

Music in Motion

WOODWORKING PROCESS GETS MUCH NEEDED UPGRADE FOR GUITAR MANUFACTURER

Matthew Jaster, Associate Editor

Experienced guitar players will tell you the feel of the fret board is one of the most important factors when selecting a guitar. Some will even sacrifice the tonal characteristics for just the right “feel” from the neck and fret board. Guitar manufacturers believe the machining of the fret board is a key operation that contributes to the instrument’s quality and playability.

Engineers at C.F. Martin & Co., an acoustic guitar manufacturer based in Pennsylvania, thought its own fret board machining process was in need of an upgrade.

In the original process, the required finish was produced by a special swinging jig that held the fret board while putting it through a motorized sanding belt. This handmade process made it easy for particles to clog the sanding belt, causing vibration. In order to achieve the required quality of the finish, the fret boards often had to be put through the process twice.

Fred Walters, engineering project manager at Martin, enlisted the assistance of Brian Rasley, a local machine builder and CNC applications consultant in Pennsylvania, to determine if the machining process could be improved.

“We were in the initial planning stages to upgrade the process when Rasley came along with a few ideas for a new system,” Walter says. “This seemed to be a much better solution to the old method that was done by hand.”

Rasley found several issues that needed to be addressed in order to meet
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C.F. Martin & Co. is celebrating its 175th anniversary as the oldest surviving guitar manufacturer worldwide.

Martin Guitar's standards:

- The belt would clog because several boards would run on the same tangent point
- All the material was being passed over the belt on the first run
- The operator had to be very skilled to run the fingerboards
- There was only one belt in operation
- The tooling changeover was too long
- The jig wasn't rigid and would flex while sanding
- It was difficult to run Micarta, a material frequently used at Martin
- The ivoroid binding would burn and spark sometimes
- They couldn't do the flat sanding on the previous system

Rasley concluded that the company needed a more adaptable system to incorporate at least four different radii. He also designed a quick-change tool system for changing the radii tooling.

With the help of David Lunn, the East Coast regional motion control specialist at Baldor Electric, Rasley built a machine with Ethernet-compatible motion control components that employs six axes of motion to automate the sanding process.

"Lunn jumped on board immediately and was very helpful as we developed the machine concept and how to employ some of Baldor's newest products," Rasley says. "He came to the shop several times to help with integrating, wiring, etc. until we had motion."

The upgraded system includes two vector motors that power the sanding belts, two servo motors that raise the sanders and a servo motor that swings the fret board in an arc. The swinging arm is powered by a linear motion axis that moves it across the sanding belts.

Lunn believes converting a handcrafted process requires precision and repeatability on the part of the new machine.

"This was achieved with a motion controller, linear and rotary servo motors and a very well built and robust design of the system," Lunn says. "Considering Brian Rasley had not used Baldor motion control products previously, he designed and built a system that incorporated our products and performed perfectly from the first test run."

Arthur Cooper, Rasley Enterprises' systems programmer, developed an algorithm for controlling the sanding process that removes the material in small increments while minimizing the clogging effects of the sawdust. He also programmed a human-machine

interface (HMI touch screen) that allows Martin to load the optimum sanding routine based on the different wood used. Included in the HMI screens are diagnostics, a belt changing process, sander speeds, initial offset and secondary offset.

"The machine is safe, versatile and can accomplish much more than the old system could accomplish," Cooper says. "The key is the accuracy. It's the most important aspect of the upgrade."

The architecture of the machine is based on a Powerlink-compatible machine controller called NextMove e100 that controls all six axes of movement. By using Powerlink, the electrical design of the machine is simplified. Programming was also made easier by using Baldor's *MINT* environment, an in-house programmable language from Baldor that can handle motion, I/O and HMI tasks.

Rasley said his team had to learn *MINT* programming on the fly for the project.

"I can't say it was easy, but we did find that it's very robust and has a very open architecture. The hardest part was the learning curve. Once we learned the language, we were off and running."

The result of the new fret board machining process has been noteworthy. The machine has been in service since December 6, 2007 and the company is now capable of hitting its daily quota in a shorter period of time.

The new machine can run more than 320 pieces in an eight-hour shift. (Previously, 150–200 pieces were sometimes run in an eight-hour shift.) Rasley says the company has gone from 40 percent rework to 3 percent. Production has increased by approximately 60 percent.

"Now, they're looking at the upstream wood milling process so the fingerboard rework will probably drop down to 1/2 percent," Rasley says. "We hit all the issues mentioned earlier and a few more that weren't on my original list."

The biggest benefit is the incremental cutting where each pass removes a programmed amount of material. While the arm is swinging through the arc, the machine is moving across the width of the belt; thus, no tangent point clogging. The machine uses a cog free linear motor that moves it 14 inches per second and stops within .002" of the programmed location when




With assistance from Rasley Enterprises and Baldor, C.F. Martin & Co. has updated its fret board machining process.



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in rapid mode.

The operators involved in the assembly and final setup of the guitars have noticed the quality of the new fret boards. They can now manage the fret boards more precisely, adjusting the relationship between the front (roughing) sanding and the rear (finishing) sanding to accommodate different style belts as they experiment to find optimum belt performance.

Rasley is servicing the machine under a one-year warranty, and says there have been several upgrades to the code as well as additional features to improve the operation. He has quoted several other motion control projects, including an automated side press machine for Martin and a deep-hole drilling machine for a Pennsylvania lumber company. 

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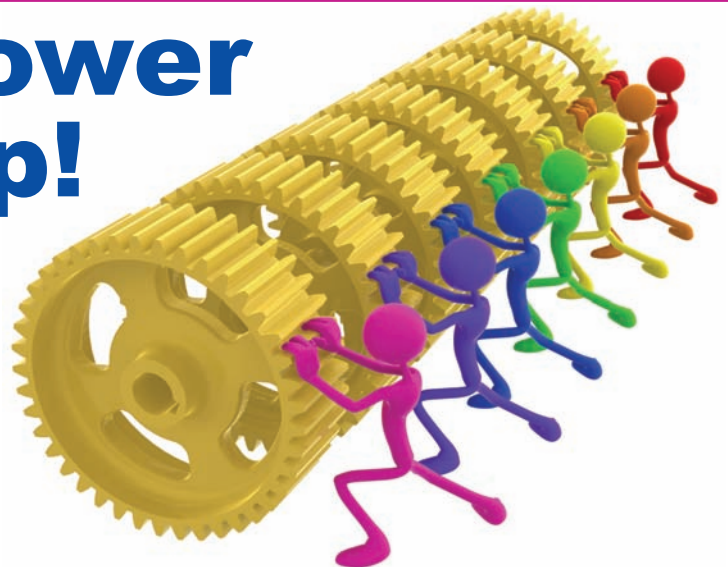
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