

# Upgrade

## YOUR MAAG GEAR SHAPER CONTROL SYSTEM SUCCESSFULLY

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**F**or much of this century, a lot of people have owed their livelihoods to Dr. Max Maag.

After years of development, the Maag Gear Wheel Co. shipped the first of many spindle-type gear shapers in 1958. The Maag design represents a more practical alternative to hobbing for manufacturing many types and styles of large gears. In fact, even today, there are

coarse-pitch, large diameter and narrow-gap double helical gears that can only be manufactured on a Maag-style machine.

Because of the machine's precision capabilities, versatility and production efficiency, many manufacturers have found it important to protect their investments and keep their Maag gear shapers in tip-top condition—especially

since the machines are no longer made. By the time the last new Maag gear shaper was installed in 1990, the control technology had changed dramatically. Also, the robust nature of the Maag gear machines that once captivated gear makers eventually became their curse, as the mechanical components greatly outlived the electrical controls. Retrofit became a part of the gear maker's vocabulary as a path to continued productivity in the future.

A full CNC solution involves installing synchronized servo motors on the table rotation, table translation and cutter box motions and removing all the unnecessary equipment formerly associated with these motions. The significant roadblocks one faces going down the full CNC path include the natural tendency not to disturb a functioning system and the ability to find a control system integrator possessing the intimate knowledge of the inner workings of the Maag gear shaping process.

There are a number of technological reasons for choosing a full CNC retrofit; however, it can be difficult to make a justifiable business case to support this decision. During the justification process, someone always points out that the Maag will not run any faster after a retrofit. Those who attempt to make it run faster, often end up burning the tooling out faster, which wipes out savings realized by the increased speed. In addition, the savings in reducing the setup time that a CNC solution would





bring become insignificant when one considers the ratio of setup time to run time. Without the prospect of increased production or significant setup time reduction, Maag projects are not usually high on the appropriations list.

But you don't have to do a full CNC retrofit. A number of less expensive retrofit options exist, from a complete control system upgrade to an individual ram drive replacement. Since 1992, Nova personnel have retrofitted two SH-250s with new control systems, reusing only the original drive motor, and one SH-250 with a new control system and a new drive motor. Nova has also integrated new drive controllers into two SH-450s and one SH-250/300, each time replacing energy-hogging motor-generator sets. In every retrofit case, whether a complete or partial upgrade was installed, the Maag shapers either met or exceeded the production rates of the machines prior to the start of the projects.

Maag gear makers usually struggle to justify making improvements to their shapers, but there are good reasons why upgrades make sense. Replacing outdated motor-generator sets provides a continuous payback due to reduced energy consumption. Another reason might be avoiding downtime spent trying to troubleshoot a relay logic control system. A major reason to consider an upgrade would be the impending demise of the ram drive motor or motor-generator set. Normally, the cut-

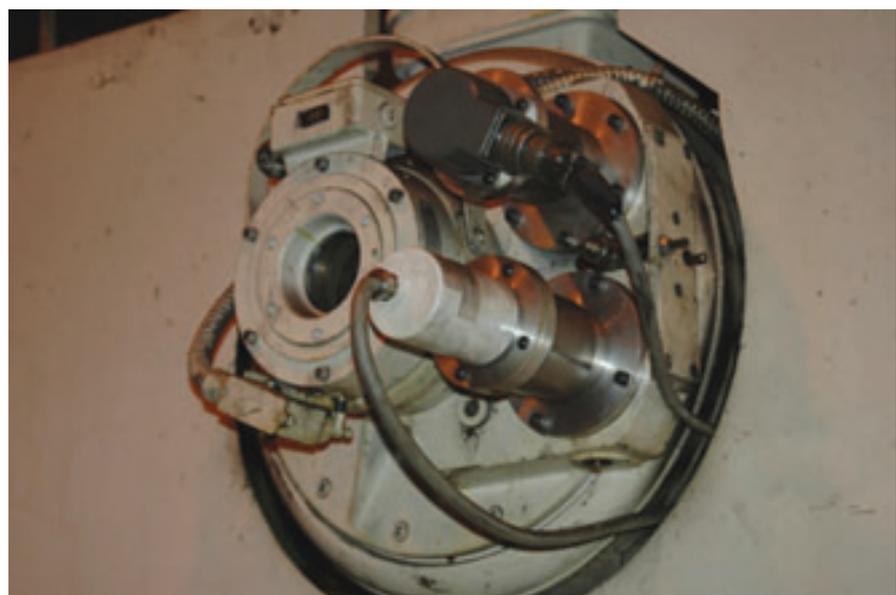
ter box motion should be steady with a smooth turnaround. If there is any jerkiness in this motion, it might indicate a developing problem with the ram drive system. An emergency full overtime repair of these components can be very costly both in terms of direct expenditures and loss of planned production time. Funds might be better spent towards updating equipment on a pre-planned schedule. Downtime waiting for the arrival of specially manufactured or repaired parts can support the case.

A much-overlooked opportunity to retrofit a Maag is when it is moved, since the machine is down and usually rewired anyway.

Another viable business case could be made for an upgrade when gear shapers

might be underpowered. This condition would exist when a shaper originally built to finish previously gashed blanks was now being used to rough cut. In that case, increased throughput could be realized with a power upgrade. In the late 1990s, the power of these machines could be increased by replacing the 32 kW DC ram motor with a 70 kW modern flux vector AC motor. Even though this combination produces about 15% less torque than an original 70 kW Maag DC motor (commonly used on roughing machines), there still is a significant improvement over a 32 kW motor. Today, new motor technologies can offer solutions to overcome the shortcomings of the flux vector motor.

The control system of a Maag shaper consists of an electronic control unit



and a relay logic section. Since the initial introduction of the first spindle-type machine, the control system has evolved through many stages to a full PLC-based implementation. The last machines produced by Maag used Modicon equipment. The original intent of the PLC initiative was to provide a degree of separation between the logic and the hardware. A secondary benefit was the capability to use software tools for troubleshooting. With this system, since the logic (software) rarely changes, new hardware elements can readily replace obsolete elements.

Nova has continued the development of the Maag control system by migrating it to a PAC (Programmable Automation Controller) platform. With this technology, it is possible to install a control system to adequately operate the shaper in present time, but also provide the potential to add full CNC capabilities as future needs arise. The PAC solution additionally provides capabilities for display of machine status, storage of part production setups and diagnostic information. These systems are designed using a Fieldbus digital I/O protocol that allows locating the physical inputs and outputs on the machine. This eliminates the gaggle of wires running through the flex conduits back to the main control. The updated control will free up at least half of the real estate in the former control cabinet.

From a gear maker's view, the upgraded machine changes very little. The pendant controls are exactly the same. The main operator panel is modified to allow the installation of an electronic display. This display/data entry keyboard annotates machine status and fault information. Because of the modular nature of the Nova solution, a ram-drive-only retrofit can be implemented on an existing Maag control system and be completely compatible with a future PAC upgrade. This interim ram drive upgrade would be seamless as far as the operator is concerned.

Nova designs and builds the systems in Milwaukee, WI. This location provides a geographical center point for the dispatch of service engineers if needed for

further maintenance. After shipment to the final destination, either plant personnel or an electrical contractor familiar with the site does the installation. This has worked well because it allows a local presence and familiarity with the hardware. Following the installation, a factory-trained engineer would commission the retrofit. In some cases, owners elect to separately contract the services of a gear shaper expert to check and resolve any mechanical issues. In the case of a ram drive power change, it is highly recommended that such an expert be involved because the overload clutch will have to be adjusted.

A Maag gear shaper is a symphony of gears, levers, motors, pumps and control units all playing together in perfect harmony. A successful retrofit will keep the parts playing together perfectly. ■

**For more information:**

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