The Importance of Workholding Flexibility

Automated cell delivers "lights-out" hobbing operations at Precision Gears with assistance from Hainbuch mandrels

Frank Burke

Finished gear wheel on mandrel after hobbing.

The 67,000 sq. ft. facility occupied by Precision Gears Inc. in Pewaukee, WI, contains a full range of gear manufacturing equipment to meet the varied customer demands of the many industries it serves. Founded in 1919, the company possesses both the technologies and experience to efficiently serve the multiple requirements of manufacturers in fields as varied as agriculture, lawn and garden, foodservice, power transmission construction, pumps, and others.

According to Dalton Campbell, manufacturing engineer at Precision Gears, "We manufacture virtually all types of gears in all types of materials. Production can involve CNC turning, milling, broaching, grinding, and ancillary services. Although we typically run lots from 100 to 2,500 pieces, we recently received an order for a much larger quantity and expect to be handling higher production runs in the future."

The complex requirements of gear production, combined with the shortage of qualified people, caused Dalton to explore the possibility of incorporating an automated manufacturing installation. Prior to designing the cell, several parameters were established.

"Our typical sizes range from 1 to 5 inches," Campbell said. "As a result, the demand for flexibility was key to our plan. Also, we wanted to be certain that the various components were mutually compatible and capable of consistently meeting our quality standards. Although our typical tolerances range from .001 to .002, the diversity of our customer base means that we might occasionally have to meet tighter standards. It was also determined that the automated unit would initially be used for the production of external gears only." As developed, the cell consists of a Nidec GE20A CNC gear hobbing machine designed for dry cutting. The machine can handle parts with a maximum diameter of 200 mm and hobbs up to 130 mm in diameter and 230 mm in length.

"Because we employ dry hobbing, we are unable to use oil for temperature control. Instead, we cool with an air blast, and chip management is handled with a small amount of coolant," Campbell said.

Nidec software controls the hobbing process.

Loading and unloading functions are handled by a Fanuc M-10iD/12 robot in a Load & Go RC front load installation.

Parts are loaded on a pivoted angled dual-sided table. In addition to loading and unloading parts from the hobbing unit, the robot turns the table when operations are completed on one side.

Critical to both the flexibility and precision requirements of the cell are Hainbuch Mando T211 and Mando G211 mandrels. The T211 delivers extremely high clamping force in the 20–200 mm range. Vulcanized clamping elements reduce vibration and protect the internal diameter of the part.

Designed specifically for gear cutting, the Mando G211 is a standard segmented mandrel with slim interference contour, as well as radial clamping with pull-back effect. Three end-stop levels offer significant size flexibility.

The first part selected for hobbing on the automated system is a so-called "gear wheel." Prior to hobbing operations, gear teeth on the ID have been broached, and hobbing is the last step prior to deburring.



Blank part on robot (all photos courtesy of Hainbuch).

Finished gears - Completed gear wheels.

"On the fully automated 'lights-out' shift, we typically run two dozen of the gear wheel parts, and each part is completed in about eight minutes. Of course, if we are running smaller gears, production can be significantly increased by switching templates for up to a maximum of 166 parts. The system has been in operation since October of 2023, and there have been no problems," Campbell said.

Much of the system's success can be attributed to the close relationship that exists between Precision Gears staff and suppliers. Michael Kucera, regional sales manager for Hainbuch America Corp., explained, "When it comes to automation, simplification is key to success. For instance, our Mando T211 and Mando G211 chucks feature Hainbuch's standard design. As the bushing is depressed onto the cone, the vulcanized segments expand the bushing, ensuring a secure grip. The G211, which was designed for gear making, allows for easy loading and maximum gripping power—major considerations when it comes to robotic operations."

"Mike was extremely helpful to us in selecting the proper equipment," Campbell said. "He guided us to a standard bushing and a larger mandrel that meet our requirements without having to go to the expense of customized bushings. Since adopting the system, we have machined a wide variety of part stops in varying sizes to accommodate different gears. We plan to automate production of smaller bore parts utilizing Hainbuch's size 0 G211 in the near future."

The success of the automated cell is being felt throughout the Precision Gears operation. The next phase includes planning for the replacement of a 26-in. gear generating machine along with all new machines preset for automation.

Michael Larson, marketing director at Hainbuch America, sees Hainbuch's development of products relating to gear manufacturing as an ongoing commitment: "As with so many other areas in manufacturing, modern technology is challenging traditional methods of gear manufacturing. Automated systems, like the one at Precision Gears, demonstrate the importance of versatility, flexibility, and fast change capability without sacrificing precision. The Mando G211 is demonstrative of Hainbuch's commitment to leadership in that area."

"In an industry such as ours, the idea of moving into fully automated systems can sound difficult, if not threatening. However, the process has come a long way. Advanced CNC technology now makes it possible to produce many different gear configurations on one machine rather than requiring a number of specialized units," Campbell said. "The marriage of increased flexibility and automation is significantly advancing capabilities within the gear making industry. With the right team and the right suppliers, it opens the door to a really bright future."

