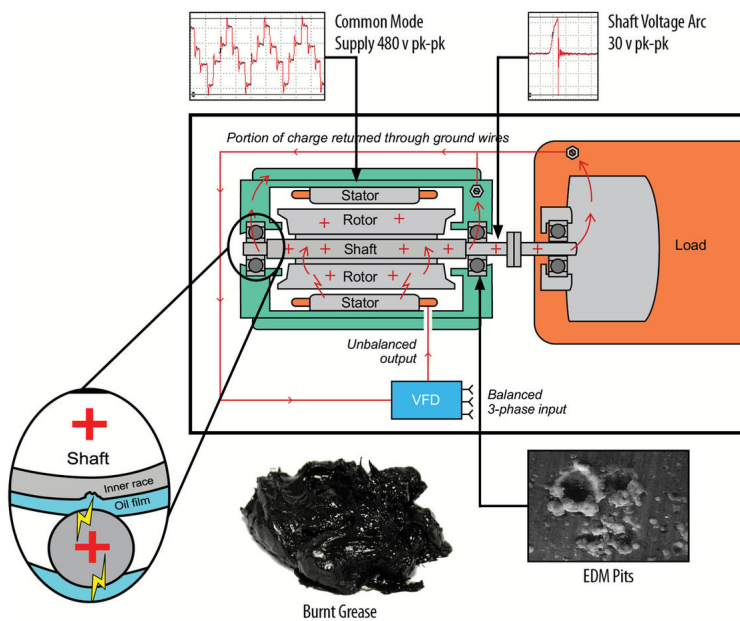


## Best Practices For Bearing Protection

Adam Willwerth, Sales and Marketing Manager, Electro Static Technology

Until all motors are designed with built-in bearing protection, plant maintenance personnel and motor repair shops will continue to replace damaged bearings. But if proper mitigation is installed, it only has to be done once. Better yet, technicians can use diagnostic techniques to head off electrical bearing damage from the beginning.

### The Problem



In processing plants, automated assembly lines, HVAC systems, and other equipment, motors driven by variable frequency drives (VFDs, also known as inverters) can save 30 percent or more in electricity costs. Unfortunately, VFDs often induce shaft voltages that can damage bearings. In fact, the costly repair or replacement of a failed motor bearing can wipe out any savings a VFD yields and severely diminish the reliability of an entire system.

### The Causes

The high switching frequencies of today's VFDs produce parasitic capacitance between a motor's stator and rotor. Once the resulting shaft voltages overcome the dielectric properties of bearing grease, they discharge along the path of least resistance — typically through the bearings.

These discharges can create millions of tiny fusion craters. Before long, they can mark the entire bearing race wall with countless pits known as frosting. In a process called fluting, periodic discharges can shape the frosting into washboard-like ridges that cause noise and vibration.

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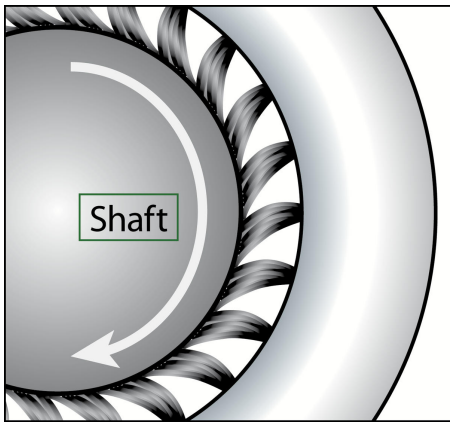
As bearings degrade, tiny metal particles blasted from fusion craters intensify friction, abrasion, and heat, which sometimes burns the contaminated grease. Too often, the end result is bearing failure and costly, unplanned downtime.

## Understanding the Damage

Inspecting a failed bearing often yields information that can be used to prevent a recurrence of the problem. Following safety precautions, technicians should:

1. Inspect the bearing cavity, retaining a sample of grease for possible further analysis.
2. Cut the outer race in half.
3. Clean the interior with solvent.
4. With a microscope, inspect the race walls for pitting/frosting/fluting.

## Protecting Motors for the Long Term



If the old bearing has electrical damage, the most reliable and cost-effective way to protect the replacement bearing is to install a modern shaft grounding ring that completely surrounds a motor's shaft with conductive microfibers. Lining the ring's entire inner circumference, these fibers boost the electron transfer rate and safely bleed off damaging voltages to ground, bypassing the bearing entirely. Microfibers work with little or no contact, so they do not clog and wear out like conventional grounding brushes. Several forward-looking motor manufacturers have recently added factory-installed shaft grounding rings as options or as standard on certain models, but these motors are still exceptions to the rule. Industrial supply houses and distributors also sell grounding rings that can be installed on new, refurbished, or in-service motors.

## Tips & Tricks for Ring Installation

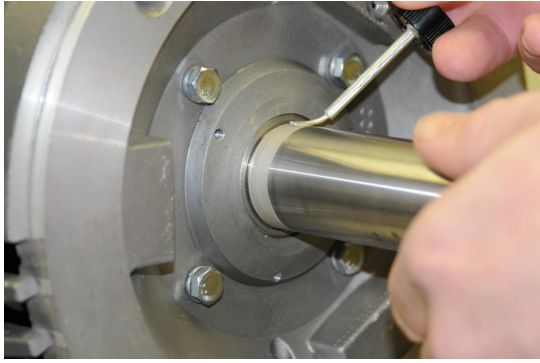
To maximize a shaft grounding ring's effectiveness, all electrical paths must be conductive. Paint on the motor's faceplate must be removed. Likewise, the motor's shaft must be clean down to bare metal.

A grounding ring should never operate over a shaft keyway, which has sharp edges and could reduce conductivity. Conductivity should be further enhanced by lightly but evenly coating with colloidal silver any portion of the shaft that will contact the ring's microfibers. This will also help retard corrosion.

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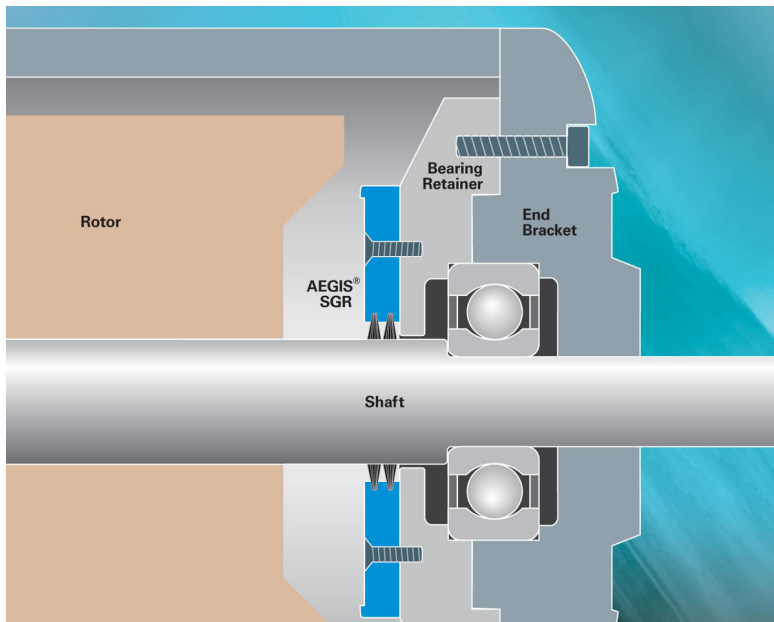
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Threadlocking gels and liquids other than conductive epoxy are not recommended for the screws that mount the ring to the motor, as they might compromise the conductive path to ground.

A split ring that slips around the motor's shaft (no decoupling required) simplifies external mounting on in-service motors.



If the motor will be exposed to dust or debris, the ring's fibers can be protected with an O-ring or V-slinger. Bearing isolators with built-in grounding rings are also available. For severe-duty environments, mounting the ring inside the motor provides the best protection from contamination. The ring can be mounted directly to a bearing retainer using conductive epoxy or screws. An additional machined spacer will keep the ring away from the bearing-grease cavity.

For motors of 100 horsepower or less having single-row radial ball bearings on both ends, a shaft grounding ring can be installed on either end. For horizontally mounted motors of greater than 100 horsepower with single-row radial ball bearings on both ends, the bearing housing at the nondrive end must be electrically isolated to disrupt circulating currents. This can be achieved using insulated sleeves, nonconductive coatings, or ceramic bearings. The ring should be installed at the drive end.

For any motor in which the bearings at both ends are already insulated, the drive end is preferred for installation of a grounding ring, to protect bearings in attached

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equipment such as a gearbox, pump, fan, or encoder.

For any motor with roller, Babbitt, or sleeve bearings, the end with such a bearing should be electrically isolated, and the grounding ring should be installed at the opposite end.

### Getting the Most From Your New Motors

Measuring shaft voltage on a VFD-driven motor provides valuable information for determining whether or not there is a risk of electrical bearing damage. Every motor has its own unique parameters. Combined with data from vibration analysis or thermography, voltage readings can be presented in a report to the supervisor/customer and subsequently used in developing preventive/predictive maintenance programs.

Shaft voltages are easily measured by touching an oscilloscope probe to the shaft while the motor is running. The best probe will have a tip of high-density conductive microfibers to ensure continuous contact with the rotating shaft.

End users of VFD-driven motors have every right to expect uptime and reliability. Inspection, testing, and analysis can provide advance warning, and when bearings fail, proper repair practices can prevent a recurrence. Shaft grounding rings such as AEGIS Bearing Protection Rings can be retrofitted to in-service motors or installed on new ones.

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*Adam Willwerth, Sales and Marketing Manager for Electro Static Technology, has extensive experience in industrial product development. He is named on four patent applications pertaining to conductive microfiber shaft grounding technology and has presented seminars on the subject of bearing current mitigation at professional conferences in the U.S. and Europe.*

For more information, visit [www.est-aegis.com/bearing](http://www.est-aegis.com/bearing) [1].

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