# Making Deep Drawn Metal Rod Components

**Article and photos by Gary Dabrowski**

Many bamboo rod makers come to the craft with limited general manufacturing knowl edge. 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 are happy to use them in the construction of their rods. This article seeks to provide some insight to those who prefer to contribute more to the construction of their rods.

Nickel silver has traditionally been the material of choice for many of the metal components of the quality bamboo rod for many years. The choice of this metal is rooted in its material characteristics and performance. 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 plates goods such as jewelry and others. 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, 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. 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.

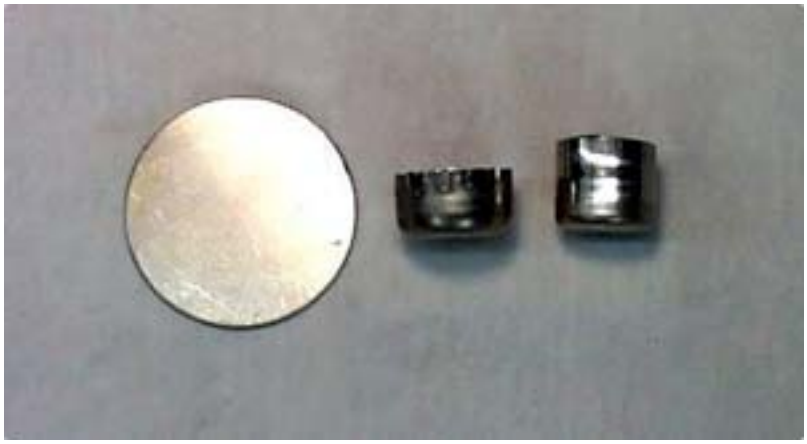
Properly tempered 18% NS is very strong with characteristics approaching that of 1018 steel. The temper or hardness of NS is an important consideration in our application. As this material is cold worked, bent, swaged, drawn or formed; its hardness or temper increases. This improves the stiffness and 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 to artisans in rod or sheet form. 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 as necessary for chucking 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.

Drawn metal goods are made using material in sheet or strip form. Sheet nickel silver is available from numerous suppliers to the jewelry trade. 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 press I use is rated at twelve tons. The remaining tools necessary are grouped into the following classes. Blank forming tools to make round flat blanks from the purchased sheet material. Drawing tools to make the first draw and drawing tools to make the second or final draw. Holding tools to permit machining and finishing in the lathe.

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 .817 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 blank diameter established, you may then turn to determining how best to produce the round blanks that will be formed into cups. Round blanks may be formed using any one of several methods. They may be cut by hand using sharp hand sheet metal shears. If you do so, 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 too short wall and could 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.

**CALCULATE BLANK DIAMETER**

BLANK DIAMETER $= \sqrt{D^2 + 4D \times H}$

$= \sqrt{(.719)^2 + 4(.719)(.578}$

$= \sqrt{.517 + 1.662}$

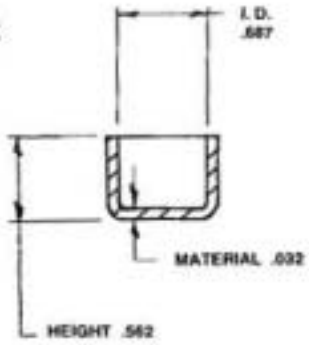
$= \sqrt{2.179}$

$= 1.476$ CALCULATED BLANK DIAMETER

D = CUP INSIDE DIAMETER + MATERIAL THICKNESS
OR .687 + .032 = .719

H = CUP HEIGHT + 1/2 MATERIAL THICKNESS
OR .562 = (.032/2) = .578

USE 1.56 DIAMETER BLANK. LARGER DIAMETER WILL PERMIT USE OF CUPS WHICH MAY HAVE BEEN DRAWN OFF CENTER

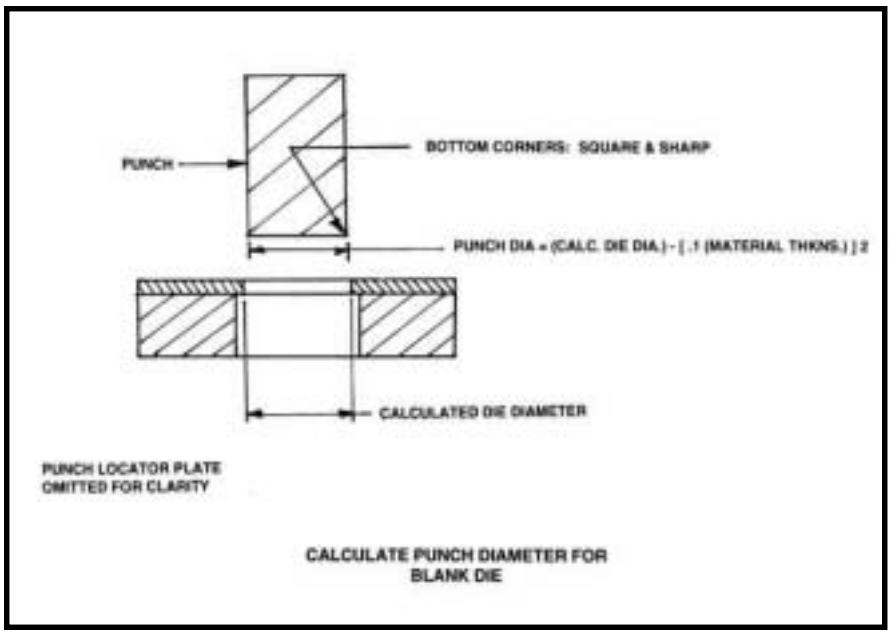



The most consistent way to make many useful blanks is to construct a punch and die. This punch and die can be easily made using a drill press and the lathe. Figures two and three provide guidance on this matter. Figure two illustrates the calculation for the diameter of the punch portion of this tool. The punch may be made slightly smaller than the result of this calculation without serious effect the to work. Just keep in mind that the greater the clearance between the punch and die becomes, the more likely is the potential that a burr will result around the blank diameter. This burr will become a hindrance later in the forming process. Make your punch long enough to allow for holding it to get proper alignment in the press. Figure three shows a generalized layout for the die. The die is shown as a laminated tool. Such construction permits the several plates to be stacked up and bolted together, milled square and then setup in the lathe for the boring of the blank diameter. 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 steel from .125 to .188 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. You must also protect the tool and prevent nicks and damage to the sharp edges of each piece. Do not plan to use ordinary cold drawn or other low alloy steels for the punch or shear plate. Such materials take nearly the same amount of time to machine and will not give you good results. To use this tool, place your NS material into the space made by the spacer plate and against the spacer plate. Slide the punch into the punch locator plate and apply force to the punch with your press.

The next group of tools needed to draw or form nickel silver cups are the draw dies. The draw dies are made in the form of simple shouldered bushings, supported in a thick steel plate. A few of the characteristics of these dies need to be calculated or made to accepted standards in order for the dies to perform properly. The remaining may be built to suit available materials and equipment. We will need two dies to make our parts, a first draw die having a larger inside diameter and a second draw die having a smaller inside diameter. Consult figure four for the reduction percentages necessary to determine the diameter to bore your dies to. Once these diameters have been selected, we need only calculate the feed radius for each die and we're ready to begin machining. Select a good tool steel for these parts such as 01, or D2 if you can get it or a high carbon alloy steel such as AISI 4150. Lay out your dies along the lines of those illustrated in figure five. Allow a few thousands of an inch on the I.D. and radius to allow for polishing. Plan on spending quite a bit of time to polish the interior of your dies both before and after heat-treating. A very smooth surface at least approaching a mirror finish will make good cups. A less than well-polished surface, especially on soft non heat-treated tools, will make scratches on the cups and be a detriment to the drawing process.




The last group of tools includes those that help locate the blanks and cups on the dies and those necessary to strip the cups off the punches. To make the first draw or to form the flat blank into the larger

*Drawing die and punch inserts used in my production die set.*

cup, a method of controlling the location of the blank central to the first draw die is necessary. This tool will also be used to manage the flow of the blank over the punch and into the die. Machine it from any steel after the layout noted in figure x. The space indicated must be made very close to the required dimension. If too large, wrinkles will likely occur on the drawn parts. Another small tool is necessary to locate the larger cup centrally over the second draw die. Machine it from any material along the lines noted in figure x. The last tool is necessary to strip the formed cups off of the punches. This tool has a few components and will work in the manner of an auto mechanics hand impact tool. Make a stripping

*A view of die set in punch press.*

*Close view of dieset in punch press.*

plate that will clamp into a bench vise and having two holes bored into it, each being a slight 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. To strip a part off the punch, clamp the stripping plate into your bench vise, insert the punch with the cup on it 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.

Production methods of making such parts are divided into two classes. The first is low volume or small order size. In a manufacturing environment, these parts are made using forming presses or machines into which are applied die sets. Die sets are a complete set of tools made to hold all the components in correct alignment, intended to perform a specific operation or sequence of operations. For low volume work, several dies may be required, each doing a specific operation or one die may be made with interchangeable component parts allowing the factory to alter the setup for each operation.

Such tools are usually run manually, meaning that materials or parts are placed into the tooling by hand. Low volume manual methods run very slow and could be costly. The next class of tools are those used for high volume production where hundreds or even thousands of parts are required per day. The tools employed here are constructed to have several stations, each doing a specific operation in progression. Material in the form of a long coil is fed into the tooling automatically. Each stroke of the press finishes a part. In my shop I produce nickel silver cups of several sizes for use on the fly rods I produce. The tooling I employ is a basic die set holder arrangement into which I interchange any one of several blank punches and dies, drawing die set ups or other tools to produce blanks or to finish parts. These tools are run in a mechanical punch press or stamping press developing ten tons of force. Typical parts produced include, several sizes of butt caps and rings for cap and ring reel seats. Winding checks and grip checks. Trim rings. Pocketed butt caps. Caps for rod tubes.

# Finishing Guide for Drawn Components

This section is intended to assist rod craftsmen in converting the drawn nickle silver cup blanks into finished butt cap, slide band and grip check for slide band (cap and ring) style reel seats. As such, they presume that the craftsman has personal skills in machine tool operation and safety.

Always wear safety glasses when operating power equipment.

### Insert

Before machining the hardware, fabricate an insert either to your preferences or to the guidelines enclosed. Measure the inside diameter of the cups and use this dimension to establish the outside diameter of your insert. Allow no more than about .005 to .010 inches for adhesive between the inside of the cup and the outside diameter of the insert. Once the insert is made you may use it as a reference to establish the dimensions for the grip check.

### Grip Check

In order to prevent the chuck jaws from crushing the cup while you are turning it, a filler piece turned to be just a few thousands of an inch smaller than 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 runout and tighten. Center drill, drill and bore to suit your previously made reel seat insert. (See links to the insert drawings included at the end of this article.) Deburr and polish the protruding cup blank. Part off to .078 wide. Buff to a high sheen.

### Butt Cap Tools

Before finishing the butt cap you will have to make a couple of simple tools. Ths first is a turning mandrill. This tool will be used to hold and turn the but cap blank in the lathe. Make this tool with a radius or chamfer sufficient to permit it to reach onto 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, nylon or even PVC.

### Pressure Pad

Chuck an appropriate piece of plastic. Turn to a diameter less than that of the cup blank, about .030 smaller than the cup O.D. or so and long enough to permit your lathe tools to clear the tail stock 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 apply modest force against the cup/pressure pad with the tailstock screw. Check the cup blank/mandrill for minimal runout. Adjust runout to be less than .005 inch. When adjusted and secure, turn the cup blank removing no more than .005 inch to clean up the exterior. Switch to your parting off tool and establish the top or height of the butt cap to conform to your design or to the drawing provided. Doing so will require the tool to penetrate slightly into the turning mandrill. 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 and buff to a high sheen.

### Slide Band

Your ring or slide band will be made from the remaining cap. 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 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 desireable 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.

### 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 injur 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 your 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. Follow wheel and compound manufacturers directions for best results.

**Disclaimer:** The successful conversion of nickle silver cups into visually and technically acceptable rod/reel seat components requires personal technical skill in machine operation, knowledge of strength of material issues and of general manufacturing technology. The supplier makes no guarantee that any individual can successfully do so and is specifically not responsible for any injury or damage that may come about as a result of machining or finishing or attempting to machine or finish purchased cups. Machining metal is inherently dangerous.

**This document and additional information including drawings of the parts noted above are available on the web. Go to http://brooksiderod.tripod.com/components.htm and click on the desired hyperlink located in the left hand column.**