



Gleason 782 Gear Hobber Control Retrofit

Customer: Gear Manufacturer – Chihuahua, Mexico
System Integrators: MasterControls Inc., L.L.C. (MCI) &
Southern Technical Services, LLC (STS)

Our customer is a large manufacturer of aerospace parts. They manufacture gears, turbines, and other complex parts in their facility. We have been in contact with them during their search for a solution to the control problems on their Gleason 782 Gear Hobber. When they decided to give up on the old control, they came to us to provide the solution.

As with many older machines, the Allen Bradley 8600 OSAI CNC control and the external Electronic Gear Box (EGB) had become outdated and hard to maintain. The machine had been down off and on for many months with various control problems. The customer was not able to rely on the machine for consistent production, so they decided to have a new NUM CNC Control retrofitted onto the machine. They asked MCI and STS to provide a total control solution. This included all new CNC Control hardware, new Machine Tool Builder’s Panel, and new I/O modules. Of course, they also needed to have their operators and maintenance personnel trained on the new control package and associated hardware. They asked MCI and STS to reuse their existing Indramat drives, motors, and feedback devices.

MCI and STS studied the existing machine documentation and talked to the customer’s engineering staff and machine operators familiar with the machine and production parts. A complete Bill of Materials was created and new electrical drawings were drawn using AutoCAD for the project.

It was important to the customer that we not change the machine footprint. MCI and STS designed a new sub-panel offsite that would fit into existing cabinets mounted on the machine. This requirement added a little complexity to the retrofit but in the end the goal was achieved. The machine footprint of the machine was unchanged after the complete control retrofit. All field devices were reused. The I/O on the machine fed back to the NUM CNC I/O Modules mounted on the new subpanels

All of the control engineering and sub-panel build was done off site. When the retrofit package was complete, a time convenient for the installation was set. The retrofit package was delivered to the customer site and the installation started. Installing the new subpanel, CNC Control, Operator’s Panel, and doing the wiring in the magnetics cabinet took about three days. When this work was completed we began powering up the machine and checking it for functionality. We worked with customer personnel during this phase of the project so they would become familiar with the new control and get comfortable operating the machine from the new panel.

When we finished the machine checkout we started running test parts. As we ran these parts we continuously took them to the customer’s QC Lab and had them inspected. The new NUM CNC control had built-in functionality to replace the old Electronic Gear Box (EGB) which had



controlled the synchronized motion required to Hob complex Gear Geometry. Having a vendor like NUM willing to partner with us on complex applications makes us comfortable taking on these types of projects.

MCI and STS develop solutions with the future in mind. We develop machine logic and machine functions in a way that can be reused on new applications. This helps us get our projects done on time. We also go to our customers with code which has been tested for reliability over and over. Our approach is what sets us apart from other system integrators.

Please see the following pages for photos of the installation and a quick overview of the specific project tasks performed by MCI and STS.

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Application Pictures:**Operator Panel**

Operator Panel with 15" LCD Screen, full membrane keyboard, 61 button MTB Panel, HPG, Spindle and Feedrate Override and three-position keyswitch. Large, bright, easy to read display and convenient placement of the Machine Tool Builder's panel.



Inside Machine

Here is a view from the Operator Panel with the door open looking inside the machine. You can see the complexity of the machine with all the axes and the hob spindle.



New Sub-Panel

This is the new sub-panel mounted in the existing control cabinet. The NUM CNC is mounted at the top right. To the left of the new CNC are the new power supplies, circuit breakers and contactors. We used NUM breakout boards which made it very easy to connect the existing Indramat drives. Below the drive interface boards is the machine I/O. These I/O boards have terminal strips on them so we could easily land the existing wiring. You can see this approach makes for a very clean installation.



Quick Project Overview:

CNC

MCI and STS replaced the existing CNC control with a new NUM CNC control with NUMGear. The new control represents the state-of-the-art in modern CNC controls with a software EGB. The control has an intuitive operator interface. This intuitive interface enables the operators to perform quick set-ups and adjustments.

The part programs for this application are generated by the NUMGear package included in the CNC. The operator simply fills in fields on a graphical representation of the part. When the fields are filled in and the tool is selected the part program is automatically generated by activating the program. All customer parts and hobs can be saved on the system by part number and easily recalled when the part is needed for production again. Using the included backup utility all programs and tools can be archived and stored externally on any USB device.

Operator Panel

A new Operator Panel was installed on the machine in place of the old panel. The operator panel includes a 15" LCD Monitor with full membrane keyboard and a NUM Machine Tool Builder's Panel with Hand Pulse Generator. The Machine Tool Builder's panel includes 61 buttons for machine functions not including Cycle Start and Cycle Stop plus a three-position key switch for limiting certain functions on the control. An industrial mouse was also mounted to the Operator Panel for convenience.

Drives

The customer kept the original Indramat Drives. These drives can be replaced later if necessary. The NUM CNC is equipped to control a very wide variety of Analog and Digital Drives.

Position Feedback

This Gleason 782 Hobber has seven CNC axes. The machine was set up to have three decimal places of accuracy when running parts in the metric system and four decimal places of accuracy when running in the inch system. The feedback device for each of the seven axes is listed below:

X-Axis	Radial	50 Lines per mm	Heidenhain Scale
Y-Axis	Tangential	2500 Lines per rev	Encoder
Z-Axis	Axial	2500 Lines per rev	Encoder
A-Axis	Swivel	60 Lines per rev	Encoder
U-Axis	Hob Gage	50 Lines per rev	Heidenhain Scale
C-Axis	Work Table	1250 Lines per rev	Encoder
B-Axis	Hob	2500 Lines per rev	Encoder

Note: Resolver feedback is not compatible with the new NUM CNC control. If resolvers are used for feedback, a converter must be added in the feedback loop to convert resolver feedback to encoder feedback.

Magnetics

The magnetics cabinet was mounted to the machine and remained in place. The control enclosure was also mounted to the machine. A new sub-panel was built and added to the



magnetics cabinet. Existing magnetics remained in place and were largely unmodified. Some small wiring modifications were required by the retrofit.

Field Devices

All existing field devices remained in place for the retrofit. None of the limit switches, solenoid valves, lamps, etc. required replacement. The I/O was connected to the new CNC through terminal strips on the NUM I/O boards.

Hob Change / Hob Shift

Hobbing operations require close monitoring of the Hob Tooling. All this monitoring is handled by the NUMGear package. The customer simply enters values into the Shift Data fields in the HMI and the control handles all hob shifting automatically and informs the operator when it is time to check or replace the hob. By controlling these tasks tightly, tooling costs can be kept to a minimum. Hobs can be sent out for grinding and recoating many times before they are worn out.

Electronic Gear Box (EGB)

Many Gleason and Pfauter hobbers used Allen Bradley 8200 and 8600 controls with a "Black Box" to control Electronic Gearing functions (EGB). The NUM CNC control performs this function in software. This reduced the complexity of the system and the number of parts to maintain.

Installation Time

Upon arrival on site we intended to run parts with the old control to establish a base-line. However, the customer was not able to get the control powered up. Since we couldn't get the control powered up we started removing it. We took all the old control hardware out including the CNC, CRT, Operator Panel, Electronic Gear Box (EGB) and sub-panel with the interface to the old control. We sorted out the wiring and removed all the wiring that would not be reused. We then installed the new Operator Panel and sub-panel. After these were installed all the wiring was landed to the new sub-panel and verified. When the wiring was complete we began powering up and testing the new control. By the end of the fourth day on site we were running dry-cycles on the machine and ready to run parts. After we were confident that the machine was running properly we started testing the part programs and running parts to check for quality and consistency.

We cut Spur Gears, Helical Gears, and Gears with Crown. The control is also capable of cutting Gears with Taper and Cluster Gears. This particular application did not require that type of cutting. As we were setting up and running production gears we were doing operator training. The interface is so intuitive by the end of the first day the operators were able to do their own set-ups including entering all part and hob data.

Integration time

Integration time included producing machine schematics, creating a Bill of Material, ordering and receiving all the hardware, building the required sub-panels for the CNC and the Operator Panel, writing all the machine logic, and configuring all the machine parameters. This typically takes six to eight weeks from the time an order is placed to installation.



Documentation

NUM produces complete documentation for integrators and end-users. A complete set of manuals was provided to the customer. Hobbing is a complex application and needs to be well documented so the operators can set up and run the machine. In addition to the Operator's Manual, a full set of Electrical Schematics (AutoCAD Format) were provided to the customer. We can store a copy of all documentation on the control. Operators, set-up and maintenance personnel can have immediate access to all documentation right at the machine.