Demagnetizing before contactless torque measurement

1. Overview

In this application report, demagnetizing is considered in the context of a contactless torque measurement. Torque measurements are used in a wide variety of fields with different technologies. Contactless sensors are used increasingly to measure mechanical quantities on rotating objects or objects that are difficult to access. One such example is measuring torque on rotating shafts with the aid of magnetoelastic alloys in conjunction with radar technology. With these, deep and uniform residual magnetism is essential, due to the fact that an external undesirable magnetic field will cause false measurements.

2. Principle of contactless torque measurement

For torque measurement using contactless sensors, a persistent polarity pattern with two tracks is magnetized onto the component to be measured in circumferential direction. The field strengths of these magnetic tracks are low.

Fixed coils are arranged at a close distance to the magnetized tracks. The two coils measure the signal of the tracks. Because they measure a differential circuit, ideally the voltages induced by external influences will compensate one another completely in both tracks. To the extent possible, this offsets the influences of the inhomogeneity of the material over the circumference and also of axial and radial movements.[1]

If a force is now applied to the magnetized component, the result is a change in its shape. A deformation, for example in the form of compression, elongation, bending, or twisting, influences the magnetism and thus the specified magnetic polarity pattern. The torque applied is determined by this change in the magnetic field flux.

[1] Thomas Kuttner; Praxiswissen Schwingungsmesstechnik; 10.5 Magnetoelastische Kraft- und Momentaufnehmer; 2015

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[2]

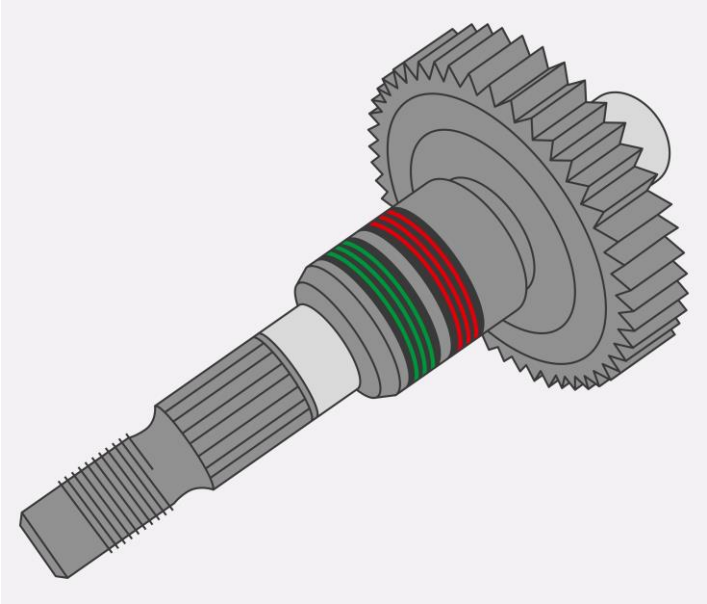

Illustration 1: Component with 2 magnetized tracks for differential measurement

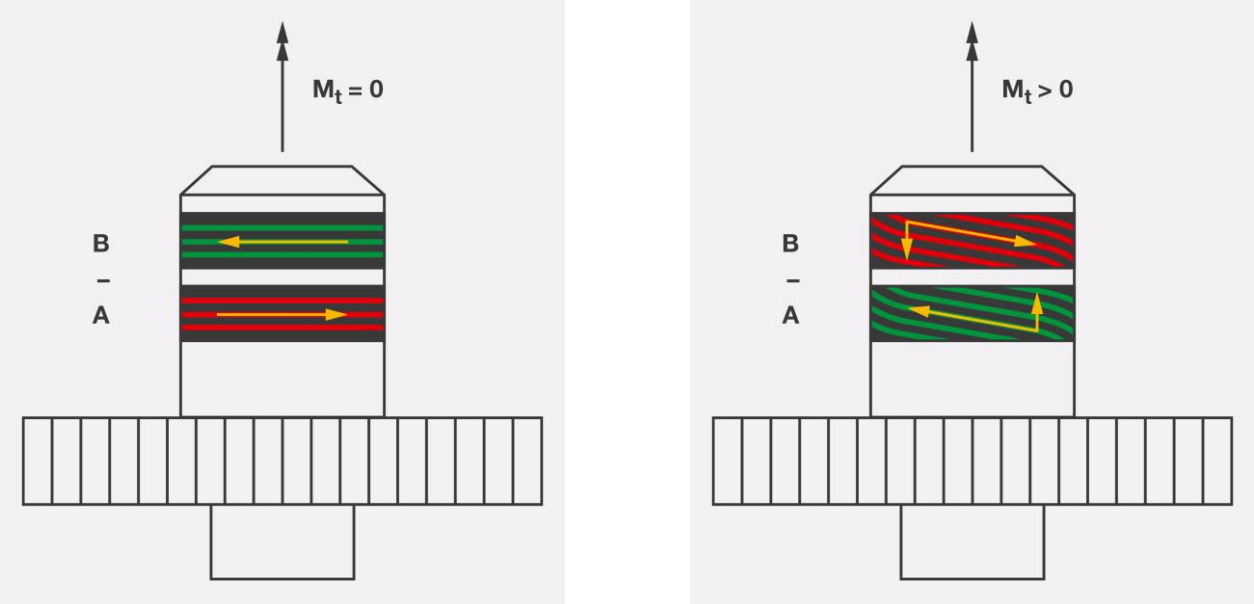

Illustration 2: Measuring principle magnetoelastic torque transducer
Left: Alingment of the magnetic elementar districts in the unstressed state
Right: Alingment of the magnetic elementar districts in the stressed state

[2] Own Illustrations, derived from: Thomas Kuttner; Praxiswissen Schwingungsmesstechnik; 10.5 Magnetoelastische Kraft- und Momentaufnehmer; 2015

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3. Negative influence of residual magnetism

For this kind of torque measurement, external homogeneous influences, such as the earth's magnetic field, can be compensated. A strong and especially inhomogeneous residual magnetism in the surrounding components, or on the magnetized component itself, is no longer compensated by the sensor measurement and can therefore cause false measurements. For this reason, a deep and homogeneous residual magnetism in the components is required.

4. Maurer Magnetic solutions

Deep and homogeneous demagnetization usually requires higher field strengths than can be achieved with conventional continuous demagnetizing coils. Conventional air core coils with no cooling and an effective aperture achieve field strengths of ~30 kA/m. This decreases residual magnetism. However, complete demagnetization and compliance with limit values are not possible with conventional air core coils with no cooling.

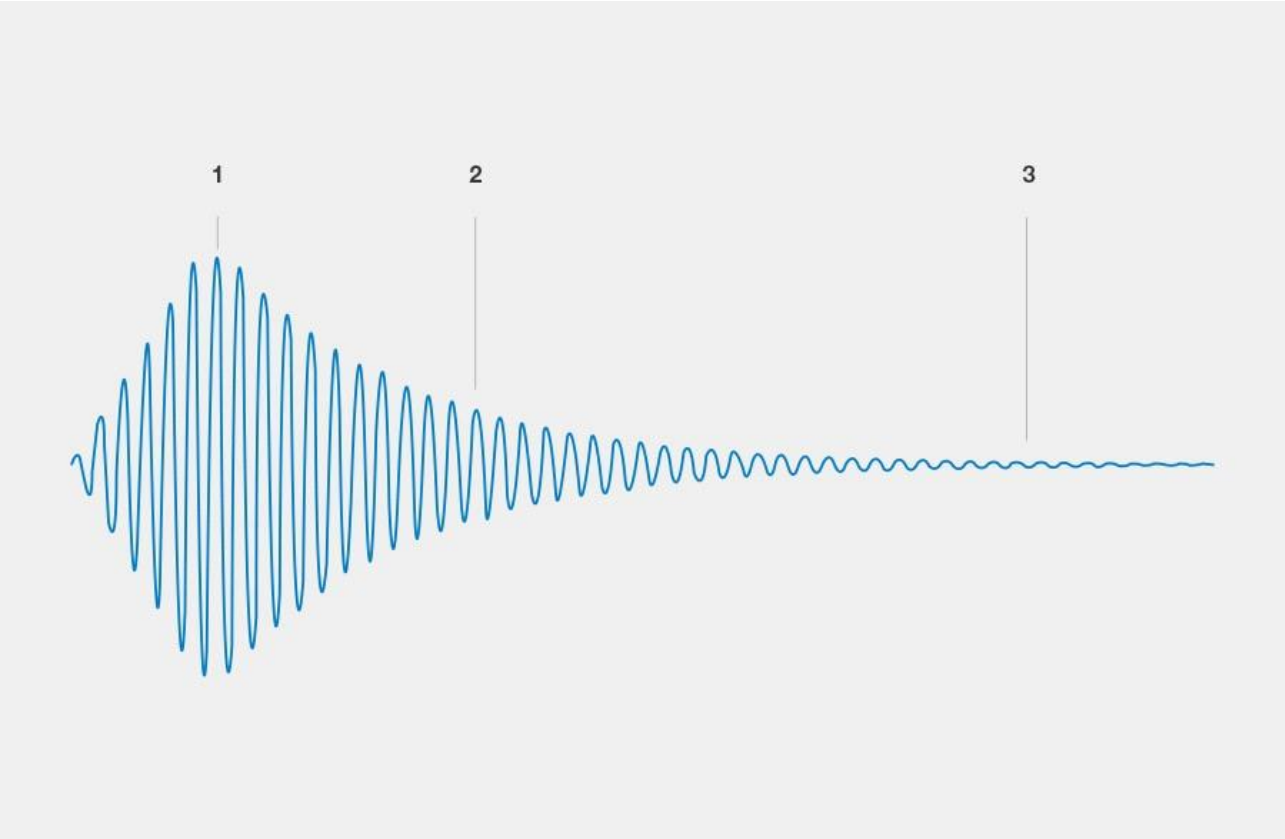

Illustration 3: 1 short, high maximum field strength | 2 high number of monotonically decreasing amplitudes | 3 precise, fine run-out to zero

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With Maurer Degaussing® pulse demagnetization, by contrast, significantly higher field strengths are achieved. Individual parts or carriers with larger quantities can be placed in the coil and demagnetized reliably with one pulse in automated production lines.

The demagnetizing system can be extended with a shielding chamber to minimize negative environmental influences while demagnetizing and to achieve improved results. In addition, this decreases personal safety distances of the exposure, while it reduces disturbing influences on adjacent processes.

Illustration 4: Customized coil with suitable shielding chamber to reduce environmental influences and decrease personal safety distances

The optimum demagnetizing parameters for a specific case (e.g. the required field strength, frequency, pulse duration, etc.) are assessed by a non-binding preliminary test and a suitable machine is customized to match the customer's requirements (effective opening and cycle time) and the preliminary test results. Customized Maurer machines with air-cooled coil modules can reach field strengths in excess of 400 kA/m.

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