

# **Crafting nickel silver rod components from sheet materials**

**A discussion of the tools and methods employed for forming drawn  
metal parts from flat sheet for low volume requirements**

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# Crafting nickel silver rod components from sheet materials

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## Introduction:

Many bamboo rod makers come to the craft with limited general manufacturing knowledge. We usually begin our journey into bamboo rod making with a focus on how to manipulate the bamboo culm and produce a useful rod shaft. The body of knowledge available to permit one to fabricate the rod blank is broadly held as many individuals are familiar with wood working and cabinet or furniture making and finishing methods and tools. If any impediment exists to the complete construction of the fly rod by the craftsman, it is in the realm of fabricating or forming metal. Certainly there are sufficient quality sources of manufactured metal goods supplying our trade. These firms offer reel seats, grip and cork checks, ferrules and numerous other components to the rod builder and many craftsmen are happy to use them in their work. This article seeks to provide some insight to those who prefer to contribute more to the construction of their rods.

Most craftsmen understand the use of the engine lathe in converting solid bar stock into useful rod parts such as checks, rings and butt caps. Such methods are generally adequate except if one considers the amount of expensive material wasted, cut away or lost and the time on machine required to make the part. There is another way to fabricate many of the same parts with little waste and far less time. While special tools are necessary to employ this process, those who are willing to make the investment in time to make tools could be rewarded with a good supply of rod parts consistent of form, readily at hand and having low cost. Deep drawing is an industrial process long used to produce seamless metal parts. The basic concepts of this method can be adapted to the construction of certain rod parts especially reel seat components.

Fine quality nickel silver reel seat components are available to rod craftsman from professional manufacturers. These components are as good as those that can be made in the shop by our selves if not better. I make nickel silver reel seat components for my own use because I believe that those individuals who purchase one of my rods, which are custom made for them, want their rods custom made in all respects. If you are attracted to the idea of doing the same then the contents of this paper may provide some assistance to you. Keep in mind that for all the effort necessary, a quality purchased reel seat with gleaming nickel silver components is well worth the cost.

Crafting specialty nickel silver rod components from sheet materials can be difficult and time-consuming if undertaken without a clear understanding of the techniques required. Special equipment and knowledge are necessary for this work. The tools and methods discussed herein are intended to be functional and be fabricated at minimum cost and effort. In industry, tools and processes are generally designed to be both economically productive and safe for individuals to operate. Work place safety is mandated by government oversight and institutional policy resulting with constructed tools and designed processes that are safe to operate within established guidelines. No such effort is made here with regard the tools and methods discussed. If you elect to pursue the construction of the tools described and fabrication of parts using the methods later outlined, you do so at your own risk as certain aspects of this work could be dangerous if attempted by individuals without trade experience. Always wear safety glasses with side shields when constructing this tooling or fabricating reel seat parts.

This discussion is specifically limited to a method of constructing cap and ring reel seat components.

I: Material.

Nickel silver has traditionally been the material of choice for many of the metal components of the quality fly rod for many years. The choice of this metal is rooted in its material characteristics and performance. The metal is manufactured in a number of alloys having different uses. We will limit ourselves to the one alloy best suited for our use. Nickel silver 65-18 is an alloy of copper (65%), Nickel (18%) and Zinc (17%). Its technical designation is SAE J463, Copper Alloy C75200. It is supplied to the manufacturing trades in various forms including sheet, strip, plate, rods, bars, tube, shapes and wire. It is generally used to produce parts such as rivets, screws, table flatware, wire, zippers, mechanical parts for optical assemblies, base for silver plated goods such as jewelry and cutlery. Its' copper base make it well suited to cold forming methods including blanking, bending, drawing, spinning and swaging. The alloy has a pleasing silver-blue-white color. Ease of formability, color and good corrosion resistance to organic products including air and water are the characteristics that have made its use in the crafting of quality fishing rod components so prevalent. Other nickel silver and copper-nickel alloys and even aluminum bronze are available and have been used in the manufacture of fishing tackle. Many of them are adequate but all of them differ in at least some of the characteristics that make 18% NS desirable. Alloys of nickel silver having less nickel do not have the bright silver-blue-white color or strength of the 18% alloy. The color of copper nickel alloys is affected by its copper component and does not have a bright silver appearance. Aluminum bronze is difficult to machine.

Properly tempered 18% NS is very strong with characteristics approaching that of 1018 steel. The temper or hardness of NS is an important consideration in our application. As this material is cold worked, bent, swaged, drawn or formed; its hardness or temper increases. This improves the stiffness and strength of the material and is the primary reason that the best ferrules are made from drawn tube having higher tempers. Other forming methods make use of this characteristic. Annealed or quarter hard material may be punched and drawn into shapes. While soft at the beginning of processing, the material progressively work hardens at each step resulting with strong, stiffer parts at the end.

Nickel silver is commonly available in bar, tube or sheet form. The volume of our usage, not being great enough to permit wholesale purchases economically, forces us to seek alternate more economical sources. Compared to fishing rod building, a greater number of artisans and firms participate in the jewelry trades. It is thru their supply network that we may obtain the necessary materials and supplies appropriate for use in the methods described below. Suppliers to this trade are generally described as suppliers of "findings" which are the raw materials, semi-finished parts, tools and such that are necessary to the craft. In addition to nickel silver, these suppliers can provide us with useful solders, pinning wire, special finishes and other metals in rod, tube or sheet form.

Nickel silver sheet or strip is manufactured to standard increments of thickness. In my work I have used #22 gauge (.0253), #20 gauge (.0320), and #18 gauge (.0403) successfully. Sheet sizes available range from 6 X 6 or smaller to as large as 12 X 36 inches. Larger purchases result in lower blank costs.

Drawn metal goods are made using material in sheet or strip form. For our use, #20 gauge or .032 inch thick material is best suited. Knowing that the parts we make will thin out some as they are formed and that finished blanks will require some machining in the lathe, this selection appears to be the best balance of thickness and cost. Most

suppliers can shear your order into strips. If purchased this way waste can be minimized.

The fabrication of drawn nickel silver blanks from which butt caps, rings, checks and other rod parts can be made, is possible with minimal purpose built tools and manual methods. In industry, such parts are generally manufactured on punch presses or transfer presses with complex tooling and run to yield many hundreds of parts per hour. Employing the same basic concepts, it is possible to make economical and successful tooling in our own shop and use them to produce the few parts most craftsmen will need when they need them. It is important to note that the construction of successful tools require that correct design methods, materials and processes be used and that the tools built be employed properly and safely. There are no shortcuts to success.

Drawn metal blanks may be made using a common bench or floor mounted hydraulic press. The best arrangement would be one where the press ram is located above the work. In this way, punches would be pushed into the dies in the normal manner. A press having a five ton cylinder would be adequate for our needs. The hydraulic press I use is rated at ten tons. The fabricated tools necessary are grouped into the following classes. Blank forming tools, to make round flat blanks from the purchased sheet material. Drawing tools, to convert the flat blanks into cups and holding tools, to permit machining and finishing the drawn cups in the lathe.

## II: Part and blank development.

Before one begins to make tools you have to establish the design of the drawn cup you wish to produce. This design will be the basis for calculating the various tool components. If you intend to make butt caps such as those on mortised cap and ring reel seats then the cup inside diameter would be equal to the diameter of the insert you prefer for your rods. I have found that a pleasing result may be had if you multiply the outside diameter of your insert by .82 to establish the height of the finished butt cap. To this you should add additional material to accommodate any error in positioning of the blank at the first draw, subsequent drawing operations and for finish machining. I use a .688 diameter reel seat insert. The finished drawn cup has a height dimension of .625 + .06 -.03 inch. The finished machined butt cap made from this cup is .562 inch tall. With your cup and butt cap dimensions, you may calculate the diameter of the flat blank required. Figure 1 provides guidance for this calculation.

With your cup design and blank diameter established, you may then turn to determining how best to produce the round blanks that will be formed into cups.

drawn cups



sheared strips and round blanks

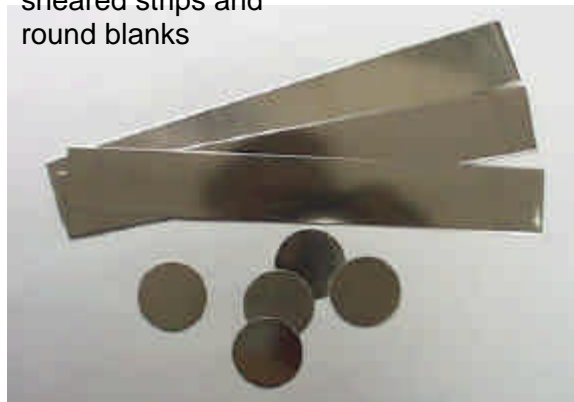
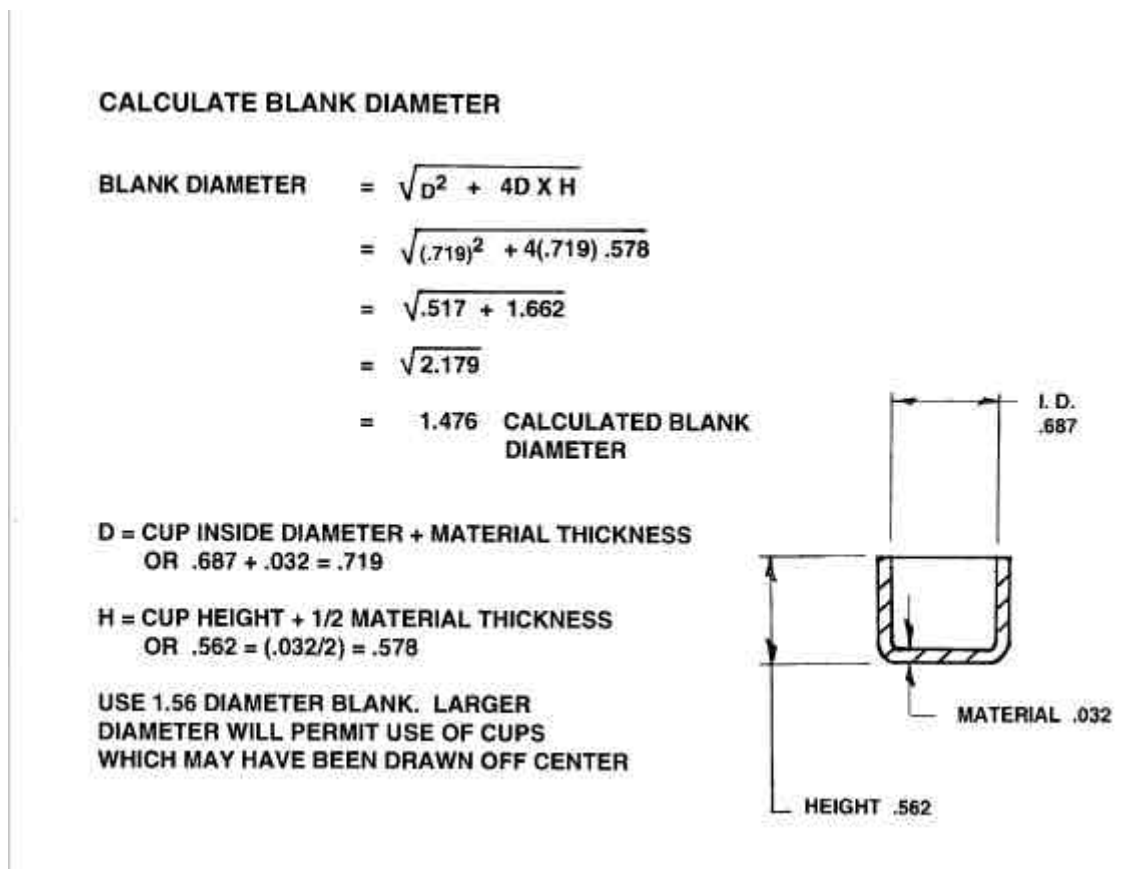


Figure 1. (below)



III: Tools; design and construction.

The tools required to make drawn metal parts from sheet materials take several forms. The drawing process requires circular blanks from which the parts are formed. These blanks are best made using a punch and die. Such a tool will shear consistently round and flat blanks having no tears around their circumference. Blanks may be cut by hand using hand shears (tin snips) but such blanks lack good flatness and size control and their edges are frequently torn. If you choose to use hand shears, you must take care to keep the material flat and to minimize any burr raised around the perimeter. The size of your blanks and their roundness is important and should be controlled carefully. If too small or out of round, the cup formed from such a blank could have a wall that is too short in one place and be useless. I have cut blanks by hand and find that the result is usually poor. Some hand shears have small serrations in the blades that transfer minute nicks into the perimeter of the blank. These nicks sometimes originate tears in the finished cups. Arch punches are available and if your blank size is appropriate for their use then blanks could be cut using a hardwood block set up with end grain to support the work and a heavy hammer to strike the punch. If one expects to make a few cups then hand cut blanks may be adequate. If many cups are to be drawn then a proper blanking die will facilitate making good blanks and not waste material.

Drawing dies with matched punches are used to re-form the flat blanks into cups and reduce these cups to final size. Useful dies and punches can be simply made. Simple holding tools for finishing the cups in the lathe will also be addressed.

### The Blank Die.

A blank die may be fabricated to produce consistently round blanks with a minimum burr. Figure three illustrates a tool intended to be used in a small hydraulic press. When constructing such a die, pay special attention to the relationship between the die and punch working diameters as described in figure two. A punch and die can be easily made using a drill press and the lathe.

The punch may be made slightly smaller than the result of this calculation without serious effect to the to work. Just keep in mind that the greater the clearance between the punch and die becomes, the more likely is the production of an objectionable burr around the blank circumference. This burr may become a hindrance later in the forming process. Make your punch long enough to allow for holding it for placement when in the press.

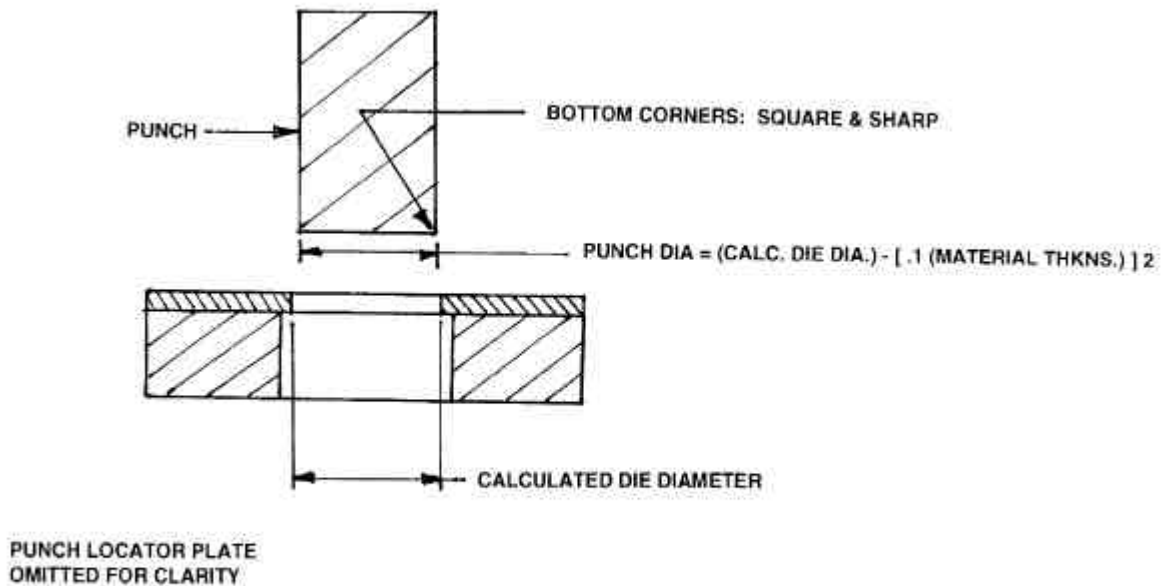


Figure 2.

### CALCULATE PUNCH DIAMETER FOR BLANK DIE

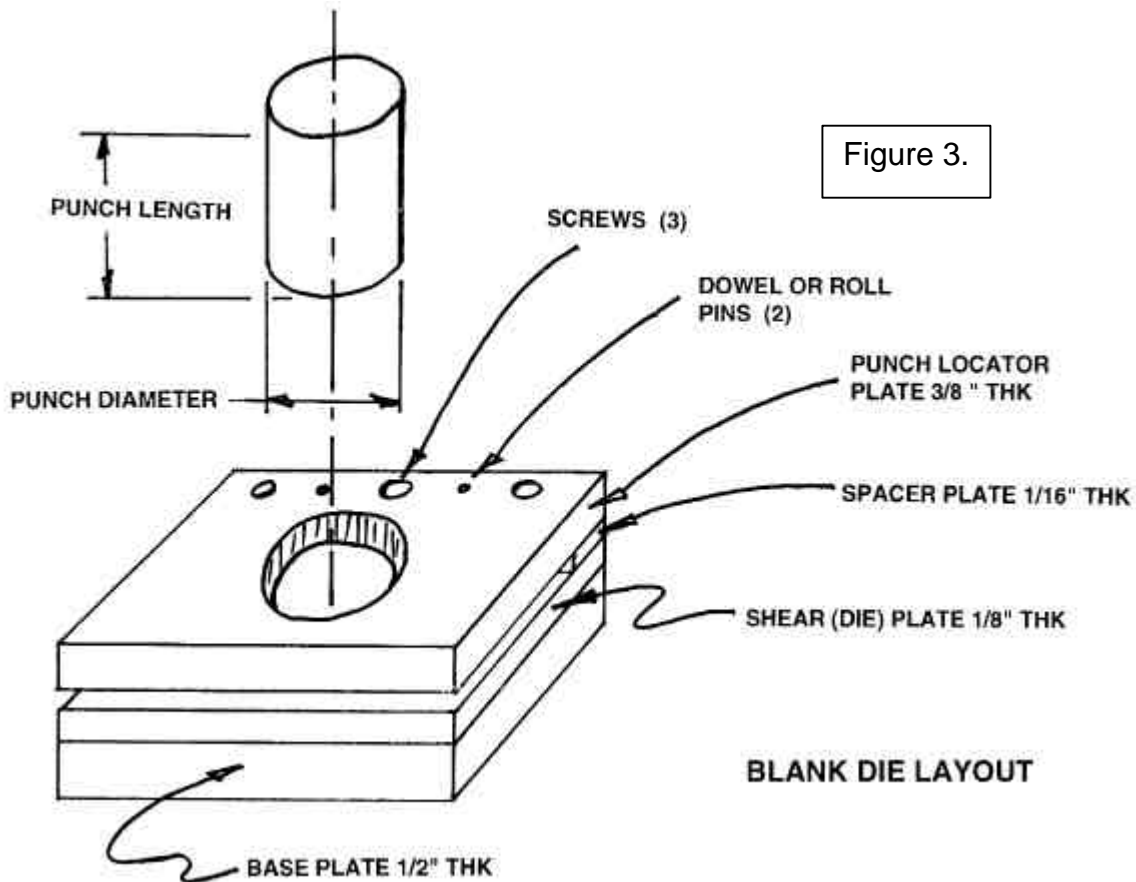
Figure three shows a generalized layout for the blank die. The die is shown as a laminated tool. This type of construction permits the several plates to be stacked up; bolted and doweled together, milled square and then setup in the lathe for the boring of the several diameters required. Boring should be controlled so that the punch locator plate supports the punch central to the hole in the die plate with a minimal clearance of about .002 to .003 inch. The shear plate should be made from tool steel from 1/8<sup>th</sup> to



3/16<sup>th</sup> inch thick. Bore it to the exact blank diameter. The base plate should be bored a bit larger than blank diameter to permit the blanks to fall through with out binding.

When selecting materials for this tool, keep in mind that the punch locator plate and the base plate may be made from low carbon steel or even aluminum. Your punch and die plate should be made from tool steel and heat treated for long life. If you expect to make few blanks than heat treatment can be avoided but if you do so, you must expect the punch and die to become dull much sooner. Use the tool with care to prevent nicks and other damage to the sharp edges of each piece. Do not use ordinary cold drawn or other low alloy steels for the punch or shear plate if you plan not to harden your tools. Such materials take nearly the same amount of time to machine and will not give you good results. Remember to add a spacer plate to separate the shear plate from the punch holder plate and permit room for the nickel silver sheet. After boring the several diameters required, the spacer plate may be shortened as required. To use the finished tool, place your NS material into the space made by the spacer plate and against it. Slide the punch into the punch locator plate, let it rest on the NS material. Apply force to the punch with your press and shear a blank. After producing a blank it may be necessary to drive the punch back out of the die and material with a brass or plastic drift.

Check the shear plate and punch between uses. If rub marks or gouges are observed, touch them up with a hard fine grit stone. The top edge of the shear plate must be maintained sharp and square. When this tool begins to produce blanks with torn or uneven edges or with a large burr, then you will need to grind the top surface of the shear plate or replace it.



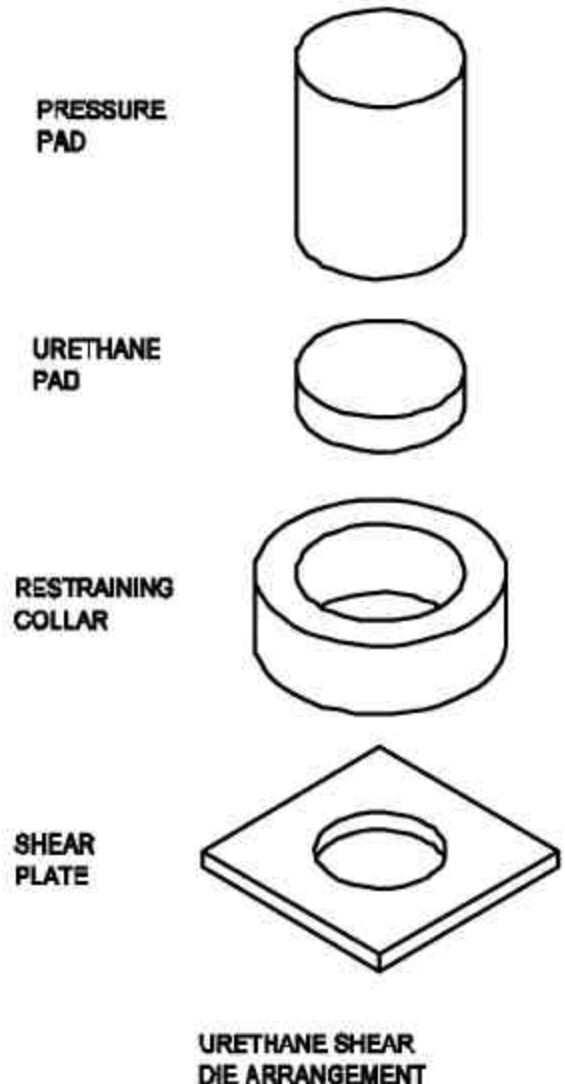
Some suppliers to the jewelry trade offer discs punched from various materials. While comparatively expensive, some craftsmen may wish to purchase these finished discs in lieu of making their own tools and stamping their own parts.

Alternative blank making tools.

During the 1930's a process was developed as a method of producing small quantities of formed aluminum parts to support the construction of aircraft. At that time, aluminum usage in aircraft construction began to grow and economical methods of manufacturing at lower quantities were required. Parts were large and quantities were small. The need to easily make changes and the high cost of hard tooling drove development of this new method. This process became known as "Rubber forming" and has evolved into an efficient solution for certain manufacturing problems. In the case of the production of net-formed flat blank parts or for our use, the making of round blanks, a later development of rubber forming offers an interesting alternative to the hard tooling described earlier.

Briefly, a steel die plate is used with a hard polyurethane pad. The plate has a hole cut thru it in the form of the flat parts desired. It is placed upon the press platen, the raw material is put on the plate, the polyurethane pressure pad is located upon the material and the press is used to apply pressure onto the polyurethane which presses upon the material and forces it into the hole in the plate, shearing it at the same time. It is more complicated in practice as the polyurethane must be restrained in order to control its flow and pressure must be applied to the pad across its entire face. Compared to the use of the punch and die, it requires more time to produce parts as the several components of the system must be removed from the press and re-stacked with every part made. It has the benefit of being easier to construct.

The shear plate may be any tool steel or even mild steel if few blanks are required. Select a thickness of at least 2X the blank thickness. The nature of tool steel will permit the shear edge to remain sharper, longer. Mild steel will not support the shear loads as well and begin to round over after only a few blanks. As this occurs, more force will be required to shear the part and the part will likely become stuck in the shear plate. Polyurethane sheet having a high hardness is selected for the pad. A minimum hardness of at least 95A is required with better results to be had if harder material of 75D is used. A ¼ inch thick pad will be sufficient. It should be sized to be about ¼ of an inch larger than the perimeter of the part you wish to make. Minimize this overlap



so as to better manage the volume of the polyurethane pad for when the volume of the pad grows so will the force required to shear a part. Take care to cut to a round shape to nest closely into a steel restraining ring having walls of at least 3/8 of an inch thick and being about one inch high. Make a pressure pad from steel that will fit into the restraining ring with only about .005 to .012 inch clearance. It should be tall enough to permit it to be manipulated by hand.

In use, a flat steel plate should be placed in the press to protect the press platen and provide a clean flat surface to support the shear plate. Place the NS sheet onto the shear plate allowing at least 3/16 inch between the edge of the sheet and the edge of the hole in the die. Onto the NS place the restraining ring central to the hole in the die. Insert the polyurethane pad and place the steel pressure pad in the restraining ring upon the polyurethane. Centralize the whole under the press ram and apply force to the steel pressure pad. The press force will be transmitted into the polyurethane pad. The fluid nature of the pad when under pressure, will force the NS into the hole in the plate, shearing it as a result. A small bump may be seen in the platen movement as the blank shears. An audible snap is a more likely demonstration of the shear having occurred. Once sheared, remove the press force, open the press and remove the die assembly and separate the blank from the shear plate. This method will require much more force to be successful. A 15 ton press would be a minimum requirement.

This process has interesting applications in other places in rod making. Ferrule moisture plugs may be made in the same way as our cup blanks. The tools for these very small parts would by necessity need to be much smaller. Nickel silver frames for stripping guides can be easily produced. Hex shaped grip checks may be made by forming a hex shaped hole into a shear plate. Make another thinner plate having a round hole with a rounded-angled top edge and apply it concentric to the plate with the hex and in this assembly you may draw and shear your round grip checks with a hex shaped hole for the rod shaft.

#### Drawing dies and punches.

In order to convert the flat blanks into cups you will need to construct two sets of draw dies and related punches. For our needs they can be quite simple and basic in layout. You will need one die to make the first draw, which is a shallow cup much larger than the finished part diameter. A second die will be required to draw the part to the finished diameter. Draw die and punch dimensions must be calculated using dimensions from your part design sketches. See figure four, table one and table two for details. Drawing dies and punches must be made from steel. For best results, choose a tool steel and heat treat the finished dies. Low carbon steel may be used but only if the finished tools are case hardened. Tool steel such as O-1 or D-2 types are preferred. Heat treat to RC 56 to 60 minimum. Lay out your dies along the lines of those illustrated in figure four.

Make your drawing dies in the lathe. When boring the diameters, be careful to use higher speeds and slower feeds in order to obtain the best possible finish. When forming the mouth radius on your dies, be very careful to make them truly tangent to the draw diameter. When the dies are made this way, the drawn cups can be removed from the punches with little effort. If the dies are made with an angular transition or a secondary radius between the mouth radius and the draw diameter, the cups will be formed firmly onto the punches requiring a higher force to strip them. Layout your design so that the top of the first draw die is flush with the top of the die holding plate.

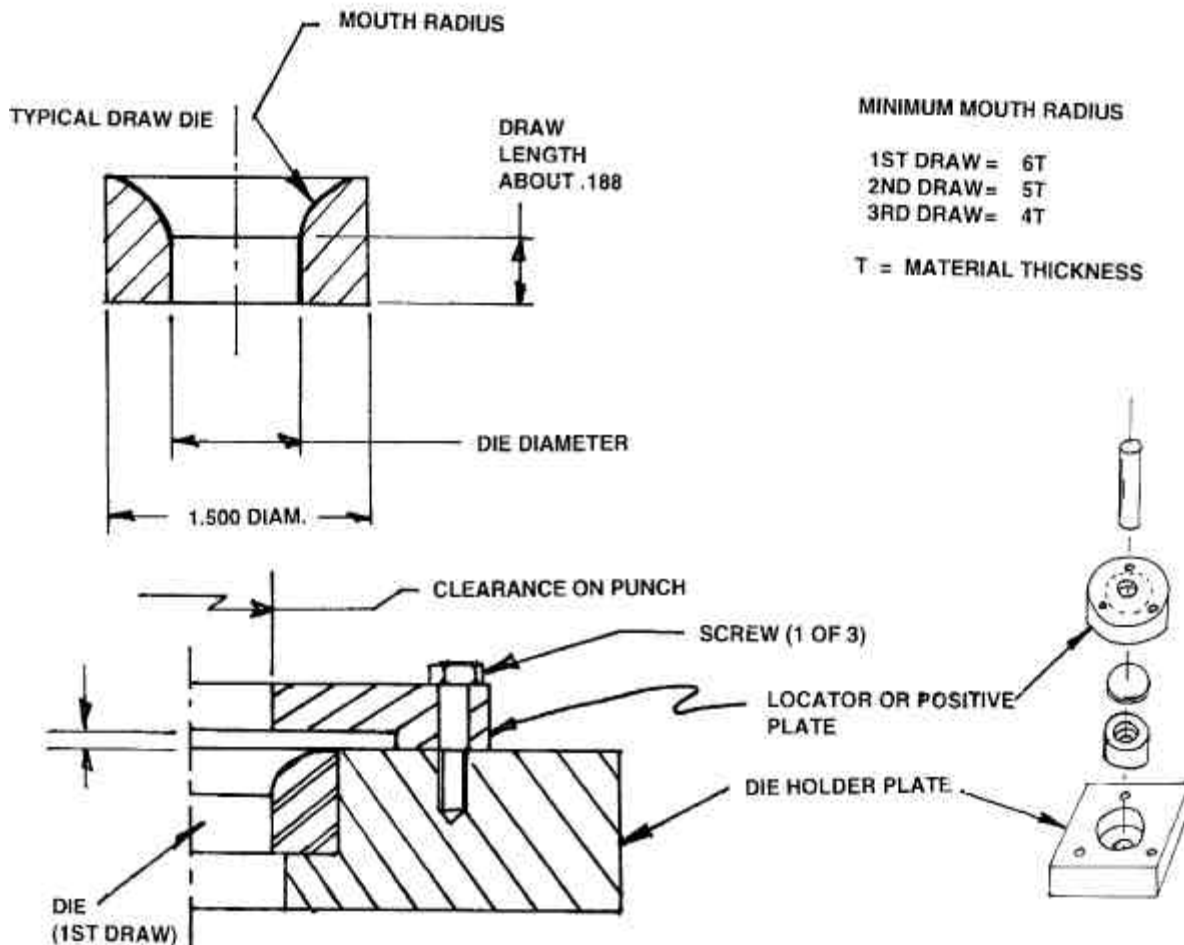


Figure 4.

This will allow the blank to be located flat against the die and permit it to be controlled by the locator plate set previously concentric to the die. Dies for subsequent draws should be dimensioned so that they protrude about an  $1/8^{\text{th}}$  of an inch above the plate to permit the cup and punch locator details to be concentrically located. See figure five. Allow from two to three thousandths of an inch finish allowance for polishing the mouth radius and draw diameter. Be prepared to spend a lot of time to polish to a mirror like finish before and after heat treatment.

Drawing dies should be heat treated to increase the hardness of the working surfaces, permit this surface to be polished to a high finish and resist scratches and scrapes from use which will effect the forming of cups. Drawing punches need not be heat treated for our use but will serve longer and with fewer problems if they are. My dies are made from either O-1 or D-2 steel and are heat treated to RC 56-60. If you cannot heat treat your dies professionally, consider the use of Casenite for the application of an adequate case hardening in your own shop. After heat treatment, polish the mouth radius and draw diameter to a high luster. Start with 240 grade paper and work up to 600 grade. Internal surfaces are best polished with abrasive paper wrapped over the end of a wood dowel. Inspect your work with an eye loop or other magnifier to be sure you have removed scratches from the previous grit. Wash the die or punch when changing grits to

be sure that no traces of the previous abrasive remains. The high polished surfaces permits the material being formed to flow readily over the tooling surfaces and permits formed cups to be removed from the punches easily.

Drawing dies, if used un-hardened will wear quickly and become scratched. These imperfections will be transferred onto the drawn cups, injuring the finish and will cause more press force to be required for the drawing operation, risking injury to both the operator and the tools. Be careful to keep them meticulously clean during use and avoid all scratches. Polish out any scratches as they occur before continuing to form cups.

Table 1.

Reduction calculations

Thickness of material	% reduction from blank to first draw	% reduction from first to second draw	% reduction from second draw to third draw
0.020	35	21	20
0.025	39	22	21
0.030	42	23	22
0.035	44	26	26

% Reductions noted are maximum figures. Aim for 95% of these numbers.

Reference calculations using maximum reductions:

Calculated blank diameter = 1.56 (.032 thick material)

Draw diameter for first draw =  $1.56 - [1.56 (.42)] = .9048$

Draw diameter for second draw =  $.9048 - [.9048 (.23)] = .6967$

Note: Draw diameter - material thickness = punch diameter.

Draw diameter + material thickness = die diameter.

Turn your punches from tool steel with a  $1/16^{\text{th}}$  or  $3/32^{\text{nd}}$  inch radius in the end intended to be applied to the material. O-1 steel is readily available and easy to work with. Size the punches so that they will be long enough to hold while in the press to get them started in the die. Be careful to start the punch square to the die. When machining your punches in the lathe, take special care to keep them truly cylindrical. Punches with negative draft will allow the cups to stick firmly onto them. When using your tools for the first time you may find that the cups will not strip from the punches easily. If this is so, you will need to refine the transition between the mouth radius and the draw diameter. If a refinement effort does not improve results then you may reduce stripping forces by applying a small square of common plastic trash bag plastic between the punch and the material of the cup before drawing the part. The polymer film acts as a lubricant and will permit easy extraction without any measurable change to the part dimensions.

## Auxiliary tools.

The last group of tools includes those that help locate the blank and cups on the dies and those necessary to strip the formed cups off the punches. To make the first draw (form the flat blank into the larger cup) a method of controlling the location of the punch and blank central to the first draw die is necessary. This locator plate or "positive plate" will also be used to manage the flow of the blank over the punch and into the die. Without it, too much material will enter the die too soon resulting with wrinkled and torn cups. Machine it from any steel after the layout noted in figure four. The space indicated must be made to be equal the material thickness plus about .002 inch. When boring to allow for passage of the first draw punch, allow clearance of about .003 to .005 inch.

Table 2.

### Calculate punch and die diameters

First draw:  $.9048 - .032 = .8728$  (punch diameter)  
 $.9048 + .032 = .9368$  (die diameter)

Second draw:  $.6967 - .032 = .6647$  (punch diameter)  
 $.6967 + .032 = .7287$  (die diameter)

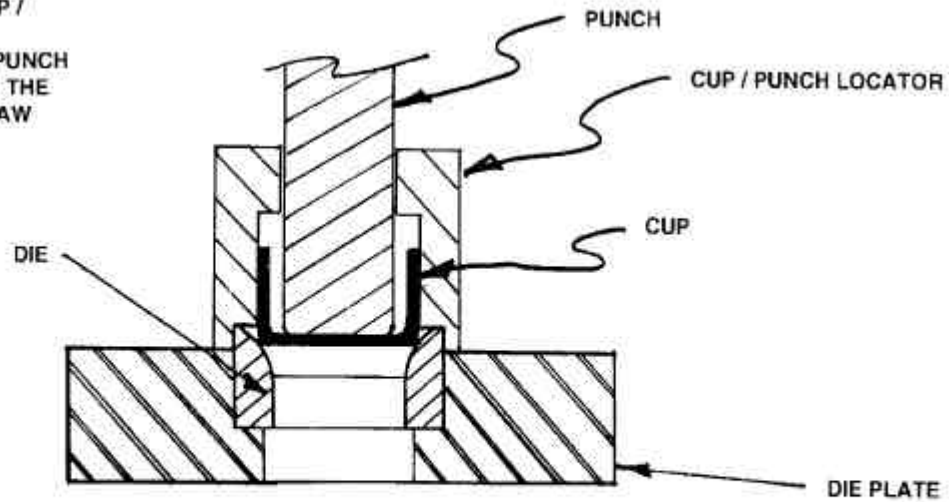
Note that the calculated punch and die diameters of the second draw is less than the required dimensions of the finished cup. These diameters should be adjusted to .688 for the punch and .751 for the die.

In order to convert the first drawn cup into a finish drawn cup a method of locating both the first drawn cup and the second draw punch concentric to the second draw die must be devised. This cup / punch locator may be made after the layout described in figure five.

The remaining tool necessary will be used to strip the formed cups off of the punches. This tool works in the manner of a mechanics linear impact hammer. Make a stripping plate that may be held in a bench vise that has two holes bored into it, each being a slight (about .002 inch) clearance diameter on your draw punches. Drill and tap the end of your draw punches with at least a 3/8-16 thread. Thread one end of a fourteen inch long piece of round bar stock to fit and tread the O.D. of the other end this rod to accept a large nut. Complete the tool by making a large sliding weight from some round steel about 2 inches in diameter. Bore a hole thru the center to pass the round bar . Slide the weight onto the bar and retain it with a nut. To strip a part off the punch, clamp the stripping plate into your bench vise, insert the punch with the cup on it thru a hole and apply the impact rod and weight. Bring the cup up against the plate and carefully remove the punch with several blows of the weight against the nut.

When using these manual methods of drawing cups I found that it made sense to make a couple dozen cups or more at one time. These would be kept until needed to finish a rod project.

NOTE THAT THE CUP / PUNCH LOCATOR CENTRALIZES THE PUNCH AND THE CUP OVER THE DIE MOUTH AND DRAW DIAMETER.



DIE SETUP FOR SECOND AND THIRD DRAWS

Figure 5.

The press.

Of all the operations we will perform in our press, the first draw or that operation that converts the flat blank into a shallow cup having a large diameter requires the largest amount of force to accomplish. The force required to draw a cylindrical cup is calculated by using the formula that follows. Where  $F$  = force,  $D$  = (outside) diameter of the cup,  $T$  = wall thickness of the cup and  $UTS = 63000$  psi for 18% NS. The force is then  $F = \pi \times D \times T \times UTS$ . Here it calculates to:

$$F = 3.1416 \times .936 \times .032 \times 63000$$

$$F = 5928.12 \text{ lbs force}$$

$$= 2.97 \text{ tons force}$$

As we will be using a manual press and insert tools and materials by hand the relationships between the parts will not likely be straight and vertical. This will require more force in order for the tools to work as expected. For this reason we should allow for about 25% more force. This considered, a press having a five ton capacity would do for the drawing operations. The force required for shearing a round blank is rather less. The force required to punch a hole is calculated by using the formula that follows.

Where F = force required, P = perimeter of the blank, ST = stock thickness and S = material shear strength (for NS it is 58015 lbs/ in<sup>2</sup>.) The force is then  $F = P \times ST \times S$ . Here it calculates to:

$$F = 1.9113 \times .032 \times 58015$$

$$F = 3548.3 \text{ lbs force}$$

$$= 1.77 \text{ tons force.}$$

The five ton press therefore will provide adequate force to accomplish both tasks.

The press noted above may be of any convenient type. Hydraulic presses are widely available and have the added benefit of applying consistent force. It may be bench style or floor mounted and need only have sufficient rigidity to resist deflection and ram travel or stroke as required for our needs. A mechanical press such as an arbor press is not a good alternative as this press cannot apply force consistently and may permit tools and parts to become stuck fast together. Shearing blanks would also be difficult due to the need to apply the presses rated capacity all at one time to overcome the shear strength of the material. The arbor press would also require a third hand to manipulate the various tooling components during drawing and punching.

It is always good practice to wear safety glasses when forming parts in the hydraulic press.

#### Making drawn parts.

When making round blanks bear in mind that not all blanks will yield useful parts so make more than you'll need. Take care to pay close attention to the details when making the first draw. Make sure that your tools are clean and free of grit and are well supported. The blank holder or positive plate must be well connected to the base plate without any movement permitted. If the space allowed for the blank is too large or the holder permitted to move vertically, too much material will enter the die resulting in a ruined cup.

If after the first draw numerous and deep wrinkles are observed around the top of the cup and lines on the sides of the cups suggesting folds then it may be that the mouth radius of your draw die is too large requiring another die with a smaller radius be made. Modest wrinkles around the mouth of the first drawn cups will be removed for the most part when they are drawn to the finished diameter.

Be careful handling the raw material nickel silver. The sheared strips may have sharp edges when you receive them. They most certainly will after you make round blanks. Assure the material is clean before you draw your cups as any grit on the blanks will scour the dies making scratches and effecting the finish on the cups.

Double check your tool setups before applying force to them in the press. If not correct, remove them and re-order them. Do not subscribe to the reasoning that more force is better or that more force will correct problems. If the tool components are not correctly used, or not in correct order or attitude, you will likely injure yourself or the tooling.



Converting drawn cups into butt caps, rings and cork checks.



**Cap & ring reel seat parts made from drawn cups**

With drawn cups in hand you can begin the process of making finished cap and ring reel seat components. As before, several tools must be constructed to facilitate this. These tools will be addressed as we progress thru the remaining description.



**Finished reel seat**

### Grip Check

In order to prevent the chuck jaws from crushing the cup while you are turning it, a filler piece turned to fit very close to the inside diameter of the cup is required. Insert this filler into the cup permitting a bit of space to remain between the bottom of the cup and the filler piece. Insert the whole into your chuck. Check for minimal run out adjust as required and tighten. Center drill, drill and bore to suit your previously made reel seat insert. Deburr and polish the protruding cup blank. Part off to .078 wide. Buff to a high sheen. If you expect to use the same design of insert then a urethane blanking die may be constructed to facilitate this hole. Such a tool may be turned in the lathe to accommodate the O.D. of the cup. A urethane tool has the added benefit of requiring less time to blank the hole. Once blanked, the check can be parted off to size in the lathe.

**Machining the grip check**



### Butt Cap Tools



**Turning mandrill and cup**

Before turning butt caps you will have to make a couple of simple tools. The first is a turning mandrill. This tool will be used to hold and turn the but cap blank in the lathe. Make it with a radius or chamfer sufficient to permit it to reach onto and contact the bottom of the cup. Sufficient space between the chuck jaws and the located cup should be allowed to permit the approach of your cut off and knurling tools. The second is a pressure pad. Make this from material not likely to

mark or indent your cup such as Delrin (acetal), nylon or even PVC. Chuck an appropriate piece of plastic. Turn to a diameter about .030 smaller than the cup O.D. and long enough to permit your lathe tools to clear the tailstock and center when this tool is in use. Face and center drill, part off and de-burr.

## Butt Cap

Chuck your previously made turning mandrill and slide a cup onto it. Place the pressure pad against the bottom of the cup and hold it in location. Insert your ball bearing tailstock center into the tailstock and slide it over to the pressure pad picking up the previously drilled center hole. Secure the tailstock and



**Setup to turn the butt cap**

apply modest force against the cup/pressure pad with the tailstock screw. This force will create friction between the cup and the end of the mandrill permitting the cup to be turned successfully. Check the cup blank/mandrill for minimal run-out. Adjust to be less than .005 inch. When adjusted and secure, turn the cup blank removing no more than .005 inch to just clean up the exterior and make it truly round. Switch to your parting off tool and establish the top or height of the butt cap to conform to your design. Do not penetrate into the turning mandrill but let about .003 to .005 of the cup remain under the parting tool. Carefully debur and Polish your work starting with medium fine sand paper strips working up to fine grits and then to steel wool. Knurl to suit if desired. Remove the pressure pad and carefully polish the entire cap avoiding the knurling. Remove from the lathe. Grip the waste portion of the cup previously held in the chuck with a pair of pliers and give it a slight twist to shear the web and separate it from the cap. Be careful, as a sharp edge will remain on both parts. Debur this edge and buff the cap to a high sheen.



**Finished butt cap**

## Slide Band

Set up as if for a butt cap. Establish the left edge of the ring in the same way that you did for the height of the butt cap. Contour the ring surface if desired and polish. Knurl if desired. Part off as before to the desired width. A lathe carriage stop with dial indicator will make turning, knurling and cutting off the ring more precise. Remove the ring and remaining cup part carefully. Gripping the turned pieces with a portion of rubber inner tube helps.

It may be desirable to form a slight conical taper on the inside of the slide band to facilitate its gripping of reel feet. This may be done using the tapered portion of a #2 Morse Taper shank tool. A hole equal to the inside diameter of your cups drilled into a block of steel will assist in driving the finished ring onto the taper shank. Use care to taper the ring just slightly as too much stretch will cause the ring to split. Grip the altered

ring with a portion of rubber inner tube to facilitate removal. Do not strike the ring as it is easily marred.



**Turning the slide band or ring**

## Polishing and Buffing.

After machining your checks, cups and rings; you may want to polish and buff your parts in order to improve the finish. Before removing them from the lathe,

you may polish the part with strips of fine grit sand paper working from 320 grit to 600 grit. After sand paper polishing you may also continue with first medium and then finer grades of steel wool. This process will provide an adequate finish for many. Keep in mind that polishing knurled parts will injure the knurling. Knurled parts should be buffed, not sand paper polished. Better still, polish those parts you wish to knurl prior to knurling. Then knurl in the normal way. If a higher luster is desired, you may buff the previously polished parts. Buffing may be done with linen or cotton buffing wheels mounted on high speed horizontal arbors. A buffing compound is applied to the rotating wheel and the part lightly applied to the rotating wheel. Select compounds intended to buff soft materials such as silver and gold. Follow wheel and compound manufacturers directions for best results.

Take care when presenting reel seat parts to the rotating buffing wheels as they may be easily snagged and thrown by the rotating wheel. Wear your safety glasses when buffing. Thrown parts are generally projected toward the floor but may be thrown toward your person.

**Warning:** Always use safety glasses when operating power equipment and machinery. Seek the guidance of experienced operators or learn the necessary skills before attempting to follow these descriptions. Machining metal is inherently dangerous.

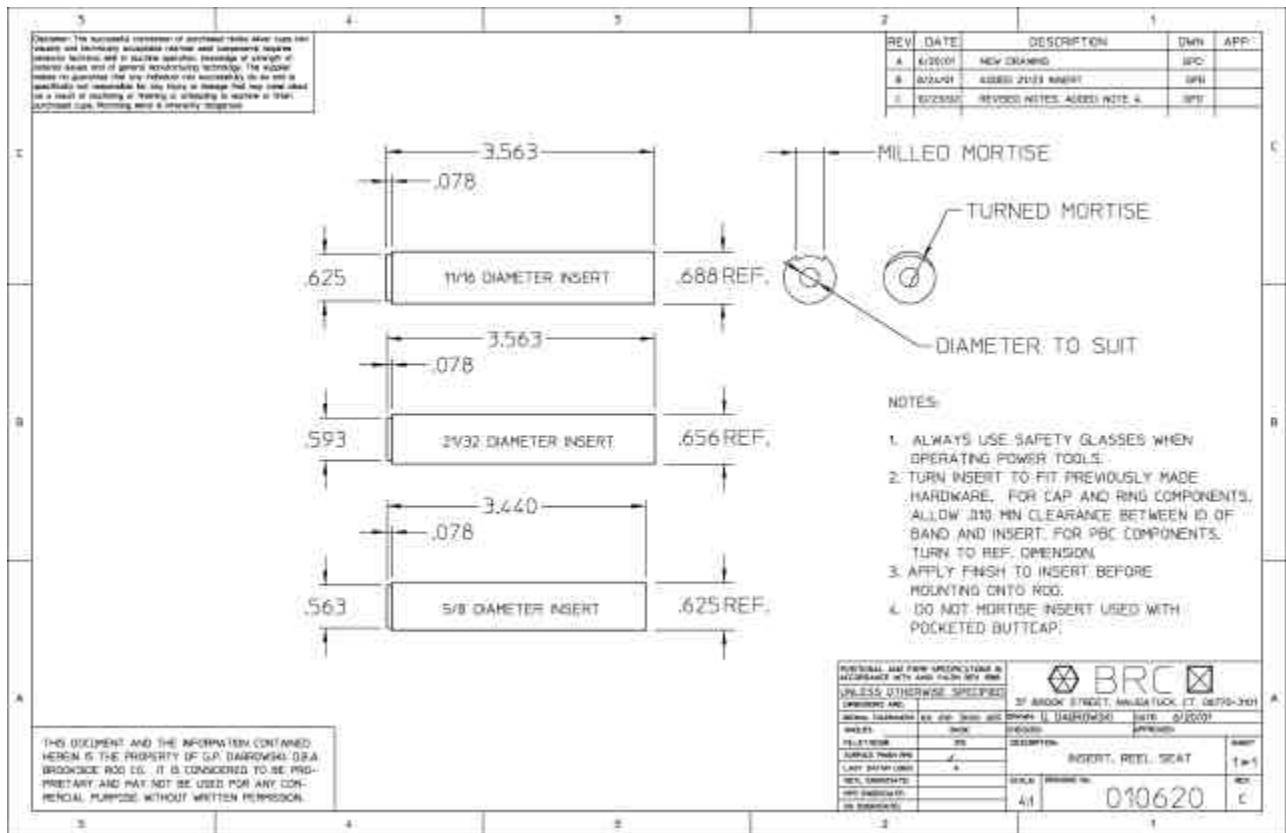
Conclusion.

The tools and methods described are just one way of accomplishing the result of making economical reel seat components. I'm sure there are others, some of which may be better. The intention of this article is to share useful knowledge and experiences with other others and to stimulate thinking, creativity and the use of new methods in the building of fine fly rods. The most satisfying aspect of these methods is their ability to permit rod craftsman to produce nickel silver reel seat hardware to their own design and style sense.

The method of making reel seat parts from sheet materials suggests the possibility of using materials other than nickel silver. Using these methods, sterling silver, jewelers bronze (a gold substitute) and aluminum may be formed. Each having its own application for a particular rod project. With correctly sized presses, nickel silver and brass may be formed into rod tube collars and caps.

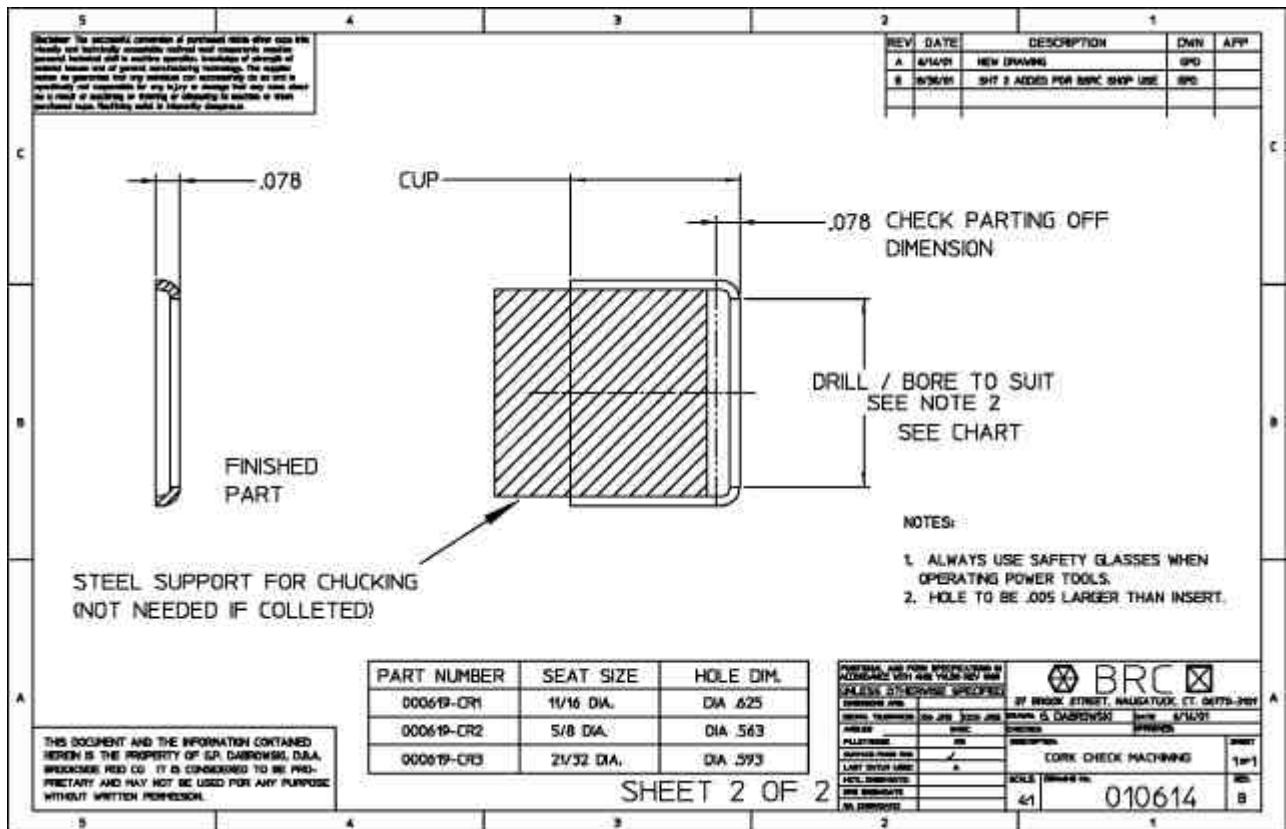
Addendum:

As an alternative to machining draw dies in the shop, useful dies may be had by using hardened drill bushings intended for fixture construction in industry. Headless press fit drill bushings and headless press fit liner bushings are available from industrial supply houses. They may be had in numerous diameters and heights and have the advantage of being well finished and hardened and have a reasonable mouth radius already in place. Smaller sizes may also be used as die matrices for blanking moisture plugs used in ferrule construction and similar uses.



Reel seat insert drawing (above)

Cork check machining drawing (below)



Notes on rubber formed grip checks:

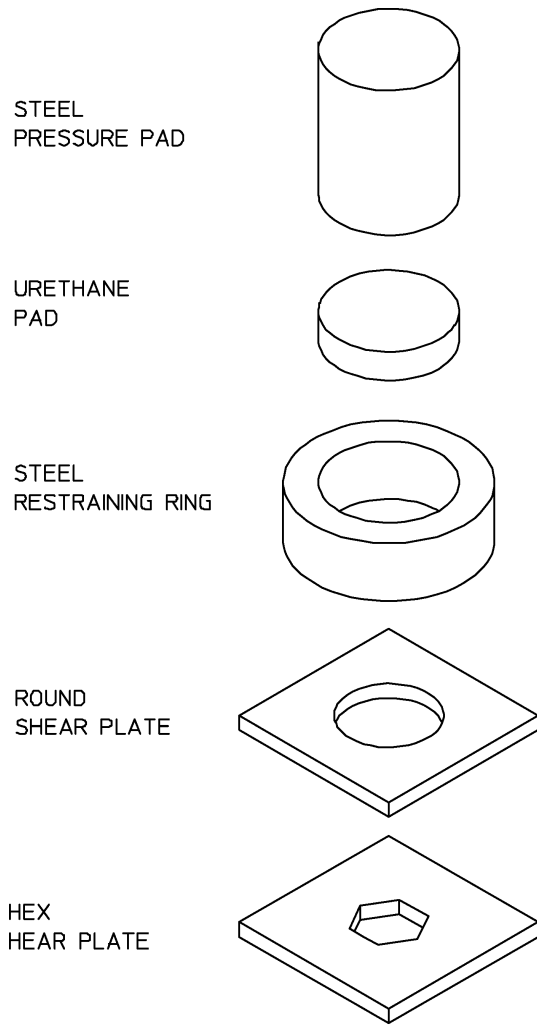
Using the method described earlier to shear round blanks it is possible to make custom grip checks having round, hex or even square accommodation for rod shafts. Checks fabricated from the material noted will be unique to your work and very light weight.

Make a pair of shear plates that are indexed together with small screws or rivets. On the upper plate, bore a diameter representing the O.D. of the grip check you wish to make. On the lower plate, provide a round, hex or square aperture sized to the requirements of your rod shaft. The indexing facility permits the plates to be separated and different sizes or types of apertures may be substituted in accordance with your needs. Indexing further keeps each form central to the other.

The plate thickness must be selected to provide the desired offset. Use thinner material than that employed in making cups. I have been successful with 28 gauge or .015 thick nickel silver stock.

It may be necessary to make your parts using several pressings, stopping to anneal and polish the partially formed parts with steel wool.

A deeper form may be possible if you anneal carefully and apply small thin slices of urethane into the developing form to help distribute the force against the material. Some deeper forms may require that you use a softer urethane to start the form and promote stretch in the material. Once nearly formed then the rigid urethane would be returned to the restraining ring to complete the shears. Trial and observation will be necessary to determine the best methods for your parts and tools.



TOOLS TO RUBBER FORM AND SHEAR GRIP CHECKS

This kind of tool will produce a part where both the hex and the round will be sheared, separating the check from the material sheet.

One may make deeper checks suggesting those used by some classic era rod builders by simply making the round shear plate thicker. There are limits to how far the material may be drawn or stretched before failure. Only trial will determine what they are.

G. P. Dabrowski  
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