Product Service Bulletin
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Ask the experts

Q: Is there a specific procedure to follow when insulating bearings? If so, what is the procedure?

A: Apply sufficient alumina oxide coating to allow for finished grinding to original bearing journal dimensions with 63 RMS, or better, surface finish. A phenolic sealer must be applied after the initial machining, but before the finish grind. Suggested insulation material:

- Alumina oxide
- Bonding material
- Sealer

Have a question for the experts? Contact us at jim.bryan@emotors.com

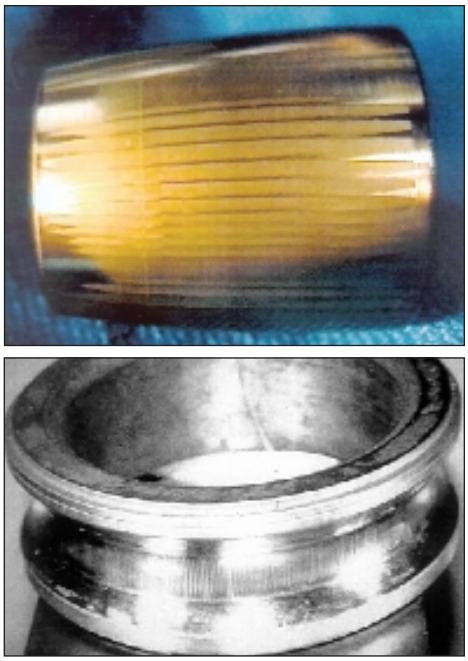
Current Trends

Bearing Down On Electrical Stress Can Protect A Motor

In the past few years, there has been a significant increase in motor problems associated with shaft voltages and currents. Voltage discharge from current passing through the bearings can cause the bearings to be damaged or fail if not properly insulated.

Shaft voltages have long been associated with medium and large electric machines; however, the increased use of variable frequency drives has resulted in shaft voltages in much smaller motors. It is theorized that the terminal motor voltage supplied by the drive is not balanced or symmetrical in some aspect. In standard machines, any break from uniformity in the rotor or stator can cause shaft voltages. Shorted laminations, gaps in the stator laminations, variations in air gap or spacing for fields or interpoles in a DC machine can result in shaft voltages in rotating equipment. Shaft voltages may also result from static electric discharge from the driven equipment or process. Other abnormalities in sine wave power supply are associated with grounding, unbalances or harmonics which may also result in induced shaft voltages.

Noisy bearings or repeated bearing failures can be an indication of electrical stress. Only after the bearings have been removed and inspected can this problem be diagnosed. Otherwise, the motor will continue to operate until the bearings fail and the motor is so severely damaged that any evidence of shaft currents is destroyed.



Fluting due to shaft currents on both a roller bearing, above, and a ball bearing, below.

Indications of shaft voltages include "fluting" or a "picket-fence" signature on the race of the bearing. Fluting due

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When rotational speed varies, the shaft currents may cause a dull, frosted appearance instead of fluting.

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to shaft currents can occur on both a roller bearing and a ball bearing. The spacing of the fluting marks depends on the rpm, diameter, radial load and magnitude of the shaft voltage. In some cases, the appearance of the balls offers the best clue. Instead of a highly-polished finish, the rolling elements may have a dull grey or smoky appearance.

The standard voltage limits for ball bearings is 100mV and 200mV for sleeve bearings. Variable frequency drives can result in shaft voltages as high as 20 to 25 volts. Because of capacitive coupling between the rotor and stator, both bearings must be electrically isolated. The standard method of insulating only one bearing will not protect bearings in a machine operated from a variable frequency drives.

US Motors suggests using a protective ceramic coating on the bearings when the bearings indicate shaft currents are present and have caused the failure. This approach may not be practical on smaller size motors, however, some bearing manufacturers do offer an anti-friction bearing with an insulated outer race or rolling element.

The practice at US Motors is to insulate the non-drive end shaft bearing journal with a ceramic (aluminum oxide) coating. Insulated sleeve bearings are purchased with the outer diameter insulated by the bearing manufacturer. Insulated bearings are provided as a standard feature on all US Motors products in the 5800 through 9600 frame series, all Titan 6 pole motors, Titan sleeve bearings motors and Titan inverter duty motors. Any product manufactured by US Motors can be requested to be modified with insulation, at an additional cost.

EASA shops receiving a US Motors brand motor for repair are encouraged to re-coat the materials before installing new bearings, if the ceramic was damaged. Keep in mind that when insulating a bearing housing, you must also insulate the face of the bearing cap. The bearing cap could come into contact with the face of the bearing, bypassing any insulation on the bearing housing.

Be sure to take special care when applying the ceramic coating because ceramic chips easily. Care should also be taken when balancing a shaft with ceramic-coated journals because the layer of ceramic is relatively thin. The rotor weight should not be placed on the journals for balancing or inspection because the point-loading is likely to break the ceramic loose from the shaft. The damage does not show up until the motor is in service, at which time the ceramic fractures, leaving the bearing with a loose shaft fit.

Other recommended measures for protecting bearings from shaft voltages include:

- Use bearings with ceramic balls.
- Insulate both bearing housings.
- Install ground brushes on both ends.
- Insulate both shaft journals.
- Install in-line filters between the motor and VFD to reduce the problem.
- Improve grounding of the motor and drive.

Some experimental products are also being reviewed. Various bearing lubricants alter the impedance to ground, which reduces the current flow through the bearings. The use of the epoxy putties such as Devcon and Belzona are also being used by other manufacturers, but load capacity and use in oil lubrication is still an issue. The shaft grounding brush system is an acceptable method, but follow-up maintenance is required. In some hostile

Ceramic or aluminum oxide spray is one method of insulating. Above, an opposite drive end bearing journal, and below, vertical motor bearing carriers, all of which have been insulated with ceramic spray.

environments, the grounding brush system is not successful.

The decision on which bearing protective system to use is often up to the end-user since cost is usually the deciding factor.

For more information about bearing protection, contact Cheri Newman, Senior Product Service Engineer with US Motors, at 314-553-2653 or cheri.newman@emotors.com.

Photos Wanted

Emerson Motor Technologies' NEMA Winding Failure Return Program was successful in identifying application-related functions. At this time, the Product Service Department would like photos of 440 frame winding failures. Our intent is to focus on application errors, improper installation and other conditions that can severely damage a motor. Please e-mail your pictures to the Product Service Engineer you are coordinating the warranty repairs with. Thank you for your assistance.