Predicting, measuring and correcting for electrical run-out using a burnishing and degaussing process

Introduction

Rotating equipment requires in-service monitoring of the rotational movement of the part to ensure that these parts run within specification to prevent failures and damage. This desire to improve the mechanical reliability of motors and generators, specifically the lower shaft and bearing housings of these components, led to in-service monitoring of both mechanical and electrical run-out. In-service Mechanical run-out is detected through vibration monitoring and electrical run-out by means of in-service eddy–current proximity probes on these motors and generators.

A typical shaft and its proximity probes are shown in Figure.1. The assembly will have its own phase reference probe to allow machines to run coupled or uncoupled while providing a phase reference. These proximity probes measure and monitor the relative vibration / motion between a shaft and its stationary bearing surface.

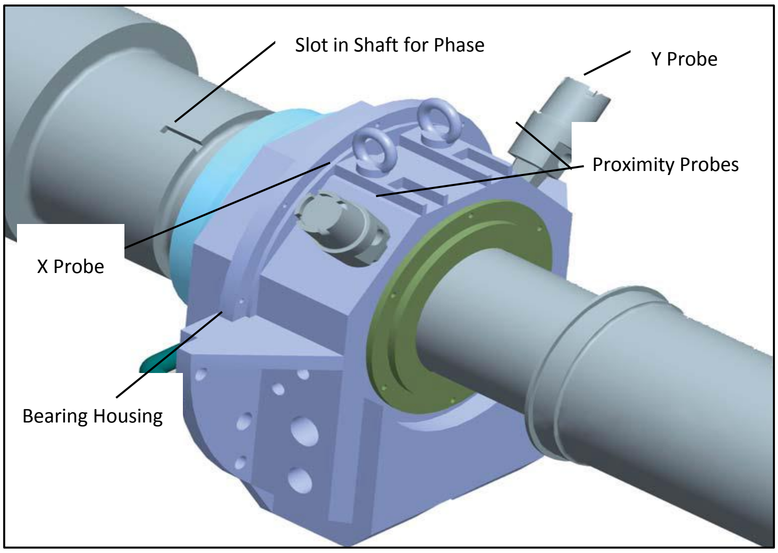

Figure.1. – Typical arrangement of eddy-current proximity probes for shaft vibration monitoring

The proximity probes are positioned over a specially machined probe track area adjacent to each bearing journal. The signal from the eddy-current proximity probe is a function of the gap between the probe tip and the target material. If the run-out changes in service, the difference is registered by the probes and will indicate to operators and engineers that the equipment is damaged e.g. worn, out of balance, poorly lubricated.

Surface imperfections such as scratches, out-of-roundness or non-concentricity with respect to the bearing journal are mechanical imperfections and will appear as vibrations that will result in measurement errors that are picked up as signals by the eddy-current proximity probes. The electrical properties of the steel in the probe track area will also lead to measurement errors that are picked up by the eddy-current proximity probes.

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These signals are defined as run-out and can be classified into mechanical or electrical run-outs. Mechanical run-out measures the deviation of the shaft from a perfectly round radius as the circumference is traversed and is measured by a dial indicator. Electrical run-out measures the deviations in the electrical properties of the material and cannot be measured with a dial indicator.

Mechanical run-out focusses more on the surface condition of the probe track area whereas electrical run-out is concentrated around the metallurgical variations around the circumference of the shaft where these metallurgical variations lead to electrical conductivity and magnetic permeability of the shaft affecting the probe track signal.

The sources of mechanical run-out include:

- Machining processes
- Dents from handling
- Rust patches
- Rotor bow due to thermal effects, gravity or other loads
- Deflective / worn bearings in machine or lathe supports

Sources of electrical run-out:

- Metallurgical variations or change
- Forging
- Heat treatment
- Grinding
- Magnetism
- Stress effects
- Handling
- Plating

Dealing with run-out consist mainly of ensuring that accurate measurements of the physical profile (using a dial indicator) of the shaft is performed and recorded to determine the mechanical run-out. Following this, electrical run-out can be measured and corrected.

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Correcting the Electric Run-out

For a true and accurate in-service measurement, the electrical run-out is measured and corrected prior to the assembly of the equipment. Electrical run-out is measured and corrected by using a process called burnishing (Figure.2). Burnishing is mainly performed on materials to improve the surface strength and roughness.

Burnishing is the rolling of a blunt tool against the surface of a work piece – with a force being applied by the tool. As soon as the yield point of the material is exceeded, plastic deformation occurs which leads up to a smoother surface profile. At the same time, compressive stresses (Figure.3) are introduced in the surface layer. Compressive residual stresses in the surface layer of a component are beneficial because it leads to the increase of the component's fatigue resistance under dynamic loading (formation and propagation of fatigue cracks at the surface of the component is reduced).

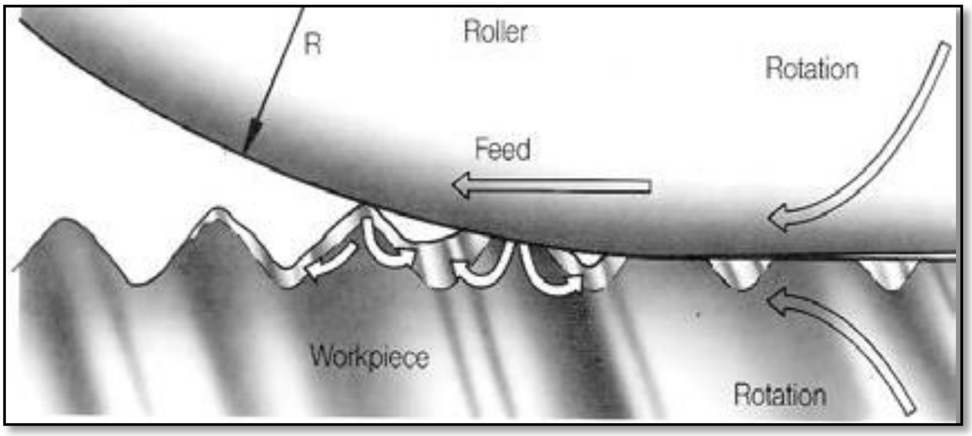

Figure.2. - Schematic illustration of the burnishing process

Metallurgically, burnishing is a cold working process that improves the surface characteristics of components. A burnished surface is actually smoother than an abrasively finished surface of the same profilometer reading. A machined surface has microscopic "peaks" that are forced to cold flow into the "valleys" during burnishing. The sharpness of the surface profile is reduced or eliminated in the contact plane causing a burnished surface to resist wear better (Figure.3).

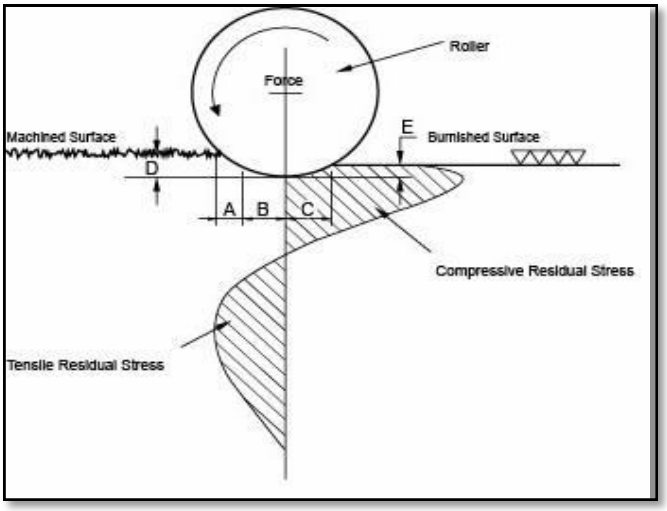

Figure.3. - Plastic deformation of the surface asperities during burnishing

Burnishing is performed by revolving the final ground/machined part in a lathe and using a diamond burnishing tool. The probe track area, where the run-out is measured, is cold worked to ensure a perfectly round, parallel and smooth surface. After completion of the burnishing process, the residual magnetism in the part, measured using a residual field indicator and a Gauss meter, is removed using demagnetizing coils.

Electrical run-out can then be measured using an electrical run-out indicator apparatus on a lathe or inspection bench, after the burnishing process. Electrical run-out is measured every 1° through 360° and plotted on graphs using specialized, calibrated equipment and applicable software (Figure.4).

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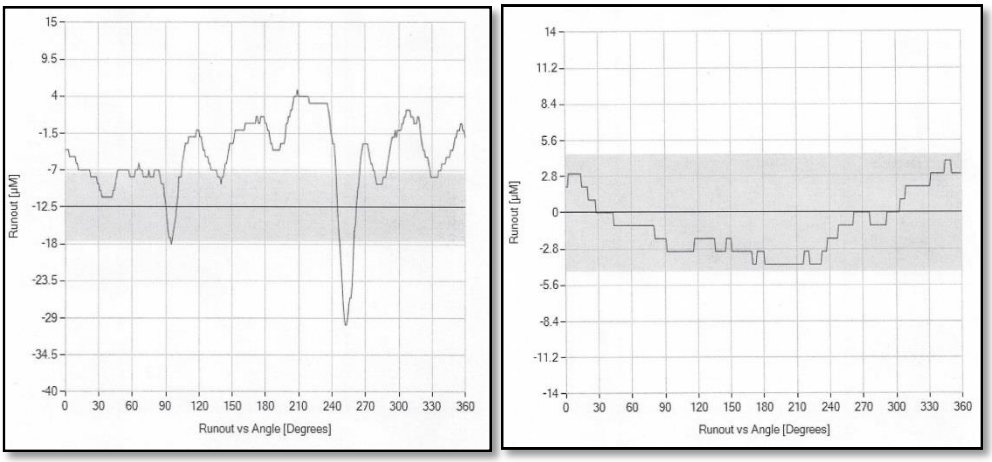

Before burnishing **After burnishing**

Figure.4. – Typical electrical run-out report

Typical equipment using burnished probe tracks

- Boiler feed pumps
- 50% boiler feed pumps
- Turbine rotors
- Compressor rotors
- Blower rotors
- Pinion shafts
- Cryogenic pump rotors

Thermaspray has the ability to offer burnishing, de-magnetizing and measuring of electrical run-outs to our customers. At Thermaspray we always ensure that our customers receive the highest quality and service that they expect form us.

Discuss your Particular Needs with Thermaspray.

Please call Thermaspray to discuss how our Probe Track Burnishing service can affect your product range in terms of its life span and quality.

I look forward to hearing from you.

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