

CNC Router Brings Increase in Guitar Inlay Volume

Since beginning to produce guitar inlays on highly accurate CNC routers instead of Pantograph machines, **Custom Inlay Inc.** has taken on so much new business that it has hired eight additional employees.

The improved cutting accuracy of the routers has allowed the company to bid on and win jobs it couldn't have handled before, such as the rectangular mother-of-pearl inlays for Gibson guitars that require a tolerance of 0.004 inch. With the earlier Pantograph approach, the first few inlays might have met that tolerance; but, as the template wore out, accuracy decreased. With the CNC approach, an inlay is drawn once in the computer, then reproduced on a router with perfect accuracy every time. This approach also has doubled productivity, from 25 to 50 mother-of-pearl and abalone guitar inlays per hour.

Custom Inlay makes mother-of-pearl and abalone inlays for guitar and banjo suppliers such as Gibson

and Jackson. The inlays may be as simple as the rectangles that indicate position on the fingerboard, or as complicated as the Gibson logo that goes on the peg-head of its custom guitars. Most of

These are Rosewood fingerboards (with inlays) for five-string banjos. The circular background is a resonator (the back part) of a banjo.

Custom Inlay's products are used on standard guitars, and the company produces inlays for approximately 300 guitars each week, not including special orders. That translates to between 20 and 25 lbs of mother-of-pearl cut weekly.

Typically, customers give Custom Inlay a drawing of an inlay design. Custom Inlay then cuts that shape out of mother-of-pearl or abalone – or sometimes synthetic pearl. For some customers, after cutting the inlays, the company also cuts pockets into the wooden fingerboard or peg-head and mounts the inlays in-house. For other customers, Custom Inlay supplies just the inlays to be installed by the customer. Customers who cut their own pockets use CNC machines and expect Custom Inlay to match their accuracy with tolerances of 0.004 inch. Either way, the inlays must fit precisely into the pockets, so cutting accuracy always has been critical for this company.

Custom Inlay first cut inlays by hand. This limited the types of jobs the company could accept because it is difficult to hand cut some shapes out of mother-of-pearl. A straight line, for example, is almost impossible. A Pantograph was the next step, and although it improved cutting accuracy somewhat, there were several drawbacks to this approach. First, it required a template that a skilled artist had to produce from the drawing supplied by the customer. Second, it

required an equally skilled craftsman to cut along the lines of the template.

And third, even though the operator would follow the template carefully, he or she might bump corners or otherwise damage the template so that it became worn and had to be replaced. Using this method, it was particularly difficult to stay within the required tolerances for rectangular inlays because, as the template wore out, the lines were no longer straight.

These drawbacks led Custom Inlay to investigate computer-controlled cutting systems. Although many CNC routers were available at the time, most were prohibitively expensive. But the Series III PC-driven CNC router from Techno-isel had the right price and included the Mastercam CNC programming system manufactured by CNC Software Inc. A few years ago, Custom Inlay purchased a Techno-isel system. Since then, the company has added two more.

Now, when a customer sends a drawing of an inlay pattern, it is scanned into the computer. A program called Adobe Streamline converts the raster image to vector data, which is then imported by Mastercam. This software, although originally designed for metalworking, is ideally suited for guitar inlays because of its ability to generate the most complex contours with little programming effort. The program



The inlays are mounted on wood prior to cutting. Once the inlay is cut, the block of wood with the inlay and surrounding mother-of-pearl is soaked in water until the glue is loosened. The inlay is then removed from the wood block.



features true 3-D geometry construction and draws perfect lines and circles. It also allows geometry to be



Shown here is a banjo resonator (the back part of the banjo) with inlays.

copied, moved and rotated with perfect accuracy. A little editing usually is required to clean up the scanned image, but once the shape of the inlay is defined, the software automatically creates the toolpath that directs the router as it cuts the inlay pattern. The process of getting a design into the computer and producing a toolpath requires a fraction of the time it used to take to create a template. And the result is an inlay that is precisely cut with an operator needed only for loading the machine.

Although the Techno-isel router was designed for production routing and drilling on materials such as wood, plastic, MDF, solid surfacing materials and nonferrous metals, it also handles mother-of-pearl and abalone well. The working area of the router is 49 inches by 41 inches and Z-axis height options range from 4 inches to 19 inches. Table technical specifications include a rapid travel rate of 200 inches per minute; a Z-axis cutting force of 200 pounds maximum; 0.0005-inch resolution and repeatability; and 0.004 inch/foot absolute accuracy.

Cutting mother-of-pearl and abalone with these routers is about twice as fast as cutting them with a

Pantograph. Operators now cut about 50 copies of the same design in an hour compared to about 25 an hour with the Pantograph. The three machines run eight hours a day, and one person runs two of them on the second shift. Perhaps more important than the productivity, however, has been the accuracy provided by these machines. Inlays are being

produced to far tighter tolerances than were possible using the earlier approaches.

In addition, the Techno-isel machine is constructed from extruded aluminum profiles that provide easy clamping capability. The machine also has four ground and hardened steel shafts and eight recirculating bearings in each axis. This shaft and bearing system is an extremely rigid system that produces smooth play-free motion and high-quality cuts.

In the years that these routers have been in use, Custom Inlay has fine-



This is a guitar fingerboard with floral pattern inlays. Block (with bell-shaped cut) is a truss rod cover. This decorative cover goes at the top of the fingerboard where it bends back to stretch the strings and hold the knobs for tuning.

tuned its production processes to get maximum use from the \$120 per pound mother-of-pearl. A unique approach of gluing mother-of-pearl to the wood rather than fiberboard and cutting right through the wood each time, makes it possible to cut more than one inlay per piece of mother-of-pearl. For example, a logo might be cut out of a larger portion of the piece and small banjo inlay cut from the remaining portion. Companies that mount mother-of-pearl on fiberboard only can use the



Pictured here is ebony wood guitar fingerboard featuring cobra snake inlay design.

area where the pattern has been cut on the fiberboard. The rest of the mother-of-pearl piece is wasted.

Besides handling standard jobs with accuracy and speed, the CNC system makes it possible to handle custom jobs in a cost-effective manner. One custom job is making inlays out of the letters in a person's name. In Mastercam, toolpaths have been created for each of the letters of the alphabet so it is possible to generate these inlays quickly.