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Ways to Extend
CNC Spindle Life

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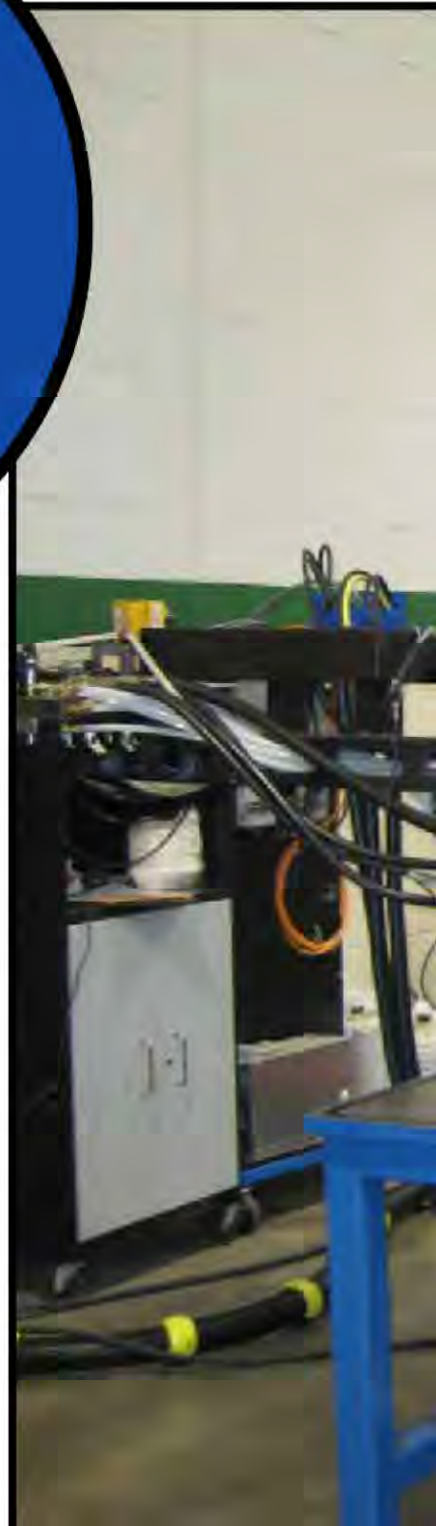
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For most manufacturers, the productivity of their CNC equipment can be measured in fractions of seconds, including not only the cutting or grinding cycle times, but even the intervals between tool changes. The performance of the spindle – the workhorse of the CNC machine – has a dramatic impact on that productivity.

When operating problems, such as excessive vibration or chatter, hinders machining efficiency, productivity may be crippled until the spindle is replaced. If no spare is available, repairing or remanufacturing the spindle could take weeks effectively putting a machine out of business in the meantime. Hence, getting longer life and optimum operating performance from spindles is a worthwhile economic goal for manufacturers.

The solution to getting higher performance and extended life from spindles on CNC machines is a combination of practices aimed at (1) preventing premature spindle failure and (2) after a failure occurs, insisting that the remanufacturer provides not only comprehensive CNC spindle repair services but can also provide modifications and operational recommendations that can ensure longer spindle wear life - even when run at higher speeds.



to Extend CNC Spindle Life

*to performance issues and insisting on painstaking rebuild/remanufacturing
ures can help machine tool operators keep their spindles on the job.*



The following guidelines can help machine operators achieve those goals:

Identify when to repair – before failure

Normally when a customer pulls a spindle it is because of part quality issues and/or intensified noise level.

“Noise often results from damaged bearings creating vibration that may eventually lead to chatter, a more severe vibration that feeds upon itself,” explains David Kirkpatrick, president of Superior Spindle Service (Taylor, MI), a company that specializes in rebuilding, grinding and machining of machine tool spindles. “Chatter often creates waves in machined surfaces to the point where the parts being are out of tolerance and must be scrapped.”

Another immediate and serious consequence of chatter relates to spindle efficiency. Many manufacturers deal with chatter by setting their machining parameters low. Therefore, instead of tool strength and spindle horsepower defining the metal removal rate, chatter becomes the limiting factor that keeps the process from reaching its potential.

Kirkpatrick, a CNC machine spindle expert with more than 30 years of experience adds, “Cutting tool chatter and spindle vibration are indicators that a spindle requires attention or a catastrophic failure can occur.”

In some cases when vibration does not cause a part quality

problem, operators have been known to run the machine until it catastrophically fails – a very expensive decision.

The solution for operators of CNC equipment is predictive maintenance. This requires regular monitoring of operating parameters and maintaining disciplined, detailed records. For example, vibration analysis should be monitored and recorded at appropriate intervals, perhaps quarterly or even monthly.

“The frequency of vibration analysis depends on the application,” Kirkpatrick says. “The temperature of the spindle should also be monitored. It is important that an expert determine that the spindle should be switched out before parts go out of tolerance or motor damage occurs. Plus, if the spindle can be changed out over a weekend, the shop can avoid critical downtime.”

Look to a remanufacturing specialist

When CNC spindle repair or replacement is needed, a remanufacturing specialist can often provide more comprehensive spindle services, sometimes also including repair of related motors, encoders, proximity sensors and drawbars.

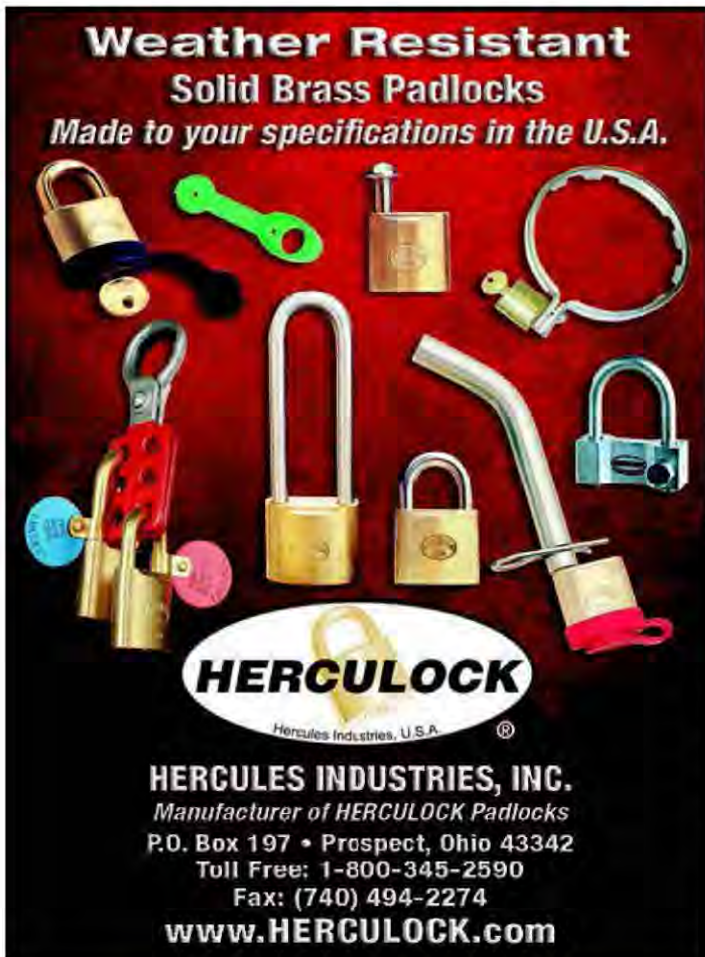
Some spindle remanufacturers, such as Superior Spindle Service, offer one-stop repair services. Because there is a direct relationship between spindle performance and the proper function of these other components, it is critical that the precision spindle repair facility be able to evaluate and service all spindle components.

The evaluation process begins with disassembly of a spindle that is out of spec or failed. In the evaluation it could include the motor – surge test, drawbar – retention force and all electronics (encoders, proximity sensors, bearing sensors, etc.).

“Service technicians meticulously should disassemble and check each spindle for adherence with the original manufacturer’s specifications,” Kirkpatrick explains. “This is followed by a geometric inspection using electronic measuring equipment that is repeatable within a micron. It is advantageous that a digital photo record be kept to insure that all repair quotes and failure analysis reports are as accurate as possible. Next, grinding, machining and balancing should be performed by experienced technicians using advanced manufacturing equipment.”

It is essential that spindles are reassembled in a clean work environment. For example, at Superior Spindle Service a class 10,000 clean room is used for inspection and assembly. The clean room is designed to prevent any airborne contaminants and humidity from affecting spindle quality and performance and further ensures that each spindle is returned to precise OEM specifications.

Look for Kaizen-type innovation and improvements



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Kirkpatrick says there is much room for Kaizen-type improvement throughout the remanufacturing process. In one case his firm was working with a major automotive manufacturer who was experiencing excessive downtime – over 31 hours - each time they had to change a spindle.

Superior Spindle Services was able to extend spindle life by incorporating specific modifications. As a result, the customer’s average spindle downtime was reduced to less than 10 hours, an accomplishment for which the spindle remanufacturer received a Kaizen Award.

“In the manufacturing environment, if you can reduce the cycle time even a fraction of a second can make a big difference. So, with respect to a 20-plus hour downtime savings, that is monumental.”

Require failure reports

For every CNC spindle repair, customers should expect to have a detailed failure report including text and photos. “This process provides the customer with documentation of the rebuilder’s findings concerning the causes of failures,” says Kirkpatrick. “This is vital because it can help customers take corrective actions to prevent future failures.”

Kirkpatrick says that his firm also provides customers with recommendations that may increase spindle service life. In some cases, application engineers might suggest ceramic (silicon nitride) ball bearings be used to replace conventional steel ball bearings. The ceramic ball bearings have 30% more mass than steel ball bearings and allow spindles to operate at higher speeds.

Expect advanced testing and verification

After spindles are remanufactured, it is vital they be thoroughly tested and verified. If related assemblies are in question, such as electronics or motors, those should be tested and verified as well.

“Advanced testing includes vibration analysis and running the spindle closed-loop on a Siemens or a Fanuc drive,” Kirkpatrick explains. “Our technicians also align encoders using special software. We also test motor thermistors, bearing thermistors and proximity sensors.”

Each rebuilt spindle needs to be thoroughly “run in” at the operating speeds as they were designed. Vibration analysis and temperatures are monitored throughout the run in procedure and may take up to 18 hours to complete. Before leaving the testing facility, detailed reports should be generated for verification by Quality Assurance Technicians.

To ensure minimal downtime and maximum productivity, the above mentioned procedures will increase mean time between spindle failures.

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