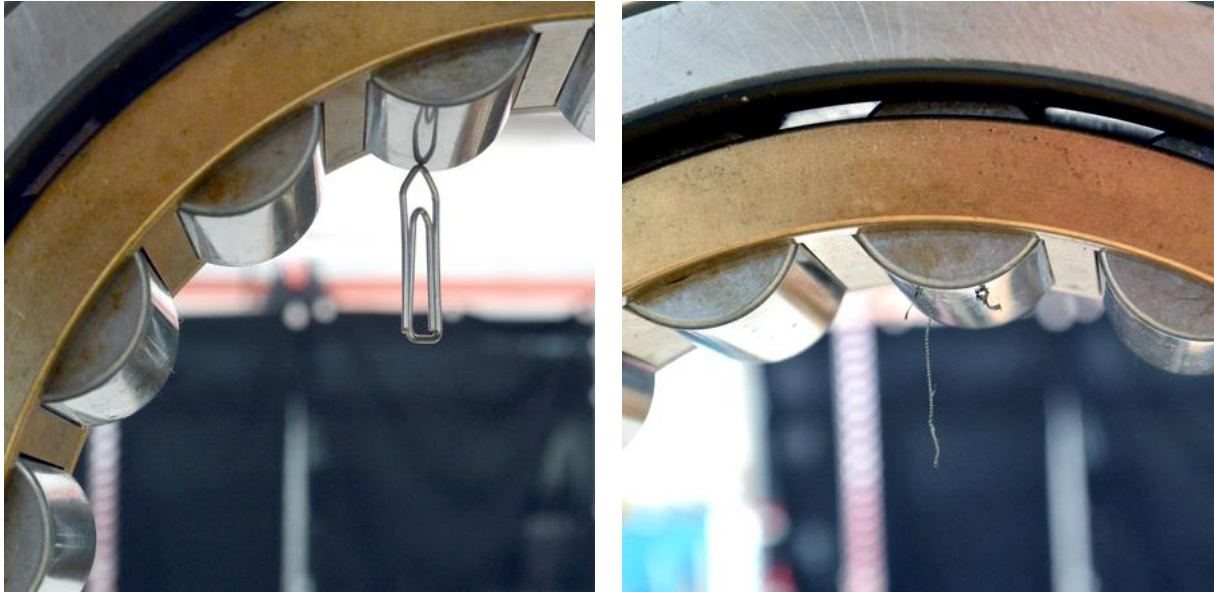


## Application note

# Demagnetization of assembled bearings



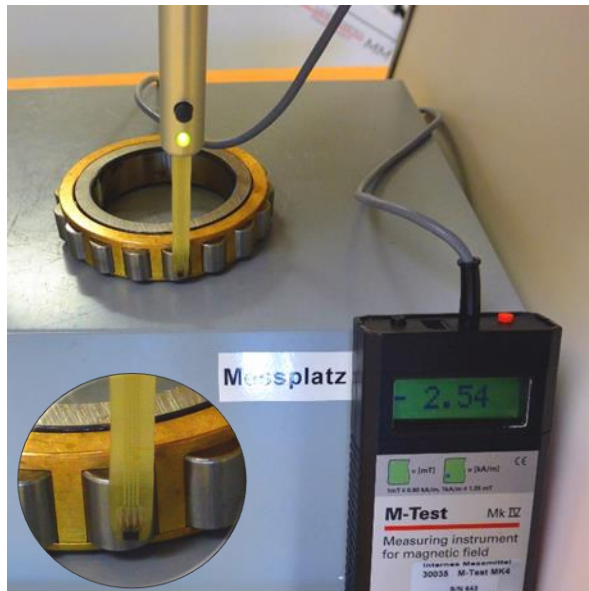
*Image: Magnetic cylindrical roller bearing (Maurer Magnetic AG)*

Demagnetization is a common process in the bearing industry. In the bearing production process rolling body, outer and inner ring are normally separately demagnetized before assembly. Residual magnetism originating from assembly processes remains often unnoticed. Numerous known damage mechanisms that reduce lifetime can be attributed to residual magnetism. Hence residual magnetism limits became widespread as an essential quality criteria within the bearing industry.

This application note focuses on the example of hot riveted bearings with brass cage. The bearing (esp. rolling bodies) is magnetized by the high riveting current. As a result, residual magnetism of up to 60 Gauss is measured on the rolling bodies. Residual magnetism is often difficult to detect in assembled bearings. If at all, it is only discovered after bearing failure.

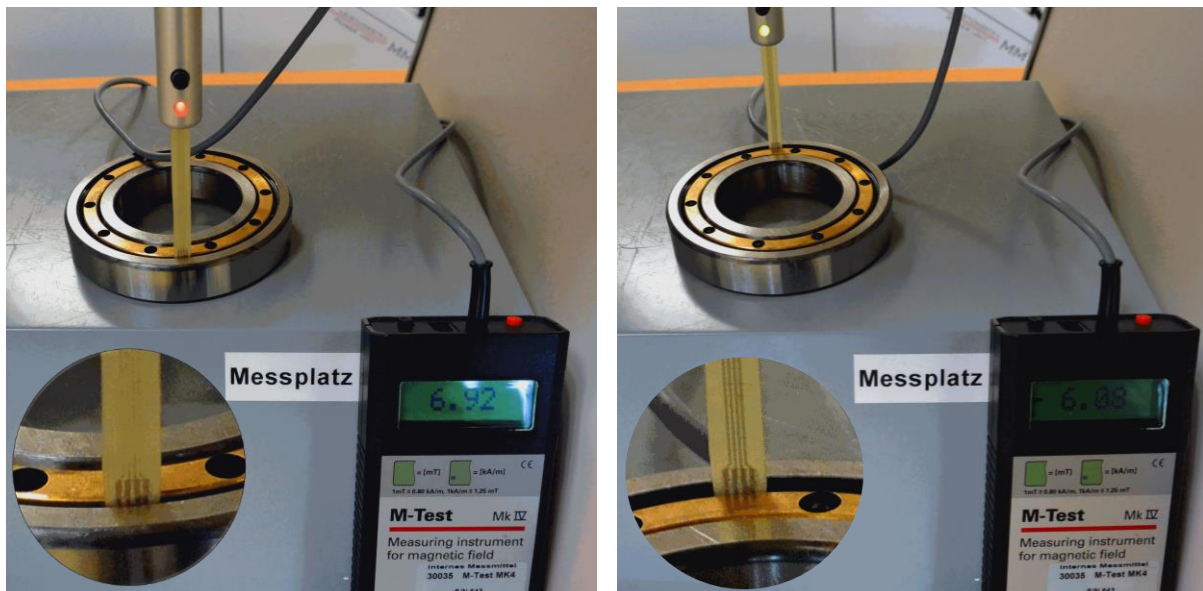
### **Measuring residual magnetism:**

The rolling bodies and running surfaces are often difficult to measure or even completely inaccessible with the measuring probe. The residual magnetism of the exterior surfaces is usually within an acceptable range. The magnetic state inside the bearing remains unknown. To measure the inside of the bearing, the use of suitable measurement equipment is essential.



*Image: Measuring of rolling bodies on a roller bearing with inner ring. Result 2.54 mT (= 25.4 Gauss)*

While the rolling bodies of bearings without outer/inner ring can easily be measured, the running surface is not accessible with the probe.



*Image: Measurement of rolling bodies and running surfaces on ball bearing. Result 6.92 / 6.08 mT (= 69.2 / 60.8 Gauss)*

Measuring of difficult to reach surfaces on rolling bodies and running surfaces is crucial for a complete quality control. If measurement is impossible, it is recommended to disassemble and inspect a few samples per shipment/lot. It is important to scan the entire surface of the bearing parts. Even though most of the surface is nonmagnetic, small, highly magnetic spots may still remain and are only detected by a thorough search.

### Demagnetization of assembled bearings

With conventional demagnetization systems (e.g. pass through coils with 100% duty cycle, surface demagnetizers) the interior of such bearings is not demagnetized, due to the low magnetic field strength and the high demagnetizing frequency (50/60Hz). The outer ring is shielding the interior of the bearing from the effective alternating magnetic field of the

demagnetizer. The field strength remains too low to demagnetize the inner components of the bearing.

The use of high performance demagnetizers with *Maurer-Degaussing*<sup>®</sup> pulse technology ensures residual magnetism below 5 Gauss on fully assembled bearings. The modular product range offered by Maurer Magnetic AG covers bearings of all diameters.

It is crucial to prevent re-magnetization in successive production steps (assembly, transport, maintenance, etc.). Tools and components in contact with bearings must be checked for residual magnetism and demagnetized if needed.

### Damage mechanisms caused by residual magnetism in bearings

- Adhesion of particles / residual dirt. The magnetic adhesive force is proportional to the square of the magnetic field strength ( $F \sim H^2$ ). Residual dirt and particles lead to denting on the running surfaces. This results in vibrations and wear.<sup>1</sup>
- Spark Tracking: Long tracks on the running surface caused by electrical discharge. Usually, the cause of spark tracking is stray current caused by the rotation of magnetic fields.<sup>2</sup>
- Heat build-up / energy loss / increased friction by hysteresis losses from magnetic polarity reversal, eddy currents from rotating fields as well as magnetic attraction forces.<sup>3</sup>
- Laboratory experiments indicate a correlation between residual magnetism and hydrogen embrittlement/cracking/pitting.<sup>4 5</sup>
- Hydrogen embrittlement/cracking leads to White Structure Flaking.<sup>6</sup>

Maurer Magnetic AG is specialised in demagnetizers, residual magnetism measurement processes, demagnetization services, troubleshooting and trainings in magnetism.

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<sup>1</sup> Barden bearing failures, chapter „Contamination“

[http://www.schaeffler.com/remotemedien/media/shared\\_media/08\\_media\\_library/01\\_publications/barden/brochure\\_2/downloads\\_24/barden\\_bearing\\_failures\\_us\\_en.pdf](http://www.schaeffler.com/remotemedien/media/shared_media/08_media_library/01_publications/barden/brochure_2/downloads_24/barden_bearing_failures_us_en.pdf)

<sup>2</sup> Waukesha Bearings: Bearing Damage: Spark Tracking <http://www.waukbearing.com/en/technical-resources/bearing-damage-index/bearing-damage:-spark-tracking/>

<sup>3</sup> Tribology in Electrical Environments (H. Prashad), Seiten 204-205 <https://books.google.ch/books?id=ulARgf5FCMkC>

<sup>4</sup> Colorado School of Mines: An Assessment of Magnetization Effects on Hydrogen Cracking for Thick Walled Pipelines. <http://www.bsee.gov/Technology-and-Research/Technology-Assessment-Programs/Projects/Project-487/>

<sup>5</sup> Colorado School of Mines: Measurement of the Effect of Magnetism an Hydrogen Cracking Susceptibility of Pipeline Steels. <http://www.bsee.gov/Technology-and-Research/Technology-Assessment-Programs/Projects/Project-576/>

<sup>6</sup> Mechanism of White Structure Flaking In Rolling Bearings (Hideyuki Uyama, 2011) [http://www.nrel.gov/wind/pdfs/day2\\_sessioniv\\_1\\_nsk\\_uyama.pdf](http://www.nrel.gov/wind/pdfs/day2_sessioniv_1_nsk_uyama.pdf)