

# Anatomy of a Rebuild

## Nuttall Gear Taps Machine Tool Builders for Shop Floor Upgrades

Matthew Jaster, Senior Editor

**Infrastructure engineers continually caution the U.S. government about deteriorating bridges and dams.** According to Nuttall Gear, the average age of the 609,380+ bridges in the United States is nearly 42-years-old and the U.S. spends an average of \$12 billion annually on repair/replacement costs.

For 60+ years, Nuttall Gear has provided highly-engineered, long-lasting gearbox solutions for the bridge market. It's one of several key heavy industrial sectors that the company provides extensive application expertise and customized solutions.

In order to accommodate these markets, Nuttall Gear (an Altra Industrial Motion Brand) relies on the latest machine tool technology. This includes upgrading and rebuilding some of the equipment.

"We had some pretty old machines on the floor that were manufactured in the late 1960s and early 1970s. It was tough to get service on the equipment and almost impossible to hunt down the necessary replacement parts," said Dan Bogdan, senior manufacturing engineer at Nuttall Gear, a division of Altra.

Instead of investing in all-new equipment, the company developed a rebuild strategy. This centered on a company-wide initiative to have at least one machine rebuilt each year depending on business conditions.

"We had recently purchased a brand new Höfler gear grinding machine and wanted to upgrade our hobbing machines as well," Bogdan said. "We couldn't justify purchasing brand new machines in this area, so we decided to see if we could upgrade/rebuild some of our core equipment to support existing sales and future growth. Machine Tool Builders (MTB) sounded like a good option based on cost, experience and service and support."

### A Rich History in Gear Manufacturing

Founded in 1887, Nuttall Gear, Niagara Falls, New York, developed and introduced single helical gears, one of the most significant contributions to the field of gear engineering. Today, Nuttall specializes in providing complete custom packaged drive assemblies combining both mechanical and electrical components to meet specific customer requirements.

Nuttall designs and manufactures a variety of gearing solutions including vertical and horizontal drives, speed reducers and speed increasers, cast iron and fabricated steel housings and flange mounted and scoop mounted gearmotors. Nuttall can provide entire drive packages including reducer, motor mounted on a bedplate with couplings, coupling guards, backstops, chain and/or belt drives, clutches, shoe or disc brakes and auxiliary lubrication consoles.

Custom, heavy-duty Nuttall drives are utilized in a range of key markets including metals, pulp & paper, mining, textile, oil & gas applications such as extruders, crushers, elevators, water screens, briquetting machines, de-barkers, conveyors, drawworks, recoilers/uncoilers and dredges.

Nuttall acquired Delroyd Worm Gear in 1997. Delroyd was founded in 1923. It is recognized worldwide for designing and manufacturing high quality, long-lasting worm gear drives and unique, custom-engineered worm gear products. The company offers a wide range of products and services including single, double and triple worm and helical worm reducers, custom-engineered worm gear reducers, standard and special worm gear sets, reverse-engineered gear sets and gearboxes and gearbox rebuilding services.

Delroyd drives are found in various key markets including power generation, metals, pulp and paper, oil and gas, min-

ing, material handling, food and beverage, textile, wastewater, cement and marine on applications such as pumps, fans, compressors, crushers, mixers, conveyors, stacker/reclaimers, turbines, cranes, winches and propulsion equipment.

### The Rebuild Strategy

Ken Flowers and Ron Peiffer at MTB answer plenty of questions on a daily basis. When you're in the rebuild, refurbish and remanufacture business, it's just one-step in a highly-detailed process. Can we automate this equipment? Is there any life left in this machine? How can we make this gear hobber more productive? Bogdan at Nuttall Gear came to MTB with his own list of questions prepped and ready to go.

"Obviously cost is always going to factor into your decision, but you're also looking at service and support, machine tool experience and any additional ideas and concepts MTB brought to the table. There's a lot of back and forth between both companies when you start discussing what you want and what you need out of the rebuild," Bogdan added.

After determining which machines made the most sense for rebuild, the Nuttall team created a strategic plan for the equipment, basically researching and documenting what features and capabilities made the most sense.

After choosing MTB to upgrade a gear hobber, Nuttall Gear has commissioned the company to rebuild a worm gear hobber and a thread milling machine. They plan to continue this in the near future by retrofitting a gear inspection machine and rebuilding an additional gear hobber. Here's a closer look at some of the equipment that has been upgraded:



## Pfauter Turbo 900 Helical Gear Hobber (Rebuilt in 2012)

Before the upgrade, the 900 was a manual machine that was originally manufactured in 1968 and incapable of cutting a lead angle within required tolerances. The 900 was also no longer capable of cutting a crown. Both of these conditions caused additional machining via offsets as well as additional shave and grind time.

Since Nuttall doesn't typically run 20, 30 or 40 pieces one after another, it was important that the setup time was quicker and more efficient.

"We need the machine to be able to set up a part and break it down, set up another part and break it down, etc. We seldom run more than 2 or 3 of the same part. This machine is typically used for pinion shafts, different lengths and different pitches, so we need to be able to setup and change-out very quickly, one job to the next."

MTB converted the manual machine to a CNC machine and it quickly became Nuttall's most efficient and reliable helical hobbing machine. Bogdan was pleased with the modifications MTB made. The upgrades led to improved lead times for both setup and machine cycle time. The crowning capability was restored, and the software was updated and more user-friendly.

"We were also very aware of the parts that were used in the rebuild, includ-

ing the new pipes, valves, pumps, etc.," Bogdan said. "These were quality parts. The machine is sturdier now and we have the option of using carbide hobs if necessary."

Flowers and Peiffer continued to answer questions and provide additional support after the project was completed. For example, Bogdan said that the company was recently running a part and wanted to perform a machining technique known as opposite hand hobbing (Cutting a right hand gear with a left hand hob).

"This is a fairly straightforward procedure on a manual machine, but when we tried to do it on the CNC machine, it wasn't working quite right. We made a call to MTB and they were able to identify what needed to be done in order to perform the technique on an automatic machine," Bogdan said.

## Norton G&E TWG 40 Worm Gear Hobber (Rebuilt in 2014)

The rebuild strategy on the worm gear hobber was to upgrade a 1960s machine that covered the smaller size worm gears (going from a minimum center distance of 2.5"-29"). This included upgrading the CNC controls, eliminating several hydraulic leaks that could not be repaired by the maintenance staff and updating machine capabilities in order to improve setup and cycle times.

Bogdan said that Nuttall Gear is a lit-

tle bit different than other companies because the company does a great deal of custom work and makes all kinds of different gearing. They are heavy into lean manufacturing and prefer not to run too many parts at once and put them in storage. The company philosophy is to run the parts as needed.

Nuttall Gear still makes fly tools for worm wheels. Essentially this is when you take a finishing tooth from a hob and use it to rough and finish the worm wheel in a single pass. The company wanted this worm gear hobber to be able to use tangential hobs, in-feed hobs and fly tools. This requires long, tangential movement on the hobbing machine.

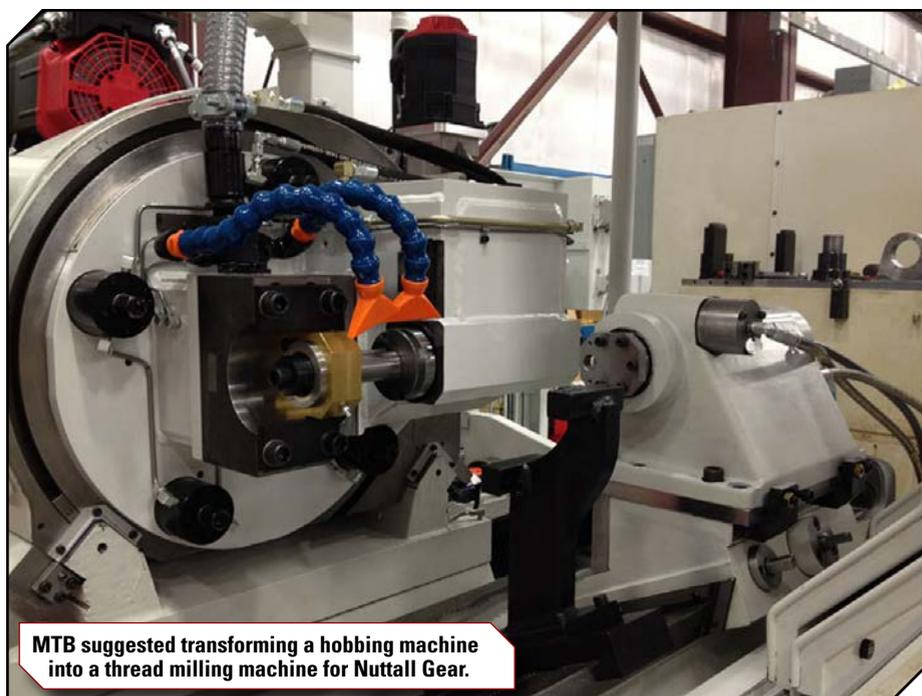
"Side to side movement has to be much longer than a regular hobbing machine," Bogdan said. "You can buy a brand new hobber and it will cut worm gears, helical gears, it will pretty much cut everything. But anywhere I go for a brand new gear hobber, you won't find the tangential movement needed if you're using fly tools."

So this particular capability needed to be custom-made in the rebuild. Nuttall required tangential and radial infeed hobbing. MTB provided both of these capabilities.

MTB also took the helical software and adapted it for use to use on the worm gear hobber. "There's different terminology and you're using different language, so they added all the software to make it easier to use and understand," Bogdan added.

Thanks to these upgrades, the worm gear hobber boasted initial setup reductions greater than 50 percent (down from 2+ hours to less than 1 hour) as well as cycle time reductions between 40 and 60 percent. The gear quality and surface finish were improved, controls were updated to CNC and the rebuilt hobbing head allowed for the use of carbide tooling thanks to the sturdier construction of the rebuilt machine.

"We couldn't consider carbide tooling in the past thanks to the machine vibration," Bogdan added. "Now we have the option if needed and it gives us more flexibility. With the redesign, we get better quality parts, better finishes and we can run parts much faster."



MTB suggested transforming a hobbing machine into a thread milling machine for Nuttall Gear.

## Pfauter 250H Horizontal Hobbing Machine into a Thread Milling Machine (2015)

This rebuild was a similar challenge. The company wanted to upgrade a thread milling machine that could provide faster setups and easier changeovers. They were still working with old machines from the 1940s and 1950s that had the same problems as some of the other older equipment.

There was no machine head stability, for example. This prevented engineers from utilizing newer tooling and lowering run times. Bogdan said they were also interested in using insertable blade carbide cutters especially for bigger pitch parts since the older machines couldn't take it due to the vibration.

The game plan was to figure out the main range of parts (pick the sweet spot) and find out if MTB could upgrade one of the machines. As it turned out, MTB had a Gleason horizontal hobbing machine that fit all the criteria. MTB told Bogdan that they could transform the hobber into a CNC thread milling machine by simply changing the cutting head.

"The platform and the base were perfect, they simply needed to make a few simple machine conversions," Bogdan said.

The upgrade offered significant advantages. The old thread milling equipment was all manual. The operator had to be standing in front of the

machine to do anything. Bogdan said the time that this took with the manual machines was unacceptable and the old machines (like the other examples) were very difficult to maintain regularly. And forget about finding replacement parts.

With the rebuild, Nuttall Gear now had automatic indexing, the software was easier to use and the machine had the capability to use different size cutters, interchangeable arbors, etc. It basically gave the company the option of doing a majority of parts in a single machine.

"This flexibility gave us the opportunity to get rid of a few machines on the shop floor. It replaces the work done on two of our previous machines, almost three in reality. We just keep the other one around for very small sizes," Bogdan said.

The rebuild let Nuttall Gear utilize carbide cutters that didn't work quite as well on the older equipment. They attempted to use carbide cutters on an older, manual machine and blew the endcap off the back of the machine in the process. "Couldn't handle it until the machine upgrade," he added.

The stability of the machine was one of its greatest perks. By converting a hobbing machine into a thread mill, gear engineers now had a stable, automated, machining cell at their fingertips.

"With the old equipment, the operator had to take a trial cut before the first pass during part setup to establish

correct size. MTB updated the software so shorter trial cuts were now built in. Cutting time improved 40 to 60 percent with carbide cutters and 15 to 20 percent with standard cutters. Part setups were significantly reduced.

## Future Upgrades

While the purchase of the Höfler gear grinding machine certainly opened up new markets and new opportunities for Nuttall Gear, the rebuilds and upgrades served an entirely different purpose.

"Each of these upgrades simply enhanced and optimized the day-to-day business we already conduct in these heavy industrial sectors," Bogdan said. "This is a cost-effective way to upgrade your plant on a set budget and think outside the box a little when you're looking at the older equipment you're still running on the floor."

Nuttall Gear still has its strategic rebuild plan in place. They plan to target another gear hobber to rebuild in the near future as well as retrofit a Maag SP-160 Gear Inspection Machine. These upgrades will most likely occur between 2017 and 2018. The company will continue to work with MTB on these and additional projects.

The markets Nuttall Gear specializes in, particularly bridge drives, is starting to pick-up according to Bogdan. "We have a lot of quotes for bridge drives and there's still plenty of work available to upgrade some of this equipment. We're hopeful that there will be plenty of new opportunities to test the gearboxes in bridge drives and offer our services and expertise."

Bogdan also sees some more opportunities in transportation, particularly light rail applications. "We're getting more work in subway systems as well as some activity in oil and gas. When the oil industry starts picking up, we'll be much busier and we'll need to make sure the equipment we're using is up to speed. Timing is everything in this business!" 

## For more information:

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Nuttall Gear

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Nuttall Gear now had automatic indexing, software upgrades and the ability to utilize different size cutters on the thread milling machine.

# The Rebuild/Remanufacture Checklist

With each rebuild project, Dan Bogdan, senior manufacturing engineer at Nuttall Gear, a division of Altra, gains more experience and learns more about the rebuild process. Here's a quick checklist of things to consider when upgrading your equipment:

## #1 Know Exactly What You Want From the Rebuild Up Front

It's better to go to corporate with a number in mind for the total cost of the project instead of coming back asking for more money during the rebuild. "If you miss certain elements in the planning phase, it might cost your company an additional \$10,000 to \$20,000. You don't want to be halfway through the rebuild and find out you need more money to complete the project," Bogdan said.

## #2 Experience is Important

Machine Tool Builders (MTB), located in Machesney Park, Illinois, provides top quality, reliable machine tool solutions thanks to its highly-experienced staff, innovative ideas and customer service and support. Bogdan did his research and had a pretty good idea about the expertise MTB provided. "If there's familiarity and knowledge of the machine and a thorough understanding of what you want to accomplish, it makes the entire process so much easier," he said.

## #3 Walk and Talk

While initial rebuild discussions begin over the phone or via e-mail, the real legwork is done right on the shop floor. "Ken Flowers and Ron Peiffer at MTB didn't just rattle off potential ideas for our project," Bogdan said. "They toured our facility, looked at all our equipment, and learned all about our machining processes before offering some suggestions for the rebuild project."

## #4 Outline and Document Everything

Corporate has to approve the cost of the project and they never like surprises. It's in the best interest for both parties to keep communication open with your rebuild, make sure everyone is on the same page and write everything down.

"You should take all of your own considerations as well as the rebuild's considerations before going to corporate for project approval," Bogdan said.

## #5 Don't Forget the Add-Ons

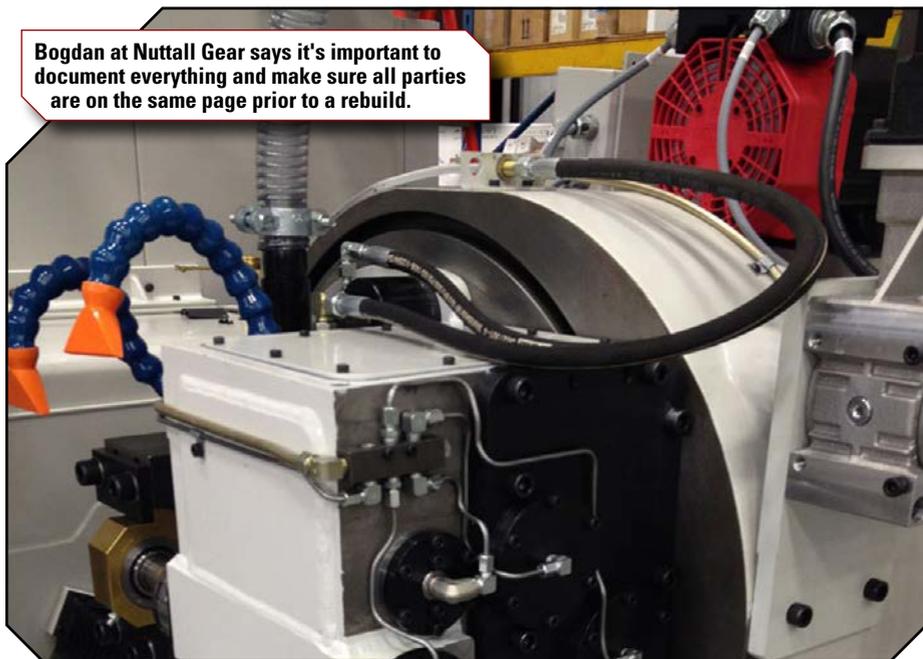
It's rarely just about putting a new cutting head in a machine or updating the controls. There are always other expenses to consider including new arbors, safety enclosures, software upgrades, etc. "Think about every aspect of the equipment and remember

said. "Why not cover every possible outcome right from the very beginning?"

## #7 Phone a Friend

There's always going to be something you miss or something you might need the machine to do down the road. Service and support is vital for the success of the rebuild. Bogdan states that MTB typically follows-up on a question or comment the very same day. "They will get back to you as quick as they can and determine what they can do on their

Bogdan at Nuttall Gear says it's important to document everything and make sure all parties are on the same page prior to a rebuild.



that many of the older machines don't have the safety features and automation capabilities that might be available after the project is completed," Bogdan said. "These are areas that will cost much more money down the road. It's better to prepare for these expenses at the beginning of the project."

## #6 Get Complicated

When you're testing parts on the machine in question, it's pointless to select the most common part you typically produce. Bogdan suggests you pick the part that is going to be the most challenging and use that for the testing phase of the project. "If you select a part that has given you the most headaches in the past and it runs smoothly, you'll be much better off in the long run," Bogdan

end to solve whatever problem you're having with the equipment. It's nice to know we can call them up immediately with any technical issues or questions," Bogdan said.

## #8 Communicate Early & Often

Bogdan believes this is just as important at the beginning of the project as the end. Keep the communication line open with your rebuild, let them know what you might be looking for down the road and what machines you might upgrade next. "This is the most useful part of the entire process," Bogdan said. "Keep talking about what you need and what areas would benefit from additional upgrades. Conversations generate great ideas for the shop floor." 