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Spindle Failures on Fadal VMC Milling Machines.

Bearing failure is the most common reason for a spindle to fail. Today it seems the "end all" solution is to sell you an "upgrade" to Ceramic Bearings. Ceramic bearings are not new, they've been around for over 30 years. While ceramic bearings are in some cases "better", as the saying goes "Better is the enemy of Good". First off, not all ceramic bearings are the same, secondly if ceramic bearings were so good, they'd be the standard of the industry. There are many different ceramic bearings; the best are solid ceramic while the cheapest are steel bearings coated with ceramic.

The basic advantage of a ceramic bearing is roundness, stiffness and weight, which depending on the application can make the difference between success and failure, especially above 20,000 rpm. Stiffness can cause chatter which is a factor of bearing stiffness, span, preload and shaft design. It's all a balance of design, the ultimate design is to have more bearing preload at the lower rpm and less preload and the higher rpm range.

In the early development of the Fadal Spindle they actually had experimented with a dynamic preload spindle. It automatically changed the preload according to the rpm. Unfortunately it was too complicated for production. The correct preload is a balance between spindle rpm ranges, higher rpm's require less preload between the bearings. Less preload reduces the heat but increase spindle "chatter" during low rpm cutting.

"The Five Biggest Reasons for Spindle Failure are listed below."

- 1. Contamination** - Typically, coolant gets by the labyrinth seal at the spindle nose and breaks down the spindle grease. It's easily detected as the grease turns a milky white color.
- 2. Heat** - This is another spindle killer. Duty cycle and preload contribute to spindle heat failure. A simple way to tell when a spindle is running hot is by checking half way up the spindle taper. At this point the inner race of the bearings is at the thinnest point of the spindle shaft wall thickness. The rule is "if you can't keep your finger on it at this point; it's too hot". A simple warm-up procedure; 5000 rpm for 20 minutes in the morning is very important for all grease pack spindles. It helps to distribute the grease evenly, after sitting over night.
- 3. Belt Tension** - The HI/LOW idlers need to be cycled. Shifting ranges relieves the belt tension caused by the hydraulic idlers. The torque of the belt causes the idler to keep going inward which increases the belt tension between the spindle motor and the spindle pulley. This causes an excessive load on the top spindle bearings which increases the heat factor. This heat factor can cause the grease to migrate down away from the top bearings. Also, cycling the idlers will increase the belt life by reducing tension on the belts. Another important check is to verify the idler air supply is less than 70 psi. The machine has two regulators; one for the tool in/out and one for everything else. Too much pressure to the idlers will cause excessive belt tension and damage the top bearings.
- 4. Spindle Coolant** - Verify that the coolant flow hasn't been reversed. The coolant must flow into the bottom of the spindle and out the top of the casting (return line). It's easy to get the lines backwards. Verify the chiller system is full and cycling correctly. The temperature differential of the chiller input versus its output is about 1.5 degrees. The BTU capacity of the chiller must not be exceeded by the run time of the spindle; the chiller system needs spindle off time to reduce the heat inside the spindle. For excessive duty cycle, consider adding another chiller.
- 5. Tool Crash** - Crashing the tool into the part can cause bearing ball/race damage and/or actually bend the spindle shaft enough to cause bearing failure.

Note: It is extremely rare for an "ITS" Spindle to fail due to bad parts or in-correct assembly. In almost all cases Spindle failure is the result of one of the reasons listed above. If you have a problem call us at 800-342-3475.