

MachineMate Marries a Hustler

Back in December of 2001 Mark Rice completed the retrofit of a Pratt & Whitney Trimac XV with a **MACHINEMATE** control. The retrofit worked so well (the P&W vertical machining center retrofit has a separate application article) that the customer decided to do another machine in early 2002. The next machine to retrofit was a lathe.

Pick Instrument Products, Galena Park, Texas, had purchased an American Hustler long bed lathe in the late 1970's for use making oil field products. The lathe was used for a few years making "down hole" products for the booming oil industry. Then the boom ended and so did the turning work. Because the machine shop was situated in a former automobile dealership, they had lots of floor space so the machine sat for many years.

As times changed, so did the work. Now Pick needed a versatile lathe with a long bed. A new one with this capability of the old Hustler would cost over \$350,000. Used machines of this size were not for sale. The old Hustler lathe was in excellent mechanical condition. Pick wondered whether it could be economically resurrected?



It could and it was. After careful reading of the prints Mark Rice decided the retrofit could be done with almost no modifications to the machine! In fact, the only modification made to the machine itself for a new control was the replacement of the old obsolete encoders with new ones. The new encoders were quite inexpensive, only \$90 apiece from CUI Stack Inc., plus \$45 each for modifying the mounting brackets. So the whole mechanical cost of converting the lathe was under \$500. (Mark and the customer also decided to replace all of the flexible hydraulic hoses because the old ones looked brittle and the O-rings in the turrets had to be replaced because they had become hard, but none of these expenses were part of a control conversion cost.)

The rest of the retrofit work was inside the control cabinet. Inside the CNC cabinet the only hardware besides the **MACHINEMATE** control is a set of power supplies for the encoders, lamps, and machine logic and a module of sixteen relays for level shifting. The American Tool lathes of this era used a separate hard-wired logic control panel (LCP) instead of a computer run PLC. The **MACHINEMATE** PLC software application (in Ladder Diagram format) completely replaces the old LCP, which is shown in the picture below left. The LCP provided analog control of the spindle, turret indexing, shift speed

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control, hydraulic control, and lubrication timing. The MachineMate now takes care of all of this.



New Burndy style connectors were ordered so that the existing machine cables would plug into the new control (shown above right). Except for the new encoders, the retrofit was a plug-and-go. All of the input signals from the Hustler were compatible with the **MACHINE**MATE modular IO system (MIO). Most of the control outputs were compatible so very little level conversion was required. Because Pick already had one **MACHINE**MATE control, this new cabinet was configured identically to the one for the Pratt & Whitney control retrofit so that shop cross training and maintenance would be easy.

Another possible retrofit problem is that the American Hustler, American Eagle and American Challenger lathes used analog feedback from the turret to indicate turret position, and they used analog output to hydraulic servomotors to index the turret. On top of this, the only signal coming back from the spindle drive is the tachometer signal, which is analog. All of these signals were combined in the American Tool LCP to produce machine control. In any other CNC control this would have required the purchase of additional analog input and output modules but not with the **MACHINE**MATE. The 4ENC4A MIO module, which is standard on systems with analog controlled drives, has enough analog inputs and outputs to run the entire machine. (This 4ENC4A module is optional for systems with SERCOS digital controlled drives.) The various analog feedback signals are connected to the analog inputs of the 4ENC4A and are read by the **MACHINE**MATE PLC, where they are used to coordinate those machine functions. The old LCP had an array of potentiometers that had to be adjusted. All of these are gone in the new system. Any adjustable settings are stored in the **MACHINE**MATE's PLC retentive parameters. The operator or a maintenance man can alter such settings as shift timing (a delay is needed since the spindle uses a clutch), index speeds, or lubrication intervals directly from the MDI input of the **MACHINE**MATE. (These adjustments are useful if the job requires oversized tools in the turret where indexing speeds must be slowed and the indexing must be restricted to keep from crashing the tool or damaging the turret. Also the shift delay can be modified if an extremely massive part or a part prone to whipping is being machined.)

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On the American Eagle series lathes, the turret position is provided to the control via an analog potentiometer in the turret. **MACHINEMATE** can easily adapt to this signal via connecting the pot to one of the analog inputs in the 4ENC4A modules. If the retrofitter wants to replace the analog pot with an incremental encoder, the 4ENC4A module has an extra encoder input that can be used for this. Most other machine controls would have required extra modules or boards but this capability is standard with **MACHINEMATE**.



The **MACHINEMATE** control is shown above, in its new cabinet, next to the American Hustler lathe. The machine tool builder's panel, mounted directly below the CNC, is an option that is available from **MACHINEMATE** INC.

The PLC portion of the **MACHINEMATE** is extremely powerful and well integrated with the CNC program. This makes special machine adaptations like an analog controlled turret PLC functions that may need to be adjusted such as shift timers, index speeds, lube interval, purge cycles, and so on can be stored as values in the control's P parameters. The operator or maintenance man can change these via MDI input without having to change the PLC.

Mark Rice sells the CNC cabinet like the one connected to the American Hustler lathe at Pick Instruments for about \$20,000 (its installation is extra), that includes the **MACHINEMATE** control already wired and with both the **MACHINEMATE** PLC application and the CNC machine parameter file already loaded. This is an attractive price for a complete CNC cabinet for a control retrofit. The price includes the amended electrical drawings and the intermediate (hook up) drawings. This also includes the encoder

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cables out to the machine but not the actual encoders. Encoders run from \$90 to \$450 per axis, depending on size and mounting area available. Typically the encoders run about \$240 each in most control retrofit applications.

Mark strongly recommends the replacement of old encoders or resolvers for four reasons:

1. New encoders are often cheaper than the repair of existing encoders.
2. New encoders can have higher resolution than the original encoders, giving smoother profiling and better accuracy.
3. New encoders have better noise immunity and take advantage of the wire cut monitoring (a.k.a., loss of encoder feedback), and are therefore safer.
4. If the machine has resolvers, replacing them with encoders is half the cost of the resolver to encoder converters. (The **MACHINEMATE** CNC requires encoder feedback from analog controlled servos.)

As described above, Mark Rice has checked the controls on the other American Tool machines (i.e., the Eagle and Challenger) so this American Hustler retrofit package can be used also on those other American Tool machine models. The only additional effort is making a few changes in the PLC application for the differences in several machine functions. Mark developed the PLC application for the **MACHINEMATE** using the Ladder Diagram format; Structured Text, another IEC1131 standard PLC programming language, is also provided with the **MACHINEMATE**.

If you need more information about the American Hustler control retrofit package please contact **MACHINEMATE** INC using any one of the methods (phone, fax, email) listed at the end of this article.

Mark Rice has accumulated experience in all facets of the machine tool industry. Mark has worked with machine tools from a number of vendors as well as many CNC controls and several PC motion control cards. **MACHINEMATE** INC supplies a family of premier PC-based CNC products. The use of Windows NT, a standard Pentium motherboard, standard PC components, an IEC-1131-3 conformant integrated soft PLC, the capability of Ethernet and standard field bus systems and the support for either analog or SERCOS drives give this CNC package the utmost flexibility and openness available today.

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