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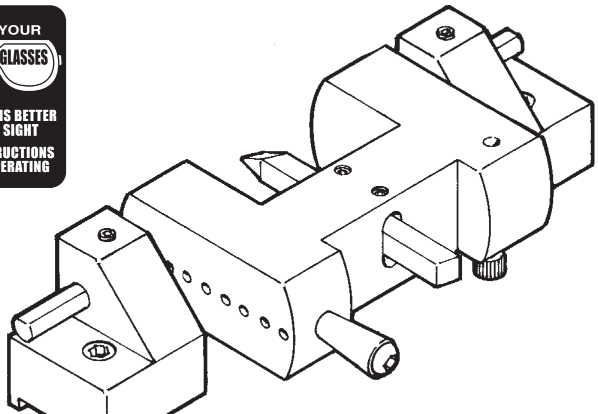


VIDEO INSTRUCTIONS AVAILABLE
For Radius Cutting Attachment setup and demonstration, please visit our YouTube channel at https://youtu.be/5-R9vqwrS9Y

SHERLINE PRODUCTS
INCORPORATED 1974

Radius Cutting Attachment

P/N 2200

Use of the Radius Cutting Attachment

The radius cutting attachment allows you to put an accurate convex or concave shape on a part with a Sherline lathe. Unlike conventional radius cutting attachments that swing the cutting tool parallel to the lathe table, the Sherline tool moves from the center of the part to the top. The idea came from the method toolmakers use to dress (shape) a radius on a grinding wheel with a diamond tool. A ball can also be cut using a two-part process described later in these instructions. Diameters up to 1-1/2" can be cut. A handle is provided that can be used on operations where the tool faces the long end of the "U" shaped cutter body. On operations where the tool faces the other way the handle is not used.

Center Height Reference Numbers

You will notice numbers engraved on the side of each support. These represent the actual distance from the table to the center of the pivot pin for purposes of calculating the center of your radius. The theoretical distance should be .940", but because there is minor variation in that distance due to production tolerances, each one is measured and the exact distance for that unit is engraved on the side.

Using the Stop Screw to Avoid Cutting Past Center

It is important to note that the cutting edge of the tool is set to cut with the lathe turning in a particular direction depending on which half you are cutting (top or bottom). As the tool passes the centerline, the tool cutting edge still faces the same way, but now the work is rotating in the opposite direction. This causes the tool to "drag." To keep this from happening, a stop screw is provided that will work in most setups. By adjusting the stop screw to hit the table when the radius cutter is at the center position, the tool can be prevented from accidentally dragging on the work. By the same token, always note the direction of rotation and make sure the cutting tool is facing in the proper direction to make your desired cut.

Setting up the Tool to Cut a Convex Radius or Ball End

The most common application of a radius cutter is to put a radius or ball end on the end of a part. The points of the radius cutter are accurately located on the centerline of the part. (See paragraph above on engraved center height reference numbers.) This makes setting the cutting tool to the proper radius a simple process. Here's how it is done:

1. Mount the two uprights in the table T-slot closest to the spindle. Pick out the center holes that will give you the best location for the cutting tip of your cutting tool. This is dependent on the final diameter of the ball. The center holes are accurately drilled on .250" centers, and only a rough location is needed at this time.

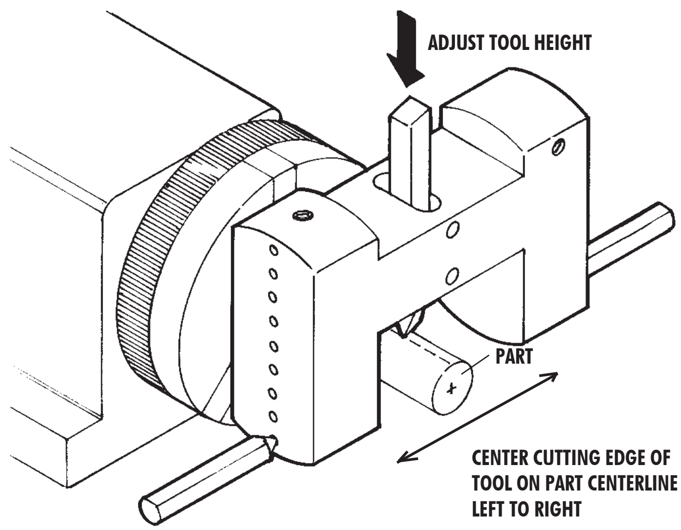


FIGURE 1—Setting the tool depth to cut a full radius on a part already at finished diameter. Adjust the tool until it just touches the top of the part. (Pivot supports not shown.)

2. The quickest way to set a cutting tool is by first turning a finial diameter (twice the radius) on the part you are going to work on with a standard lathe tool before mounting the radius attachment. If the part is already turned to the finished diameter and you wish a full radius on the end, simply raise the yoke to the vertical position and lower the tool until it just touches the top of the part. (See Figure 1.) This will establish the proper radius. It would be safest to set the tool to a slightly larger radius just to be safe and then "sneak up" to the final dimension once most of the material is removed and you can see how close the final cuts are coming to your desired radius. Move the radius cutter away from the end of the part with the leadscrew. Rotate the tool (assembly) and move the saddle towards the part until the tool is in a position to take a light cut (approximately 0.020") on the top corner. The first

series of cuts are accomplished by rotating the tool up and back. Then move the saddle and radius attachment about 0.020" closer. As you get down to the final cuts you will be able to see which way you are off and make final adjustments with the crosslide handwheel to finish up exactly on center to cut the full radius.

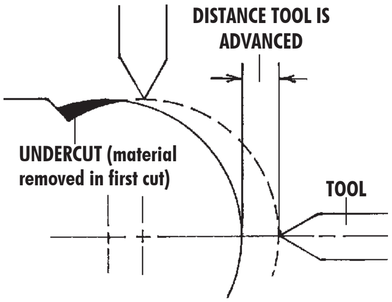


FIGURE 2—The area in black illustrates why you don't want to cut past top dead center until you know you are at final size.

3. Remember that the tool will cut the full amount it has been advanced at the center but will not reduce the diameter at the top and bottom of the part. (See Figure 2 above.) If you move the tool past the top dead center before the tool is cutting at its final position you will undercut the opposite side of the ball. This makes it wise to stay back 10° or so from top dead center until the tool has reached its final position. This creates a "damned if you do and damned if you don't" problem. If you don't cut over the top you can't accurately check the diameter of the ball, and if you do you may scrap out your part. The easiest way out of this situation is to set up on a scrap piece and get the tool set. The radius remains set even if the attachment is removed and replaced on the lathe as long as the tool isn't moved in the radius cutter body.
4. Another way to set the tool would be to accurately cut or mill a gauge block to a dimension that is the center height of the part over the table (.940" or the amount engraved on the attachment) **PLUS** the desired radius of the part. Set this gauge block on the table and move your tool down to just touch the top of it with the attachment in the vertical position. (See Figure 3.)

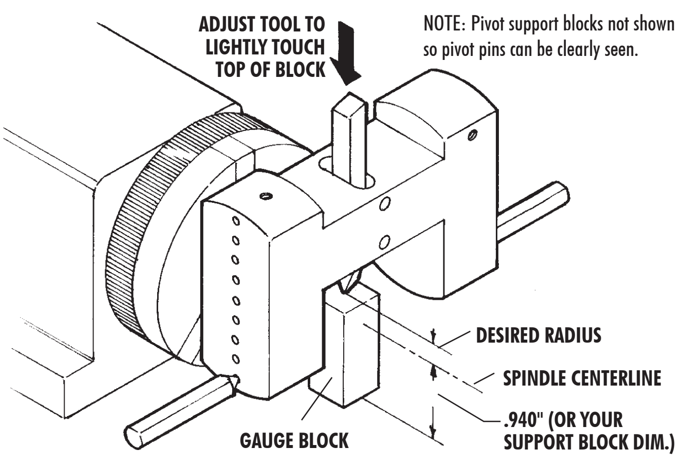


FIGURE 3—Using a gauge block to set the tool height for a convex radius. You can use this method when the material has not been turned to the final size of the ball end.

The tool can also be set for cutting a small concave shape using this method only the radius would be **SUBTRACTED** from the 0.940" dimension rather than added for obvious reasons. (See Figure 4.)

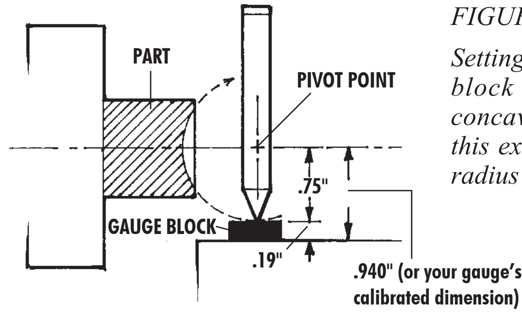


FIGURE 4—

Setting up a gauge block for a small concave radius. In this example, a .75" radius is cut.

To cut a large concave radius, a height gauge can be used to set the tool height. The height gauge is set to .940" **PLUS** the desired radius as seen in Figure 5 below.

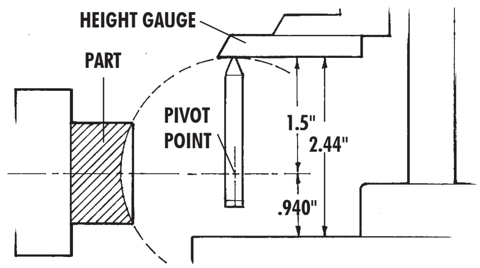


FIGURE 5—

Using a height gauge to set up a large concave radius. In this example, a 1.5" radius is cut.

Correcting for an Incomplete Radius Cut

When cutting a full ball end, if your first attempt measures undersized, you will have to scrap out the part and start over. That is why we suggest you start with what you know will be a slightly oversize cut. Once you are near the final size, here is how to adjust the cutting tool depth to get the exact size:

1. Measure the diameter of the ball you have cut. You can't reset the tool until you know the diameter it is actually cutting.
2. If, for example, the ball is 0.010" oversize, the tool must be moved in the cutter body 0.005" (half the desired distance) closer to the part. To do this, first record the leadscrew handwheel setting with the backlash taken up in the clockwise direction and the tool touching the end of the center of the part. This should be done right after your last cut was made so you know the tool is just touching the part.* Now use the leadscrew handwheel to back the saddle/radius cutter assembly up more than the correction needed. Turn the handwheel clockwise again with the difference calculated in. The tool should now be .005" from the part. Loosen the set screws holding the tool in the body and move the tool until it just touches the part*. Tighten the set screws and make your final cut.

***NOTE:** Whenever you move a tool up to touch a part to set its position, don't push it into the part. Make sure it barely touches. Pushing a tool into a part will cause it to take an extra couple of thousandths off on the next cut, and your part will come out undersized.

Cutting a Concave Radius

Full convex radii are easy to measure because you can use a caliper or micrometer. A concave radius is more difficult to measure. It is better to spend the time accurately clamping the tool using a height gauge than trying to check your radius with a template you can't view accurately. Some things in machining have to be controlled with the setup rather than with an inspection method and this is one of them. Concaves up to about a 3" radius can be cut. (See Figures 4 and 5.) Remember that when the cutting tool is extended a long way from the support of the yoke, it can be more difficult to control. Lighter cuts must be taken to achieve a good finish and accurate size but the tool should be controlled in a positive manner. Don't let the tool set on the part without cutting. Use the various pivot holes to try to keep the point of the tool as close to the yoke as possible to maximize the rigidity of your setup.

When cutting a concave radius you will use the holes nearer the center or short end of the yoke. For smaller radii, the cutting tool points into the "U" of the yoke. For larger radii the tool can be reversed and pointed toward the outside of the "U". In deciding which center hole to use it will help you to know that the center pivot hole is centered on the inside surface of the "U" and that the pivot holes are located on .250" centers.

Here is a simple formula that can also be useful when working with concave shapes:

$$r = \frac{c^2 + 4h^2}{8h}$$

Where r = radius, c = diameter of pocket and h = height (depth of pocket)

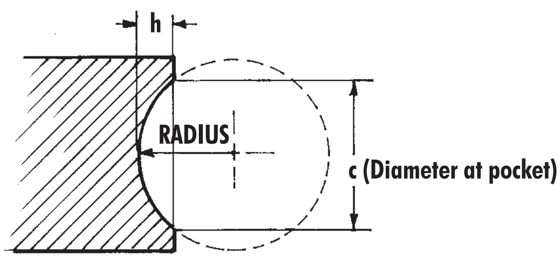


FIGURE 6—Measure the diameter of your pocket to obtain dimension "c". Then measure the depth of your cut with a depth micrometer or with the depth rod of your caliper against a straight edge to obtain dimension "h". You now have the dimensions you need to accurately calculate the radius you have cut. The radius can be calculated to the same level of accuracy as your measuring technique.

Making a Complete Ball

Using the radius cutter you can cut past the vertical point to make more than a half of a circle. However, because the cutter body will eventually hit the chuck, steady rest or some other part of your setup, you cannot cut a complete ball. (This is a problem for conventional horizontal-swing radius cutters too.) You can still make a complete ball using this tool, but you will have to do it in two steps.

First, turn half or a little more than half of the ball to the final radius and cut it off leaving enough material to form the opposite side. Make a mandrel with a diameter about 2/3 of the final diameter of the ball. Cut an angle into the face that will allow the completed half to be centered on the mandrel and epoxied to it. After the epoxy has hardened the ball can be completed with light cuts. Once finished, the ball is broken off the mandrel. By measuring the part with the anvil of the micrometer on the previously machined surface and the spindle of the micrometer on the surface you just machined the completed dimension should be equal to the diameter. A ball should always measure the same in any direction.

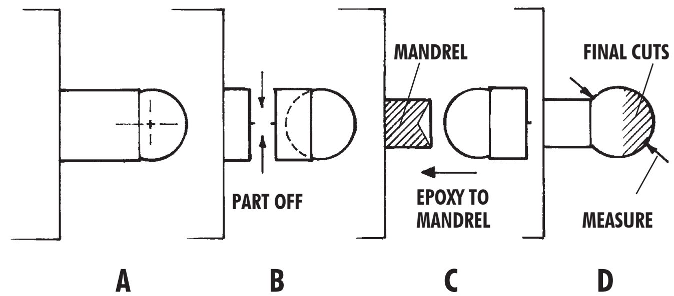


FIGURE 7—Cutting a complete ball using epoxy to attach the ball to a mandrel to complete the second half of the ball. A) Turn a little more than half the ball. B) Part off the piece leaving enough to complete the ball. C) Epoxy the piece into a mandrel with a tapered depression. D) Complete the ball using light cuts. Measure across the first and second turned portions of the ball to confirm the diameter.

Another method would be to center drill, then drill and tap a hole in the end of the half-completed ball. Using a cutoff tool, part off the piece from the stock leaving sufficient material to complete the ball. Make a mandrel with a threaded stud centered on the end and screw your part onto it. Place the mandrel in the chuck and use the radius cutting setup you used to make the first half to complete the rest of the ball.

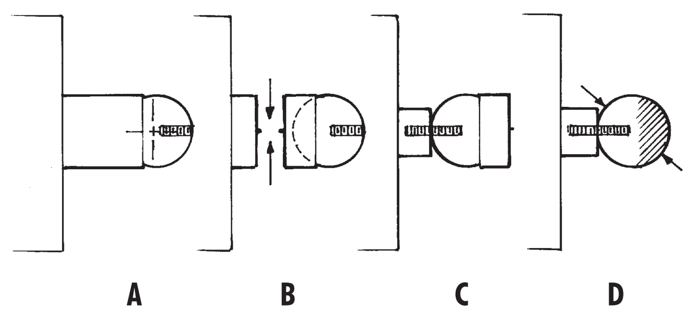
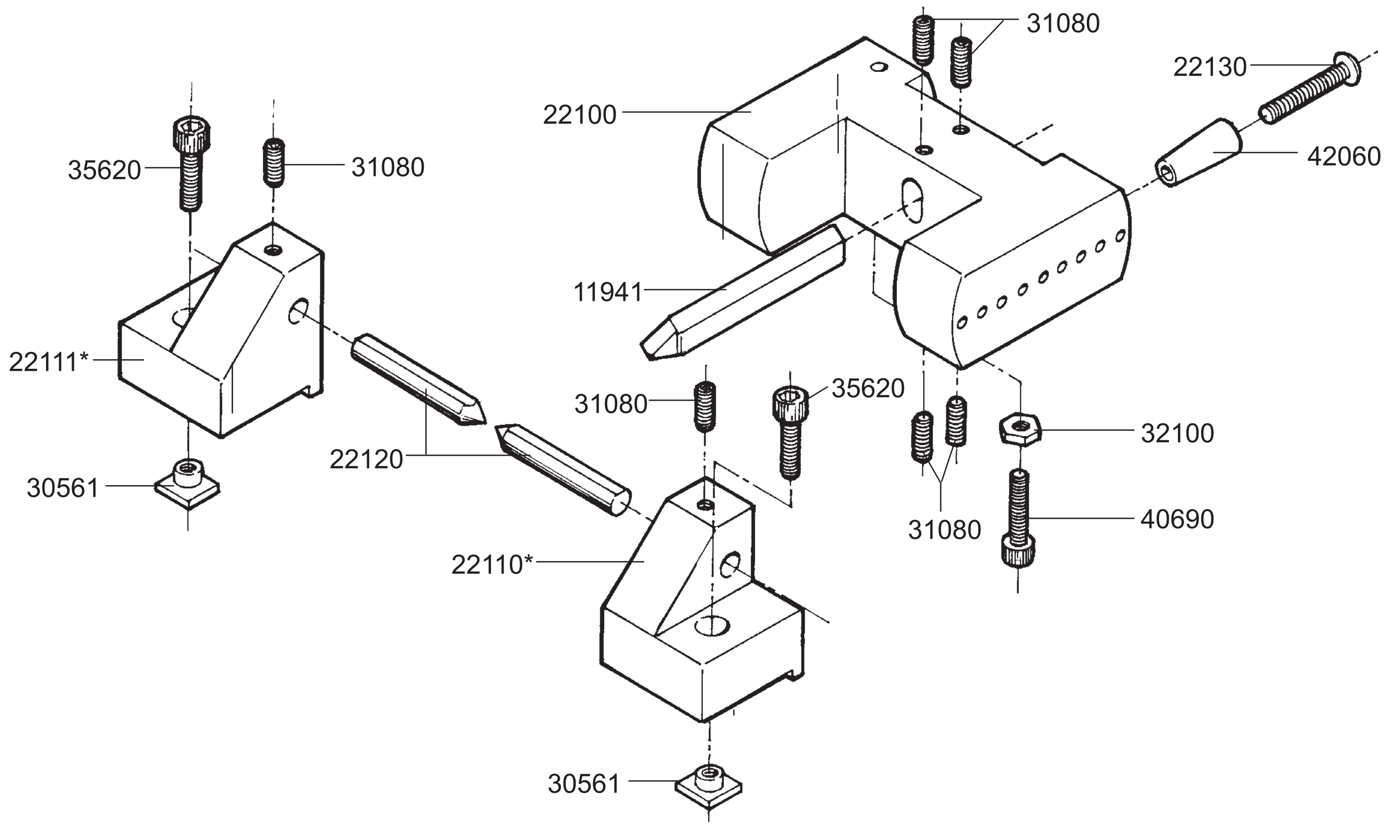


FIGURE 8—Using a threaded stud in the mandrel to hold the ball for the second operation. A) Center drill the end and tap hole, then turn first half of ball. B) Part off. C) Attach part to threaded stud in mandrel. D) Turn final half of ball using light cuts and measure to confirm diameter.

The radius cutting attachment further extends the capabilities of your Sherline machine shop. With it you can apply a professional touch to your parts that would be difficult or impossible any other way. Though we have shown just a few examples here, we think you will find that, with a little imagination, there are many more ways it can be used.

Thank you,
Sherline Products Inc.

Exploded View



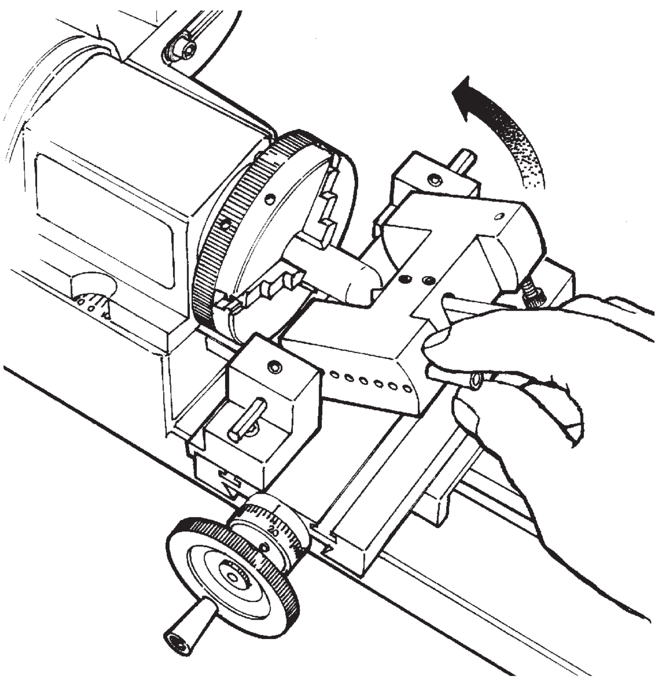


FIGURE 9—The radius cutter shown in use cutting a ball end on stock supported in a 3-jaw chuck.

Parts List

NO. REQ.	PART NO.	DESCRIPTION
1	11941	1/4" Cutting tool
1	22100	Radius cutter body
1	22110	Radius cutter support (Left)*
1	22111	Radius cuter support (Right)*
2	22120	Radius cutter pivot pin
1	22130	10-32 x 1" button head socket screw
2	30561	10-32 T-nut
6	31080	10-32 x 3/8" cone point set screw
1	32100	10-32 hex nut
2	35620	10-32 x 7/16" SHCS
1	40690	10-32 x 3/4" SHCS
1	42060	Plastic handwheel handle

*NOTE: These parts are manufactured and measured for center height at the factory. The height is marked on each half. Therefore, they are sold only as a pair for replacement parts.