13: Steel base plate with angle iron legs

Step 5: Create Guides for the 20-Ton Bottle and Weld to Base Plate

Take time to center the bottle jack well, as it is critical to the design. Mark the corners of the bottle jack on the base plate with a Sharpie. Cut a small ½" to ¾" thick section of the 3" square tubing to create guides for the bottle jack to sit in.

In a previous version of this document I suggested welding the bottle jack to base plate. However, upon use, I found that the bottle jack base flexes and those welds can break. The bottle jack doesn't need to be affixed for it work well, it just needs to be in the right position. These guides will make sure the jack

is perfectly centered and it can be dropped in and pulled out. Using guides as opposed to welding the jack has the added benefit of being able to remove the jack at any time for adjustment or replacing. In addition, it makes the whole assembly easier to move because the individual parts can be transported separately.

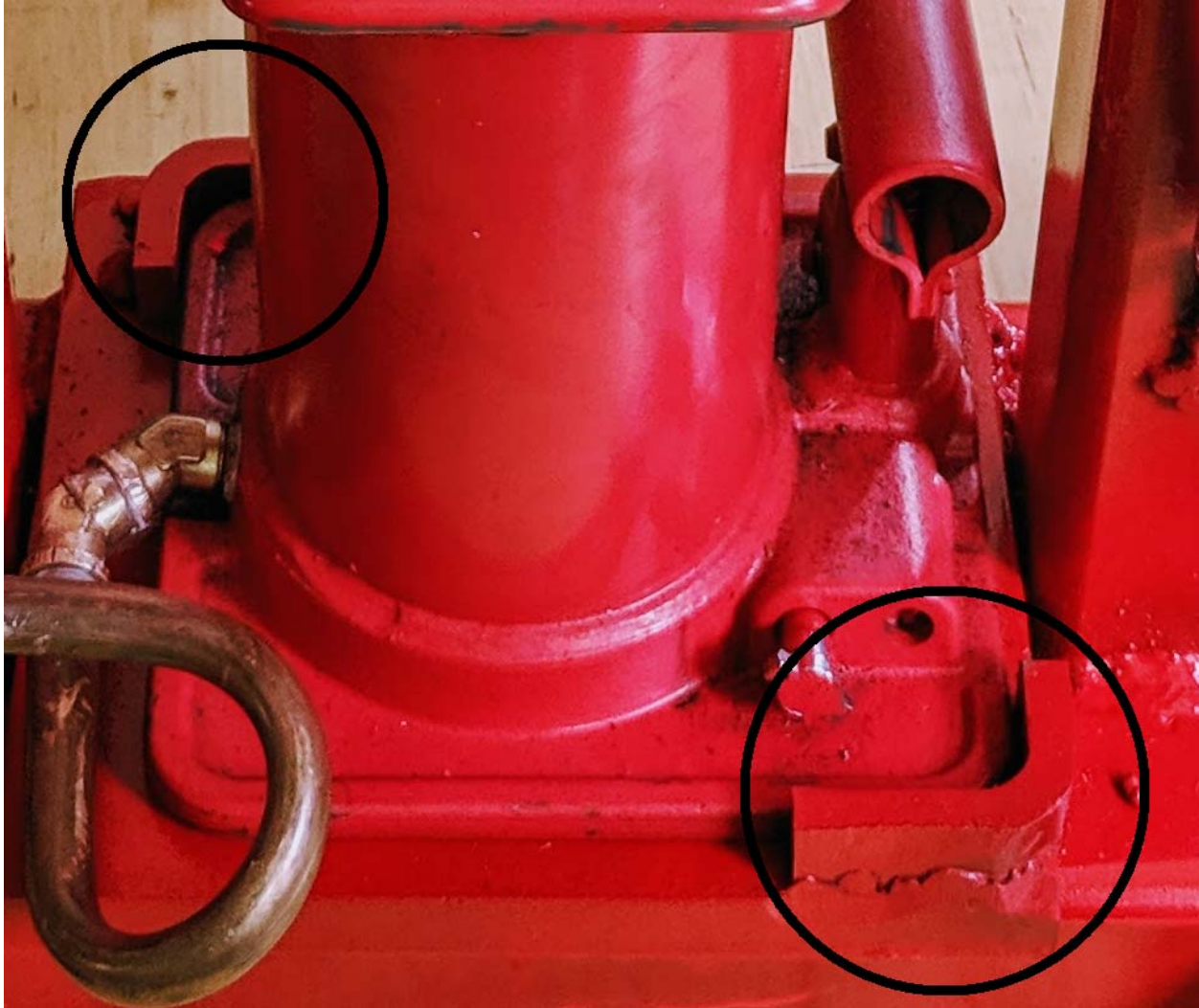


Figure 14: Weld guides for bottle jack from 3" tubing

Step 6: Cut "C" Guides and Weld to the Floating Top Pressure Plate/Platen

The "C" guides keep the floating pressure plate/platen in-line with the fixed top plate, but also provide a bit of forgiveness if the die or form you are pressing does not produce 100% level/parallel pressure evenly across the floating platen.

Cut off the 3" square tubing to 1 ½" thick slices to match the thickness of the floating top platen. Then, cut off a side of the square tubing to make it a "C" form (figure below). With hot rolled steel, there is a nub on the inside where the steel was welded into a tube shape. Be sure to cut off the side of the square with the welding nub so the inside of the "C" shape is smooth. Weld these forms directly in the center of the 6" side of the moving top pressure plate/platen. Use your angle grinder to create a level

surface on both sides. Once welded, the floating pressure plate/platen should be able to be added and removed from the frame at an angle with the bottle jack in-place with the piston lowered all the way and the height adjustment screw lowered all the way too.



Figure 15: Creating "C" Guides for the Moving Top Platen

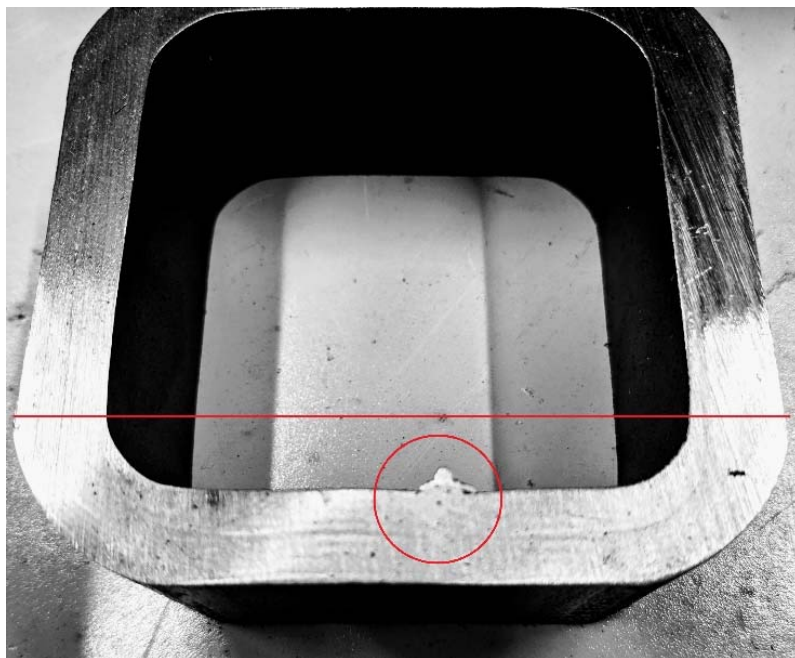


Figure 16: Cut off the side of each with the inside welding nub

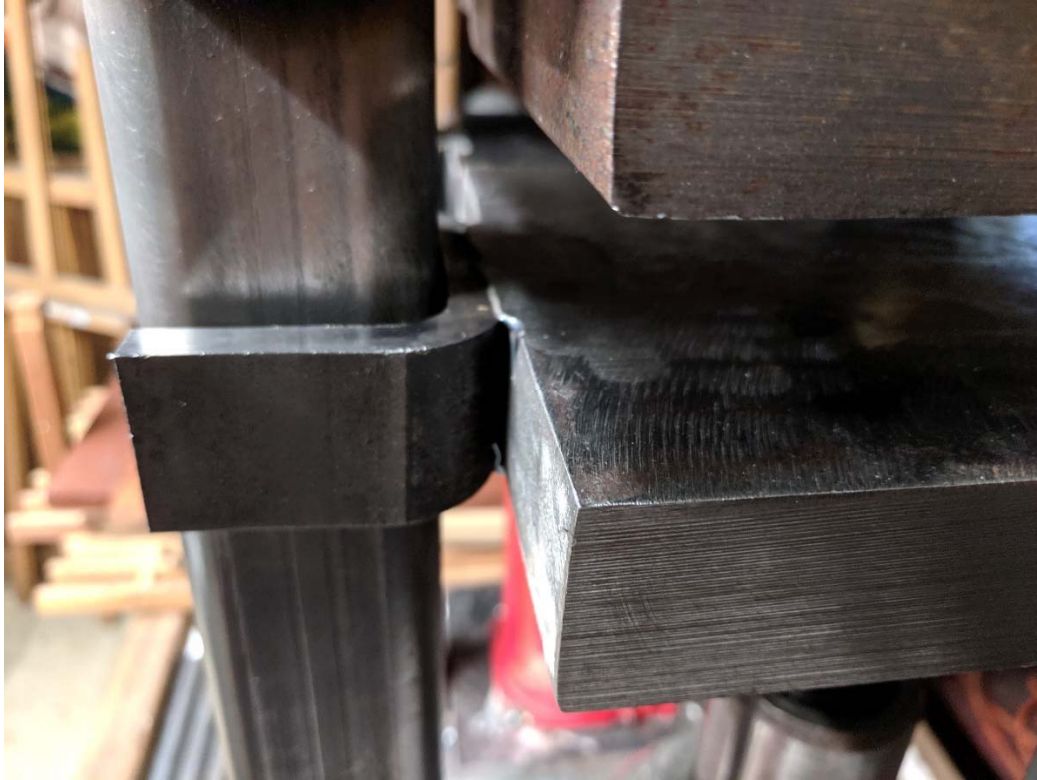


Figure 17: "C" Guides Welded to Moving Top Platen

Step 7: Attach Hooks and Springs (optional)

Even with the heavy plate/platen, the press bottle jack will not quickly return to its recessed position without adding springs to the design or pushing it down by hand. This is not a fault of the general design of the press or bottle jack. These bottle jacks are designed to lift heavy objects like vehicles, which normally have enough downward pressure, after lifting, to retract the cylinder. Adding springs and spring (rope) hooks will make transitions quicker if you are working on production designs that require quickly moving between parts.

Attach the spring (rope) hooks to the "C" guides and the vertical 2" square tubing at the bottom via welds. I would avoid drilling holes in the vertical frame as to not compromise the integrity of structural steel.

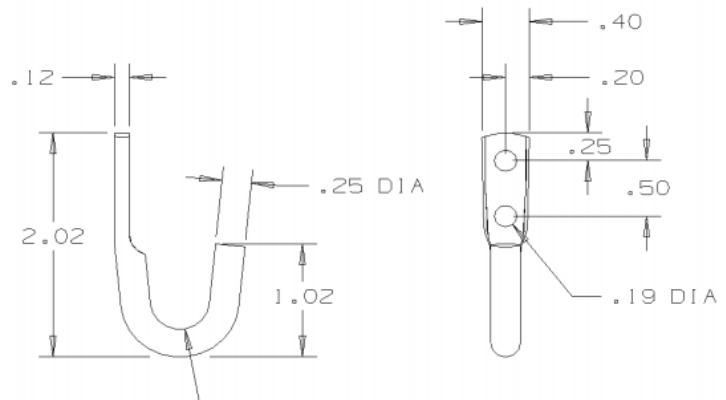


Figure 18: National N220-574 Rope Hooks

I have found that the National 2" rope hook (PN: N220-574) are the right size for the press. You can use something similar, as it is not crucial to the design if they work.



Figure 19: Century Spring C-277 3/4" x 6-1/2" x 0.91"

For the 4 springs, I found that Century Spring model C-277 works well too. You need to make sure that the springs do not

deflect (stretch) too far when the floating platen is extended all the way upward to the top plate. When the hydraulic cylinder is retracted all the way down, the springs should have only slight tension on them, so that it does not extend too far when the jack is raised all the way to the top.

With all 4 springs, the top platen lowers the hydraulic cylinder quickly.

Step 8: Paint Frame (optional)

Given it is raw steel, it will rust over time, even a few weeks. However, this step is purely cosmetic. If you do paint, cover the bottle jack hydraulic seals so that they don't get contaminated with paint.

Step 9: Add Gauge (optional)

If you have jack such as the Norco 20-Ton with a gauge port (model: 76520BG), you can add a gauge to it out of the box. Norco sells a gauge kit for a few hundred dollars, but you can find high quality gauges on eBay for around \$20-\$40. For your gauge, get one that can record pressure up to about 10,000 PSI. 20-Tons (40,000 pounds) of pressure will read about 6,700 PSI. In addition, make sure the gauge has a 1/4" NPT thread.



Figure 22: 10,000 PSI Pressure Gauge

There are some instructions out there for modifying bottle jacks that don't have gauges to add a gauge port. If you are going to attempt to do this, look for a bottle jack that is not welded shut at the base, and is threaded instead. This requires draining the bottle jack of the hydraulic fluid and opening it up.



Figure 20: C-277 welded - only slight tension at rest



Figure 21: Norco 76520BG 20-Ton Bottle Jack with Gauge Port

I have found that brass fittings and tube work best. Steel or galvanized steel pipe for the gauge line don't seem to work well to create the high-pressure seal that is necessary. You will likely need to play around with the fittings and angles to make the fit within the frame. Be sure to seal all threads with Teflon pipe tape. Also, as you add the gauge and tubing to the jack, you will lose hydraulic jack oil. You can pick up hydraulic jack fluid at any auto repair store for around \$5 a quart. All hydraulic bottle jacks have a rubber filler nozzle to add more fluid.



Figure 23: Norco bottle jack with gauge

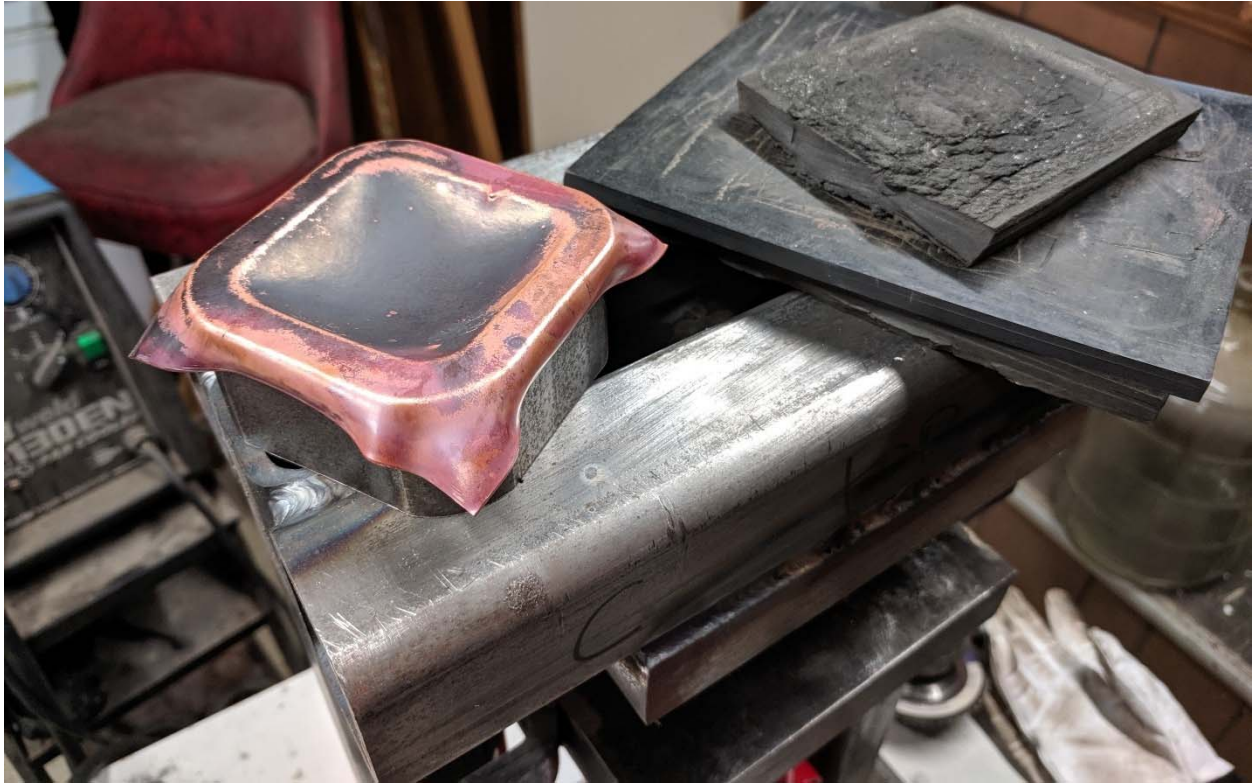


Figure 24: Example pressing of annealed copper using 3" square die