

Field Rebuild of a Matsuura MV1000 Machining Center

There are many old CNC machines that were built solidly but their electronics are degrading due to age. By retrofitting the machine with new electronics, the machine can run as when new. If a larger investment is made for a rebuild, the machine's mechanical hardware (such as ball screws and ways) can be refurbished and the machine really is like new again.

HM Dunn is a company based in Texas specializing in aerospace components. One of their Matsuura MV1000 machining centers had failed and had been in storage for two years and now HM Dunn had a number of parts that it was capable of producing. The MV1000 is a vertical two-spindle machine that had a Fanuc 3000C control. In April 2000, Red Fultz of HM Dunn approached Mark Rice to rebuild the Matsuura MV1000. Mark Rice is an entrepreneur based in Texas, not too far from HM Dunn, and has extensive CNC and machine experience, including several years installing Matsuura machines back in the 1980's.

As the machine was in storage, Red had the time with an idle machine and he was willing to make the investment to fully restore the machine back to top condition. The entire machine would be serviced as part of the rebuild.

The machine's two spindles are gear-driven from a single motor. Each spindle had its own tool changer and tool carousel. The machine ran programs for titanium parts with profiling done via keller cutting. These NC programs included many very small linear moves at high feed rates where the desired surface is generated from the CAD system. This programming technique requires much more memory to store the large part programs. A typical part program could include 18000 NC blocks consuming 300,000 bytes. Some part programs can exceed 1 megabytes.

Mark says, "I recommended the MachineMate control since I had experience with it and I knew it would do the job."



Mark recommended the MachineMate control based on the control's features and on the price. The MachineMate has an open PC-based CNC architecture with an integrated soft PLC. The operator interface is straightforward, with just about any operator action being available in just one or two keystrokes. The PLC uses standard ladder diagram programming (structured text is also standard) so no proprietary PLC language had to be applied. Mark prefers ladder diagramming for the customer's machine because it seems easier for the shop floor personnel to follow than structured text. The soft PLC can perform the conversion between the IEC-1131 languages as needed, and different modules can be done in different programming languages within the same application.

The control can run its part programs directly from the PC hard disk so the part program storage is almost unlimited. The control's performance is more than sufficient to handle the keller cutting profiles, as the CNC handles a very high NC block throughput. The MachineMate is also capable of almost unlimited block-to-block execution speed for short

durations. The MachineMate can also run from the battery-backed CMOS memory (available from 128KB to 872KB) in the control if the programs are small. This is useful when the machine operator is usually limited to running those programs that are already loaded into the memory. This memory also has space reserved for PLC retentive variables, machine set up parameters, etc. Some PC-based controls rely only on the hard drive that may lose set up parameters in a loss of power situation.

When recalling the HM Dunn proposal, Mark said, “The basic (proprietary control) was very expensive to get enough memory to run even one program. You had to buy the largest memory package available just to hold one program. With the (proprietary control), you had to use (their) control, (their) drives and (their) spindle. That made the price more than \$20000 higher than having the MachineMate control, a Magnetek spindle motor and drive and Kollmorgen Servostar drives for the axes. I priced the proposal using both models so he could see the difference and (Red) went with the MachineMate control.”

The Matsuura machine had solid construction. During the course of the retrofit, everything would be replaced or refurbished except the machine frame and the spindle head. The control, drives and motors were new, as mentioned above. The axis ways were reground. The 20-year old machine required just 0.006” to be taken off the X ways to obtain a square and the Y ways required just 0.002”. As Mark says, “with the machine being so sturdy it held up very well.” The ball screws were remanufactured. New hydraulic components were provided. A special adaptor was required for the mounting of the new spindle 15hp motor.

For the spindle, Mark used the Magnetek GPD515 drive and motor. The Servostar 500 series controls were used with 100 in-oz motors for X and Y-axes and with a 200 in-oz motor for Z-axis.

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When replacing the control, the 24VDC outputs were converted from current sink to current source for the MachineMate. As new wires were being strung, this did not affect

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the task other than the mark-up to the machine's electrical schematic. No extra wires are needed for a sink/source conversion.

Mark designed a new operator station for the machine including a custom enclosure. The switch panel below the MachineMate consisted of just nine buttons, with several having more than one action. The buttons that were rarely used (such as a spindle off button) took on an alternate function if held in for several seconds. Mark's PLC program can provide the operator with messages for each step of an operation (like a tool change) so that if there is a mechanical hang-up, the operator can quickly determine the cause of the problem.

After the refurbish activity was completed and the machine was ready to run, a test cut of a 6-inch diameter circle was made. The first circle was within 0.0015" of round. With a few gain changes to the axis drive tuning, subsequent cuts were less than 0.001" out of round on the very first day of operation.

Initially the axes will have their maximum feed rates somewhat reduced while the operator becomes familiar with the machine. The X and Y-axes were initially restricted to 300 ipm and Z-axis is at 250 ipm. After the operator is comfortable with the machine, the maximum rates for X and Y will be increased to 500 ipm. Before the retrofit, X and Y were limited to 400 ipm but Mark is confident that with the new equipment the machine is capable of the improved performance.

HM Dunn successfully ran these large part programs directly from the MachineMate hard disk. The part program would often exceed 40 blocks per second and the surface finish was never affected. Other vendor's CNC products have to store the part program in a local memory module to achieve higher throughputs but the MachineMate can achieve those rates without such hardware options. MachineMate can run its part program both from the on-board battery-backed CMS memory or from its hard disk. When performing part program checkout, Mark found that NC block number searches within these large programs were nearly instantaneously even when the part program was on the hard drive.

The refurbished machine was cutting parts for HM Dunn in December, less than eight months from the start of the field rebuild. Just one person, Mark Rice, had handled the entire electrical and mechanical retrofit design and rework process.

Two months after getting the machine into production, Mark relates, "The Matsuura with (the) MachineMate control is putting out almost four times the work that Red Fultz thought he would get off of it. The limiting factor is the cutting tool. If he can find better cutters and get more spindle speed, he could increase throughput."

Since Mark is in the retrofit and rebuild business, he planned this project with an eye on the future. He says, "The retrofit/refurb that I have done on this Matsuura is being prepared as a package that can be used for either single or twin spindle Matsuuras manufactured between 1979 and 1984." Mark is flexible with this package so that it can be implemented with other interests (retrofitters, rebuilders, integrators, etc.) as well as other Matsuura machine owners.



Mark has been involved in CNC activity since 1978. From 1979 to 1984, he was busy full time with Matsuura installations in Texas. That previous experience with Matsuuras is one of the reasons he was involved with HM Dunn and this Matsuura retrofit. Over the years, Mark has accumulated experience in all facets of the industry. Mark has worked with machine tools from a number of vendors (Matsuura, Mazak, Monarch, Mori Seiki and others) as well as many CNC controls (like MachineMate, AB, Bendix, Fanuc, GE, Mazak, Mitsubishi and others), as well as a number of PC motion control cards.

Mark says, “MachineMate with its open architecture is the best PC-based control that I have seen and one of the best feature-friendly and versatile NCs on the market.” He has been able to complete the PLC programming for several MachineMate applications in just a few days (for a simple machine) to just a few weeks (for a more sophisticated machine). Mark has done MachineMate retrofits close to his home base of Bedford, Texas, and as far away as Knoxville, Tennessee.

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The picture above is Mark Rice, when he recently visited a potential customer to provide a retrofit proposal.

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