Spindle failure happens

Will you be ready when your spindle goes down?

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Most spindle failures are not predictable and always seem to occur at the worst possible time. This article will review some of the things that can be done to keep spindles running longer, identify potential problems early, and minimize machine downtime when machine spindles do fail.

Machine wrecks will happen. The catastrophic ones will shut you down without notice and always seem to happen at the worst possible time. For this type of spindle failure, the best advice I can give is to develop a relationship with a company that specializes in precision spindle rebuilding—a rebuilder that offers emergency spindle repair service and has qualified field service support when you need it.

The rebuilder should be an expert in precision spindles and perform a failure analysis as part of its standard rebuild process. The failure analysis will provide insight into what has caused the failure. The rebuilder should, for example, provide free tear down and evaluation as part of the spindle rebuild quote. All repairs should be "firm quoted" and all work should be backed by a written warranty for additional assurance your spindle will be returned in "like new" condition.

In selecting a spindle rebuilder, price is always important, but even more important is the confidence you have that the spindle will be fixed in the shortest possible time. For example, the rebuilder should maintain a database on all customer spindles with records for vibration, inspection, etc. that can be used for future reference.

Tools for the job

The rebuilder should preferably have in-house engineering and manufacturing capabilities, allowing it to reverse-engineer and make replacement parts should they be required. This will save time and money and get machines back in production faster than waiting for parts from an OEM supplier. If the rebuilder has complete in-house capabilities, chances are you will get a better rebuild because they will correct and repair the actual problems and not just replace bearings. With in-house capabilities, manufacturing new spacers, regrinding a tool taper, and truing a spindle face are easily accomplished with less delay and at reduced cost.

A quality rebuilder should have the proper equipment to test and measure spindle performance. For example, if the spindle is equipped with a power drawbar, the rebuilder should be able to check the setup position of the grippers and measure the tool retention force. Problems in this area can lead to severe spindle problems and machine damage.

After the repairs are made, the rebuilder should balance the spindle and collect vibration signatures to verify that the spindle bearing condition is good. This spindle information should be kept for future reference and used as a baseline for future repairs. The spindle should be properly run-in to ensure it is returned with "like new" performance.

Telltale signs of problems

Historically, the most common cause of spindle failure is bearing failure due to contamination from coolant ingress, condensation, contamination, and chip damage. In most cases, contamination enters the spindle because the spindle seal has failed. A spindle operates in an atmosphere with high humidity and one where the spindle is continuously subjected to intense coolant spray, swarf, and chips.

A spindle can give advance notice of a problem. With some advance indication of a spindle problem, begin to schedule downtime to best fit your production schedule. Some of the earliest problems can be detected by listening for unusual noises during spindle warm-up and during cuts. Any unusual noise, a decrease in tool life, an unusually high level of rework or scrap, or a decrease in performance can also be early signs of spindle problems.

If the machine has a belt-driven spindle, check drive belt tension as a part of normal machine maintenance. A loose belt will slip and not transmit enough power. If the belt has too much tension, the spindle and motor bearings can be damaged and cause premature spindle or motor failure.

It is good to know the normal operation temperature of your spindle. If you can, record baseline spindle temperatures for the front and rear bearings and monitor changes in temperature. In some cases, an increase in temperature is the first sign of a problem.

Listen for noticeable changes in the way the machine sounds during warm-up and during cuts. Sometimes bearing noise can be heard during warm-up and give advance notice of a failure.

Machine vibration can also be an indication of a spindle problem. Some vibration is normal and related to the machining process. However, certain frequencies can indicate problems with the machine, spindle, or cutting tools. To minimize vibration, use sharp cutting tools that are balanced in the tool assemblies. If the vibration is due to heavy cuts or hard material, remove less material and/or slow down the cutting feedrate. If the vibration still exists during machining, the problem may be in the spindle.

Nixing recurring problems

Some spindle rebuilders offer on-site preventive maintenance programs where technicians check machine spindle for vibration and temperature during scheduled visits. These data are then compared to the pre-recorded vibration signature to catch a spindle problem before it becomes critical and the spindle fails. These programs work well for production shops that want to maximize production and schedule machine maintenance.

Over the years, many spindle rebuilders have seen their share of bad spindle designs. In many cases, it wasn't the fault of the manufacturer, but advances in technology have changed the operating environment in ways that can cause spindle failure. Advances in spindle technology have overcome these problems, and many advances can be retrofitted into older spindle designs to eliminate recurring problems, increase spindle performance, and improve reliability.

New greases, specifically designed for higher speed spindles, allow for higher permissible operating speeds, lower operating temperatures, and longer spindle life without the necessity of using inherently less reliable air/oil lubrication systems. Improvements in bearing materials and geometries allow for higher load capacities, speed, and precision, while providing lower operating temperatures.

Do’s and don’ts of spindle care

Preventative maintenance is important for any piece of equipment, especially the spindle. Keeping the exterior of the spindle clean will help increase its reliability.

- Do not let dirt and chips build up around the spindle shaft or seals.
- Before installing tools, clean spindle tapers and pilots, and don’t tighten cold tools in a hot spindle.
- Change air supply line filters regularly. If the spindle is equipped with a positive air purge system, maintain correct air pressures at all times. If the spindle is equipped with air/oil lubrication, change the lube filters regularly, use the correct oil, and maintain the correct air/oil delivery rate and pressure.
- Do not blow compressed air or coolant into spindle seals or at the face of the spindle in an effort to clean it. This can cause contaminants and chips to be forced into the spindle and cause your spindle to fail.
- If air or lubrication lines are removed to perform machine service, bleed the lines before they are reconnected.
- Check o-rings for wear and tear and replace to eliminate the possibility that contaminates can enter the spindle through these areas.