

Bonny Doon Silhouette Die Forming Kit

Created by Phil Poirier

Instructions by Jack Berry

SAFETY

Working with a hydraulic press can be dangerous if appropriate safety practices are not followed. It is prudent to have instructions on the proper and safe way to use a hydraulic press for metal forming. Bonny Doon and the author disclaim responsibility or liability for any injury that occurs with the use of these tools or instructions.

SILHOUETTE DIE FORMING

Silhouette die forming (also called matrix die forming) is a technique where a sheet of metal is forced through an opening in a rigid solid surface. If the target metal is larger than the die opening a domed shape will be formed in the metal leaving a flat flange of surrounding metal. Usually the force is applied with a hydraulic press to a sheet of urethane (a rubber-like material) which then forces the metal through the opening. In an uncontained system part of the force is lost due to movement of the urethane in directions other than into the die opening. The Bonny Doon Silhouette Die Kits have the advantage of using a contained system making the process much more efficient and requiring less pressure to form the metal. Contained systems also allow the use of softer urethane which form target metals more deeply than hard urethane. The entire process is affected by several variables briefly discussed below.

The Bonny Doon Silhouette Die Kit consists of two plates each with several die shapes cut from 3/8" thick steel. A metal containment cup (also called a form box) has openings in the sides at the base to slide the die plates from the side into place for forming and a thumbscrew to immobilize the plate. The cup has an opening in the bottom to aid in pushing any formed metal back out of the die should it stick.



Three urethane pushers included are: a 3/4" thick 80 durometer (medium soft), a 1/2" thick 60 durometer (soft) and a thin (about 1/16" thick) 95 durometer (hard) sheet. These will accommodate various forming situations (depth and definition of forming and embossing). A thick metal "pusher" (sometimes called a platen) is also included to push the urethane into the dies.

PROCEDURE

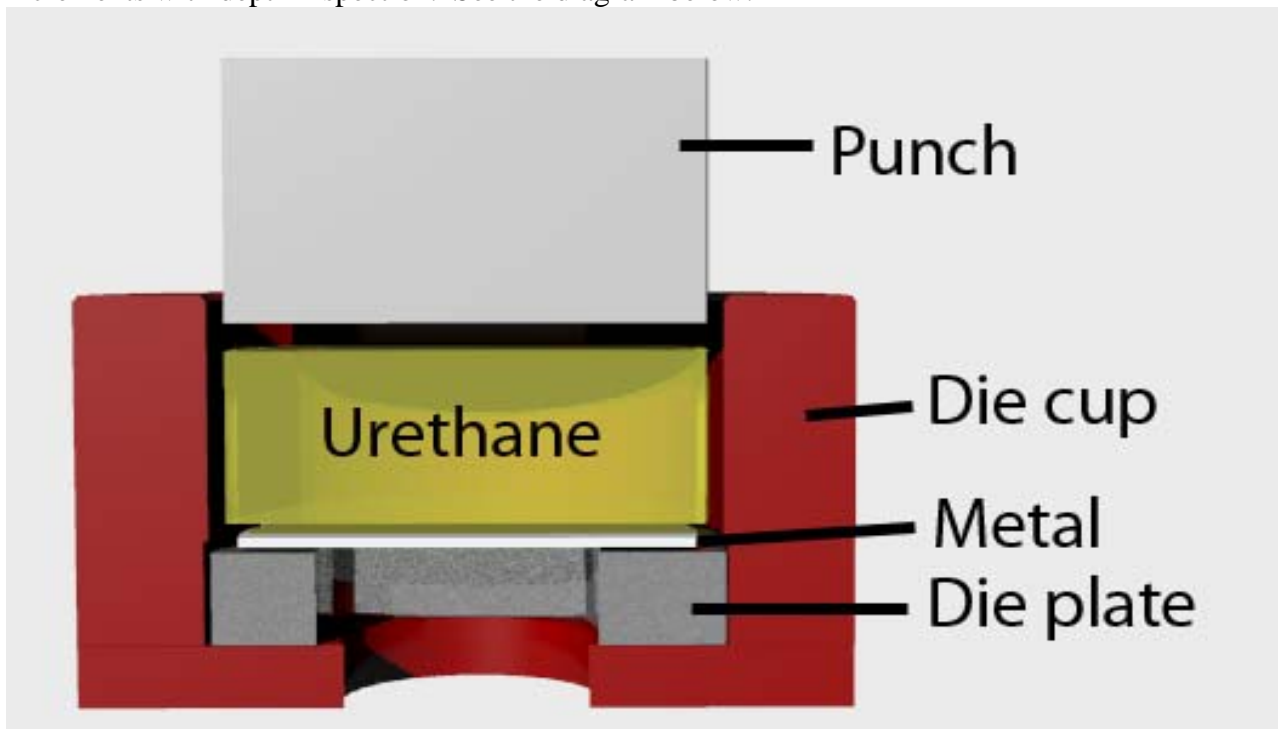
1. The metal to be formed should fit within the cup and the thin urethane disk can be used as a template to cut the circle of target metal when using a full 2" circular metal blank. . You may find it useful to use the thin urethane as a template to cut out a transparent heavy plastic disk. This can then be used to cut out a chosen area of metal (while viewing through the plastic) when using a textured sheet of target metal.
2. Choose the die to be used and slide the die plate into the opening at the bottom of the forming cup so the desired die opening is centered in the cup. Tighten the thumb screw to immobilize the die plate. The die plate should be positioned in the cup so the side with the plate number (#1 to #20) is facing up (against the target metal). This side has been made to give an accurate shape. Do not use the bottom side of the die plate because it has machining artifacts.
3. Place the circle of target metal in the cup followed by the urethane disk to do the forming. Position the metal pusher disk in the cup on top of the urethane.
4. Put the assembled kit into the hydraulic press with the cup centered on the bottom platen. If using a die at the end of a die plate the weight of the unused plate may cause the kit to tilt. This can be stabilized by placing any small object about ¼" thick under the overhanging die plate to support it.
5. Raise the lower press platen to do the forming. Contained urethane is much more efficient so if you have experience with uncontained forming (such as open acrylic die plates) you may be surprised how little pressure is needed to do the same amount of forming with the Bonny Doon kit. Be conservative and check the amount of forming at intervals of pressure. Take notes on the pressure needed (or number of strokes on the jack handle for presses without pressure gauges).
6. You may want to start with the softer urethane (60 durometer) which will form the metal more deeply than a harder urethane. If the edge of the die form is not defined enough (a crisp edge) you can follow with a second pressing using the 80 durometer urethane. This will give the edge more definition.
7. If the die formed edge of the target metal is still not crisp enough (somewhat rounded) press again gently using the metal pusher without any urethane. Only a small pressure is needed for this since there is no loss of force into urethane.

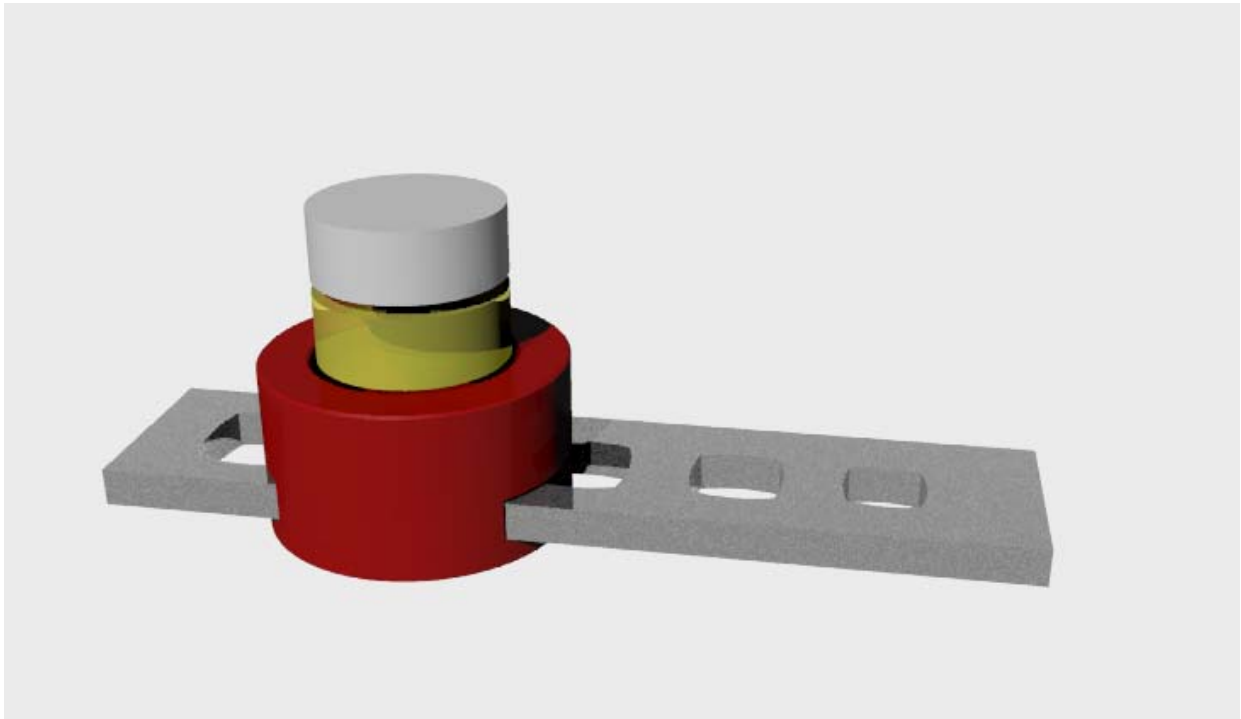
SOME POINTS TO CONSIDER

1. Softer urethanes (like the 60 durometer disk) will move metal more easily and deeply into a die opening than a harder urethane (like the 80 durometer). However, the hard urethane will apply more force to the flange of the target metal making it less likely that the flange will also be drawn into the die. Sometimes it is advantageous to press with hard urethane first to hold the flange in place and start the forming followed by a softer urethane to cause a deeper forming. Typically extremely deep forming in a form box involves some movement of the flange into the die opening. The goal is to have some flange metal move into the die which decreases the amount of thinning of the stretched metal but not so far as to draw the outside of the flange edge into the die giving an incomplete form. For example, if a circle of target metal is drawn into a circular die so a half sphere is formed as the dome without any flow of the flange metal into the die the average surface area will increase by a factor of 2. Thus, the average thickness of the metal will be ½ of the starting thickness (like 20 gauge thinning to

26 gauge). This amount of thinning will be decreased if some of the flange metal is drawn into the die during the forming giving a stronger form. This should not be a large issue with these die plates since extreme forming is usually not done here. See the discussion about form depth in point #5 below.

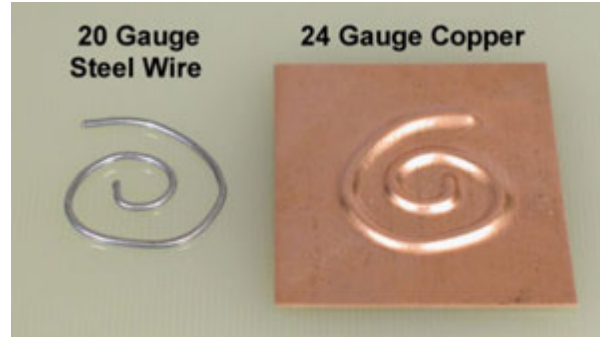
2. As discussed above, using only a soft urethane can also leave a rounded edge rather than a crisp edge where the metal bends over the edge of the die. If this is undesirable you can finish with a gentle pressing without any urethane using the metal pushing disk. This will apply much greater force to the flange edge making it very crisp. If using highly textured metal this procedure can also flatten the texture in the flange area which may or may not be desirable.
3. The heavier the metal formed the greater the pressure needed. Metals textured with folds (such as microfolded sheets) will need very small pressures since the volume formed is primarily done by unfolding the texture rather than stretching and thinning the metal. Thus little or no flange metal is pulled into the die.
4. The smaller the dimensions of the die opening the greater the pressure required to form the metal.
5. The die plates are 3/8" thick so don't try to form metal much deeper than the plates or your metal form could hit against the bottom of the die cup. Since a die form will be domed the center of the dome will be the deepest spot (the apex of the dome). The bottom of the forming cup has a 1" diameter hole so you really can form a dome a little deeper than the 3/8" thick die plate but no area of the formed dome outside that 1" circle can be deeper than 3/8" or the metal dome will hit the sharp edge of the bottom hole in the forming cup. This can increase the depth of forming somewhat but must be done carefully and in pressure increments with depth inspection. See the diagram below.





6. Remember that intensifiers can be used to form resistant shapes like the smallest dies. Intensifiers can also be used to focus pressure on specific areas of the die opening such as resistant corners or narrow areas. Intensifiers are small pieces of urethane placed within the die at areas needing extra pressure. Heavy rubber sheeting or even slices of plastic erasers can be cut to size and shape and used as intensifiers. Giving an intensifier a specific shape can give you great control over the forming process.
7. The dies are made so the edges are very defined (almost sharp). This will give a very crisp edge to reasonable thick sheet metals which are usually used for silhouette die forming using flat sheet to give strength to the form. If you are working with rather thin metals the crisp edges may tear your metal with deep forming. If this is your case you can remove a very small amount of metal from the edges with a very light treatment with 320 grit paper. This will allow the use of thinner metals but still give a crisp edge to thicker metals. When using metals with microfold textures (which are usually thin to obtain the texture) the edge problem is usually of no consequence because the formed volume is made by unfolding the texture and little stress is put on the edges. Another tip is to strengthen thin, textured metals by forming with a “liner” of thicker metal. For example, layer a 24 gauge liner metal on top of the textured metal. The liner and the textured sheet are formed simultaneously and will mate perfectly. You can also include the liner in the finished work to add strength. In any case you should always treat your dies with great care. Even though they are made of steel the edges can still be damaged with neglect. When not in use apply a light coat of household oil to prevent rusting and store in the plastic netting protector it was shipped in.
8. Small areas of embossing can be done very effectively with the silhouette die kit. Slide a die plate into position in the forming cup but center a blank area between the die openings so you will have a plain flat steel area positioned in the center of the forming cup instead of a die. Even better, use a 3/8” thick x 2” wide steel plate (a common size at metal shops) instead of your die plate so you won’t take a chance on damaging your die plate. Place your embossing die (such as a shaped wire) on the steel plate, place your target metal on the shaped wire, followed by the thin (1/16”) 95 durometer urethane. Last, place the metal pusher disk on and apply force in the press. The image below shows a demonstration sample of a shaped 20

gauge steel wire and the resulting target 24 gauge copper sheet after pressing. This was done using the Bonnydoon Lite 12 ton press without a pressure gauge. Notice the very deep embossing that was accomplished. Do not use embossing wire thicker than 20 gauge with this thin urethane or you may tear your urethane. If you want to emboss a longer strip of metal you can slide the metal into place from the side opening and successively emboss it with various patterns as you move the target metal strip through the side cup opening. You are only limited by the width of the side opening which is 2".



Embossing with the Bonny Doon Silhouette Die kit and the Lite Press

9. If you want to use a custom die shape of your own design it can still be done with the Bonny Doon Silhouette Die Kit. For example, cut an acrylic die blank as you would for non-contained die forming but use an acrylic plate that is a 2" diameter circle so it fits into the containment cup. Use a double layer die each of 1/4" thickness (a commonly used size). This will then be 1/2" thick giving plenty of room for the forming and covering the openings in the side of the containment cup. This will prevent a loss of pressure out the side of the cup. Using your own custom die plates (like acrylic plastic) also gives you the opportunity to do very deep die forming by stacking several dies in the cup to increase the distance from the bottom of the die to the 1" hole in the bottom of the forming cup. Of course, you are still restricted to a cup diameter of 2" so this will influence the depth of forming that is reasonable in a particular design. Generally, the larger the die opening diameter the more depth a design can accommodate.
10. If you are using expensive metals and doing many multiples you may want to consider the exact shape of the starting metal blank for economic reasons. A metal blank that is large may waste metal by leaving an excessively large flange that you will remove later. A blank that is too small can result in the metal edge being drawn into the die. You can refine the exact metal blank shape needed to minimize waste. The ideal situation would be to have a blank shape that would allow the desired amount of metal flow into the die opening during forming and giving a minimal remaining flange with little waste. The strongest form possible will be one where there is no stretching and thinning in the formed dome and this requires significant flow of the metal into the die leaving a smaller flange. Several variables affect the process such as the type and gauge of the metal, the required strength of the final form, the die opening size and shape, the firmness of the urethane (measured in durometers), the starting flange size when forming first begins and if there will be a need for a flange to remain for fabrication purposes. Remember that the flow of metal will be different in different areas of the die depending on its shape. Little flow will occur in narrow areas or sharp corners and more flow will be seen in wide areas with gentle curves. A hard urethane will retard the metal flow by holding the flange in place with more pressure than a softer urethane. The larger the size of the starting flange size the more firmly the urethane will be held in place. Finally, you can increase the amount of metal flow into the die by using a lubricant such as liquid "Bur-Life™". This decreases the frictional resistance between metal and urethane and

between stacked layers of urethane in form boxes. The variables are complex and interactive so it is best analyzed with experimentation.

11. Bonny Doon also makes many other die shapes with graduated sizes of the same shape on each plate. These are convenient for making larger and smaller die forms such as matching shapes for earrings and pendants. Custom die plates with graduated sizes of your own designs can also be made by sending 1:1 scale sketch or a sketch with the desired dimensions to Bonny Doon.

SUGGESTED READING

A printable PDF file entitled “Silhouette Die Instructions” under the link [Shoptalk](http://www.poirierstudio.com) at www.poirierstudio.com by G. Phil Poirier.

“Tooling for the Press”, G. Phil Poirier, an instructional CD on the many tools that can be used with the hydraulic press.

“Nonconforming Dies” by Susan Kingsley, in “Metals Technic”, Edited by Tim McCreight, Brynmorgen Press, 1992.

“Hydraulic Die Forming for Jewelers and Metalsmiths” by Susan Kingsley, 20 Ton Press, 1993.