Rabbets and Splines

With a table saw

Rabbets filled with splines of a contrasting color are a way of making "segmented" turnings without having to cut n-sided rings. The shapes can be as simple or as complex as you wish, or have patience for. One of the three types of samples has the rabbets cut at ninety degrees to the table, one at forty-five and the larger one at sixty.

Safety in cutting rabbets and splines. This whole thing will be more fun if you do not cut any fingers off. The first two safety measures are to be sure your pieces are flat and square, and that your saw blade is sharp. The next important measure is to use the proper pushers for moving the wood. If the distance from the fence to the blade is less than the width of your spread finger, use a pusher. Also use a feather board on the in-feed and a properly sized splitter of the out-feed. The feather board will also go a long way in ensuring straight and even rabbets and splines.

Cutting a reasonably large square is extremely difficult and dangerous. Cutting a small one is impossible and will almost **certainly get your fingers cut**. If you are not ripping (or cross cutting) a board that is many times longer than it is wide, i.e. making a number of pieces, glue on a waste board of exactly the same width as the piece. Not only will this save your fingers, but you will find it hard to keep the cut from widening at its end. So the end should either be the waste board or an extra length of the piece that will be discarded.

Let me repeat, do not try to cut anything on a table saw unless it is much longer than it is wide. Use a waste board, or have lots of extra length on the piece; or glue a number of pieces end to end. Pine makes a cheap waste board.

The first step - cutting the rabbet. A very good and sharp saw is essential if you are going to achieve good results. The very first thing to do is to square up the wood, both the piece where the rabbets will be and the piece from which you will cut the splines. The opposite sides should be even and parallel, and the adjacent sides should be perpendicular to them. The next step in cutting the rabbets is to cut spacers that will position the wood. These are strips of a specified thickness. For the kit with three inlays, there are two spacers. For the kit with the four inlays there need only be one spacer. The spacers can be cut from a material that will not warp or change shape. MDF works well, but plywood or ordinary wood can be used.

The saw blades for cutting the rabbet ideally should make the bottom have square corners. Most blades do not do this. The usual combination blade has alternating teeth cut right, left and center. The result is the cut has an upside down "U" shaped bottom. Ripping and cross cut blades usually have this teeth pattern, but it is not so pronounced and the bottom of the cut is flatter. The blade thickness or kerf should be very much smaller than the diameter of the turning. Common thin kerf blades are 3/32", about as thin as you can get without going to very special and therefore expensive blades.

The number of spacers is one less than the number of cuts. Find the center of the wood. Position the fence and the appropriate number of spacers to align the blade with the center. If there will be three rabbets, use one spacer for the center cut and either two or no spacers for the two side cuts. If there are four rabbets, set the first with one spacer but have the cut moved off center and away from the fence. The second cut is with no spacer. For the final two cuts, turn the wood around and repeat the two cuts, one with and one without the spacer.

The cuts can be either with the blade perpendicular to the saw table or at some angle. Although the kerf does not change what is seen looking down on the turning does. The inlay appears to be the thickness of the kerf only if the cut is perpendicular and is in the center of the turning. The larger the angle of the cut and the closer to the curving edge of the piece the larger the inlay will appear.

If the rabbets are tilted away from each other, they diverge at an angle which is twice the tilt angle. This means that the distance between the inlays in the finished piece will be the distance between them on the bottom plus the amount of the divergence arising from the thickness of the bottom of the piece. It is easy to have the separation too large.

How deep should the cuts be? The easiest way to answer this is to make a perspective drawing of the turning. The drawing will have a top, i.e. circular, view and a side, bowl shaped view. Both views should show the wall thickness. The top view shows the extent of each inlay. This dimension projected on to the side view shows how deep to make the rabbets. Experience is a good teacher. Small turnings are difficult because the inlay usually has the 3/32" thickness and a couple of these plus the spaces between them mean the inlay furthest from the center is likely to be near a wall. You probably do not want to make the wall angle too steep at the rim. If the inlay gets close to a steep side, the inlay thickness will appear to be very, very large.

The second step - cutting the splines. The size of this single spacer is the key to cutting the splines. The case where the rabbets are perpendicular is the simplest. First align the fence so the first cut just trims the piece of wood. Now put the spacer between the fence and the piece of wood and make the second pass, cutting off the spline. A small piece may break off and remain attached to the spline at its end. Make the spline longer than the rabbet so that this nub can be cut off. A spline a little longer than the rabbet also helps in the glue up. For the perpendicular case the spacer is exactly two times the width of the kerf. How do you make a spacer that is twice the thickness of the kerf? Again make a trimming cut; then move the fence toward the blade a distance that is three times the size of the kerf. Of course, it is easier to make the spacer just a little bit smaller than it should be and then thicken it with a layer or so of duct tape. Trying to thin a cut spacer is usually out of the question. But with luck you can get it right, particularly if you have a good scale on the table saw. Tape over the spacer and the piece of wood to guarantee the spacer assures that they move together as you push them through.

Of course the height of the spline must be large enough to fill the rabbet, plus a little extra so that the spline is proud of the surface. Do not have it protruding too much. You have either cut it off or sand it down. If the rabbet is perpendicular and the spline piece is as thick as the rabbet piece, the spline will be high enough, of course.

If the rabbet is at some tilt angle, draw a tilted line on the piece that will have the rabbet and measure how much you need. If the piece that you use cut the splines is not thick enough to make the splines, you will need to cut the splines at the tilt angle. In this case the spacer needs to be thicker. Either make a trial cut on a waste piece and measure the gap in the plain of the table or calculate what it will be. The details are left to the student, but the answer is that you make the spacer twice the value of the blade kerf divided by the cosine of the tilt angle. (You cut the spacer by setting the fence three times the width, of course.)

The third step – gluing the splines in the rabbets. There are two approaches to fixing the splines in the rabbits. The first is to use very low viscosity glue, i.e. thin cyano-acrylate or super glue. You set the spline in place and dribble the thin glue along both sides of spline. The wood will wick the glue down into the entire depth of the rabbet. The second approach is to use thicker glue, e.g. Tightbond III. (Tightbond III has a little less viscosity Tightbond II and a little longer working time.) Run a bead along the opening of the rabbet and then press the spline down into it squishing the glue down.

The big advantage of the cyano-acrylate is that the spline is fully seated on the bottom. The disadvantage is that the glue has very little strength. If the rabbet and the spline are parallel to the grain

direction, the weakness of the joint may not be a problem since there will be little relative movement of the two types of wood. However if the rabbet and the spline are cross grain, there will be movement and the joint will feel the stress. Of course, small pieces have less of a problem than larger ones.

The problem with Tightbond III, or any glue with a high viscosity, is forcing the extra glue out of the rabbet so the spline bottoms out along its entire length. Generally you get only a short time to press the spline down. There is a lot of glue to squeeze out of the ends that can be a fair distance from the center of the rabbet. Obviously smaller pieces are easier, as are shallower rabbets. OK, what do you do with large pieces and deep rabbets? The answer is that you "open up" the rabbet. Start with a flat surface and put a thin and narrow strip on it. Place the rabbet over the thin strip. The use clamps to force the sides of the piece down onto the flat surface. This bends the piece and opens the rabbet. Put a little glue in the rabbet and push the spline down. Take the clamps away and use other clamps on the sides of the piece to close the rabbet on the spline. Naturally if the thin strip is too thick you can bend the piece too far and crack it. (Actually I have never had one crack.)

Another advantage of the cyano-acrylate is that it sets quickly. The Tightbond takes about a half hour to set and 24 hours to develop full strength. Once the glue dries, this is the body piece of the turning.

The fourth step – assembling the pieces. Assuming that the inlays will be at the bottom of the turned piece and extend up toward the rim, the first step is to flatten the face where the splines emerge from the rabbets. If you want the inlays to start at the rim and extend down toward the center, the uncut face is already flat. There are all kinds of ways to flatten the face with the splines. Drum sanders and planers can work, particularly if the piece (or the piece and the waste board) is quite long. However, the example piece is a small square, and it can be flattened on the lathe.

Start by making a waste block, using either a chuck or a face plate. The waste block should be at least three inches long. Flatten its face. After cutting the face with a gouge, use a low number sand paper on a flat board to sand the face completely flat. The waste block will eventually be turned into a spindle where the diameter is the size of the foot on the turned piece. Put double sided tape on the flattened end of the waste block. Mark a small hole in the center of the body face with the splines. Use the point of the live center to position the body and stick it to the double sided tape. Do not let the point make too deep a hole. Once the body is in position use finger pressure, first, and then use a piece of waste wood and tighten the tail stock to assure the seal. The waste wood will prevent the point of the live center from digging in. Next flatten the face. Use a gouge to remove the protruding edges of the splines. Use a low number sand paper on a flat block of wood to assure the face is completely flat. Then remove the body piece from the face plate waste spindle.

The next step is to glue a piece to the waste spindle. For small pieces five minute epoxy works fine. This piece will become the foot of the turning. Mark the center of this piece and use a point on the tail stock live center to position the piece on the end of the waste spindle. The point will make a hole in the foot piece and you have to be sure that the foot is higher that this hole is deep. You can use the live center pressure to force the foot piece onto the spindle. Again a block of wood between the tail stock point and the foot piece will keep the point from digging in. The sample piece for the foot is quite small so be careful to get it centered. Alternatively cut a larger piece and use it instead of the small one provided. It is very important that the grains of the foot and the piece with the rabbet are aligned. If it is not flat and even, flatten the foot piece.

Now find the center of the previously flattened piece with the rabbets. Use the face that will be the top (or rim) of the turning. Use an awl to make a whole in the exact center and use the point on the live center to align the piece with the foot. Glue it on the foot being sure to **align the grains**. For small pieces, say less than six inches, five minute epoxy is fine. You can use the pressure of the tail stock.

If you want to have a top rim that matches the inlay wood, flatten the body piece and glue a third piece onto it. This rim is not provided with the samples. You can attach this piece either using the tail stock pressure of use clamps between the rabbet piece and the rim piece. This piece is not provided in the sample.

Now let the assembly set – ten minutes for five minute epoxy and at least twelve hours for Tightbond.

<u>The fifth step – turning (at last!)</u>. The assembly now consists of a waste block spindle, a foot piece and a body piece. Perhaps you had the forethought to cut off the corners of the foot and body pieces with a band saw before gluing them up. But I rarely do. So the next step is to convert the square blocks to circular ones. <u>The important thing is not to cut on the ends</u>. If you do, the pieces will split.

Draw a circle on the outer face that just fits in the square. Start the cut on the face just outside the circle and slice outwards. Continue doing this, removing the wood at the corners and steepening the sides. When a great deal of the corners is gone you can use the end of the piece. This works for the body and can be made to work for the foot. Cut into the waste block and move from it toward the body. As you go in, the foot piece will become a spindle. Once it is round do not go very much further

since the sample is a small piece and the foot will not have a large enough diameter. I use a parting tool to make a sharp corner between the spindle of the foot piece and the bottom of the body.

The turning is now a spindle shaped foot attached to a round "plate" that is the body. Carve the back of the body. I usually start my cuts somewhere on the bottom face and cut out and up. This is, of course, cutting "up hill", but it works. I usually leave the body piece just a little larger than "completely round". When the bottom is more or less the shape you want, I finish rounding the top face. I then finish the bottom cut. Remember the slope at the rim should not be too steep. Shaping the inside is next.

I start the cut somewhere and move toward the center. This is cutting down hill. When a little of the center has been removed, you can start making the side of the bowl starting at the rim. Once you have achieved the thickness you want move of down the side. You should not try to return to the rim. Since the piece is cross grain, it quickly goes just a little out of round and you can't come back to the rim if you are to have a reasonably thin side.

The last two steps are sanding and parting off. You can finish the bottom of the foot either by a reverse chuck (a jam chuck or jumbo jaws) or use a drill press with a sanding disc.

A couple of words about the sample. The wood for the samples is decking and similar to teak. Like teak it cuts easily, but dulls the tools rapidly. It is very grainy and achieving a high gloss finish will be extremely time consuming. You can use CrystaLac pore filler. Several coats should do it. After CrystaLac and ordinary finish should work. For the most part, the splines are reasonably white maple. These will show great contrast. A few of the splines are a little darker.

Some may find these instruction far too detailed – "Does he think we are stupid?" Others may find this to sound like it is too difficult. It really isn't. Have fun. And when you make one on your own be careful and don't cut any fingers when you make the rabbet cuts.

Two last remarks. If the rabbets are cross grain gluing can be more difficult. The glue is absorbed into the end grain a swells the wood, making it difficult to push the spline into the rabbet. Some of the photos show cross-grain splines. I usually have "opened" the rabbet and then clamped it closed again. The spline goes entirely through the body in some of the turnings. In these cases I glued a piece of plywood to the body and cut the rabbet into it.