Effective Methods for Checking Grinding Quality

By Robert M. Fix

Grinding affects the performance of a gear component, therefore it’s important to optimize the grinding process and eliminate defective parts before final assembly.

GRINDING IS OFTEN THE LAST PROCESS in the manufacture of high-quality, high-load-bearing gearbox components. High-load-bearing gears are hardened for greater strength and ground to reach tight dimensional tolerances. But too much heat from the grinding process can relax beneficial compressive stresses, soften a surface that should be hard, and, in the extreme, produce tensile stresses and cracking. “Burning” your parts is one surefire way to shorten service lifetime.

Once the process of final grinding is reached, a lot has been invested into the part thus far. Then, the final grinding takes time, and it’s expensive. Naturally, inspection operations should be minimalized as they add no value to the product and are time-consuming as well. Critical dimensions must be checked and feedback must be sent back to production. Determining if a part has been cracked in heat treatment or by grinding can be as fast and simple as a visual inspection. But what if the part has been burned in such a way that a nital etch inspection is needed to look for soft spots? And what about the part before or the part after? Or maybe the process is drifting from low stress grinding toward grinding burn. It would be helpful to have trending feedback and process control before burning conditions are reached.

In the grinding process, quality plays a vital role in getting the most out of the part manufacturing. Effectively and properly working the grinding process helps eliminate defects to the parts. Also, it’s important to optimize the grinding process. Reducing the speed of the grinding process will most likely yield high-quality products, but the productivity goes down. It is vital to the component lifetime and safety that possible defective parts are picked out of the production line before the final assembly.

BARKHAUSEN NOISE: A METHOD FOR CHECKING GRINDING QUALITY

An effective method for checking process control and quality inspection is the Barkhausen Noise method. This method was first discovered in 1919.
and implemented to grinding quality control during the 1980s. It is sensitive to residual stresses and microstructure, which are directly involved with the grinding quality of the part. The method is nondestructive and is based on the micromagnetic properties of ferromagnetic materials.

With the help of this method, it is easy to control and adjust the process so that no defects are produced due to insufficient cooling or a worn grinding wheel. The method also allows simple integration into the process so that it spots and sorts out the defected parts from the production line. Collecting and documenting testing data can be automated. As a fast and nondestructive method, a 100-percent inspection can be arranged for the most important and complicated parts, such as camshafts, crankshafts, and gears. The method also picks up heat treatment defects, such as soft spots.

THE GEAR INSPECTION CHALLENGE

Gears are essential for many machines, and they come in many shapes and sizes. Because of their shape, inspecting them for grinding defects is often challenging but necessary.

The Barkhausen Noise method can be implemented into the inspection — manual or automated — of gears, and there are existing solutions that have proven their effectiveness. At a minimum, a Barkhausen Noise sensor, a Rollscan instrument, and a data acquisition software are needed to make the inspecting measurements on simple gears. When the gears are more versatile in shape, the number of manufactured gears is large, the manufacturing costs are high, and the vehicle they are used in is valuable and sensitive, more effective automated systems are justified.

ROBOT MOVES THE SENSOR

The Barkhausen Noise method benefits from steady sensor contact with the part. For this task, the robot is ideal. Using it to hold and move the sensor on the surface increases the repeatability and reproducibility of the measurements compared to the human hand. The RoboScan system for gears is already a proven example of this application. Depending on the variety of parts to be inspected, RoboScan can include one sensor (RoboScan 500) or several different sensor types (RoboScan 600) for inspecting gears from straight gears to helical and bevel gears. The robot needs to be taught and programmed to do the task.

Stresstech Group’s new GearScan 500, specially designed for spur and helical gears, together with the EasyGear software can be used for simple, quick testing of many different gears.
MEASUREMENT PATHS EASILY CREATED

First, the gear data — such as number of teeth, the different gear diameters, and helix angle — must be input into the EasyGear software. Then, the gear can be installed to the GearScan 500 stand for making the Barkhausen Noise test. EasyGear software provides a virtual environment for programming of measurement paths on different types of gears for the GearScan 500. The software adapts to various types of spur and helical gears. Measurement paths that include all gear teeth can be programmed, as well as sections or single teeth and left, right, or both surfaces of the teeth flanks. Creating measurement paths occurs as easily as entering values to a few parameters. The GearScan 500 system allows testing both gear root and flank using different sensors. The system can modify and test different sizes of gears, gear shafts, and other special designs. Its compact design includes all required hardware together in one unit.

ABOUT THE AUTHOR: Robert M. Fix received his Bachelor of Science in Engineering with a major in material science. Since 1998, he has been president of American Stress Technologies Inc. and head of sales in North and South America. Stresstech Group specializes in grinding quality inspection systems and has solutions and instruments for inspecting a large number of components, from small injection nozzles to large windmill gears.

FOR MORE INFORMATION, visit American Stress Technologies Inc. at Gear Expo, Booth #2120, and go to www.stresstechgroup.com.

The GearScan 500 System allows for fast detection of common manufacturing problems such as grinding re-temper burn as well as heat treatment and stress-related defects.