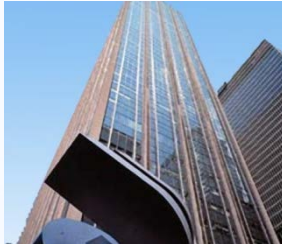


Shaft Grounding Ring Case Study

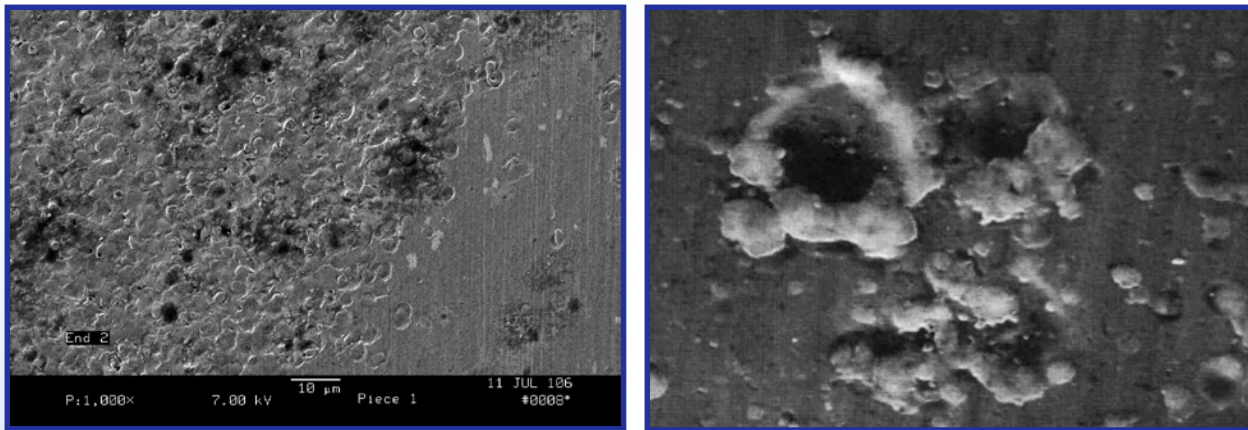


250 HP VFD Driven Motor



The Problem:

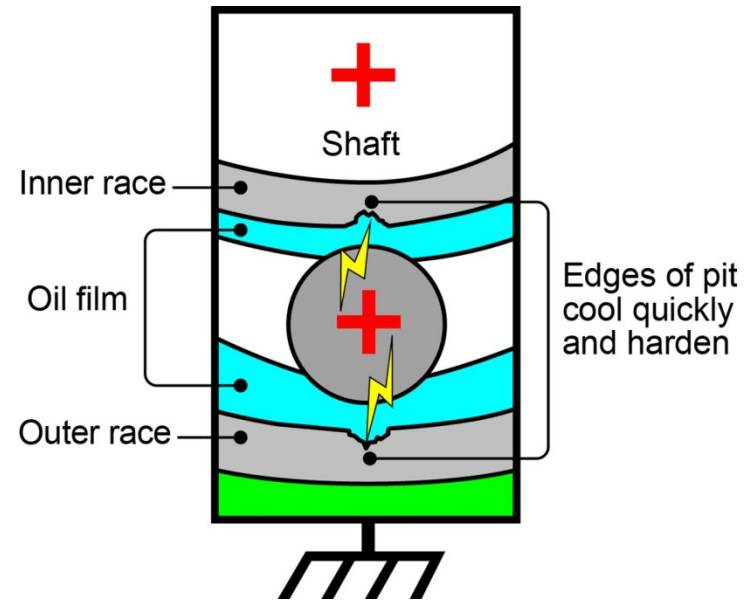
Destructive shaft voltages discharge in electric motor bearings and cause electrical pitting damage, bearing lubrication degradation and catastrophic “fluting” damage in the motor’s bearings.



Pitting due to Electrical Discharge Machining as seen under an electron microscope

Voltage arcs through the bearing

- Voltage arcs through bearing, and electrical discharge machining (EDM) produces thousands of pits
- Eventually, the rolling ball bearing causes fluting damage to race
- Bearings degrade, resulting in bearing and motor failure



Result in Fluted Bearings



Case Study:

250 HP Chilled Water Pump

- These chilled water pump systems have been operating for 12-18 months. Audible bearing noise already present 4 out of 12 pump motors.
- Audible noise is typical of the washboard pattern known as “fluting” that is the result of shaft voltages discharging through the motor’s bearings.

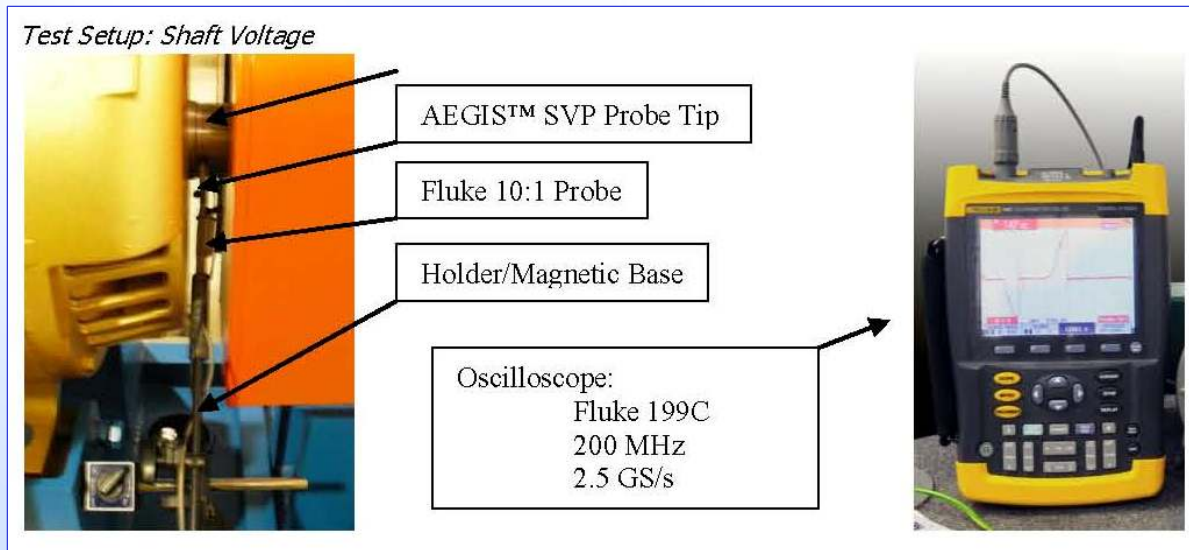


Pump systems tested in case study.

Test Measurement Objective:

Measure Shaft Voltage

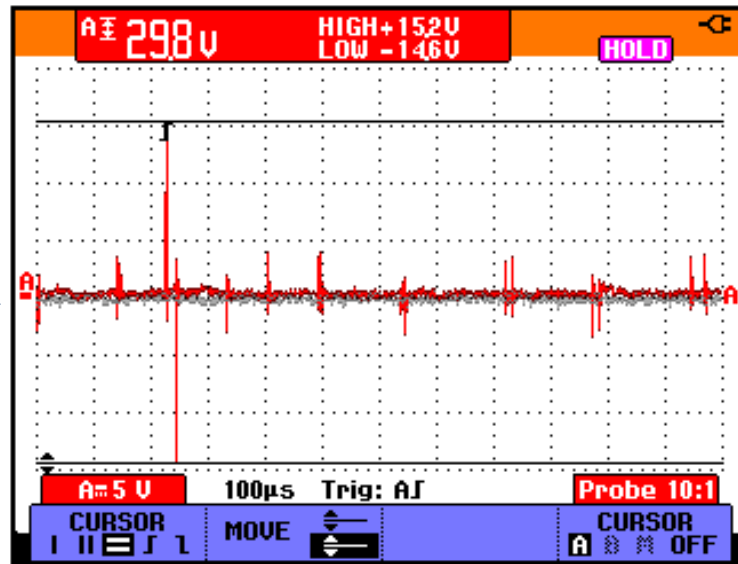
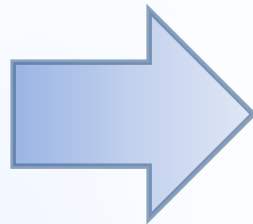
- **Test setup:** Fluke 199C 200MHz Scopemeter with AEGIS® SVP tip on Fluke 10:1 probe applied to the motor shaft while operating.
- **Objective:** Determine if there is an induced voltage on the motor shaft and check for bearing discharge wave form.



250 HP Motor on VFD

VFD Induced Shaft Voltage

Reading 1: 29.8 v pk – pk with positive and negative voltage spikes present of ~14-15v pk indicates bearing current discharges. Audible bearing noise present indicates “fluting” damage to bearing race.

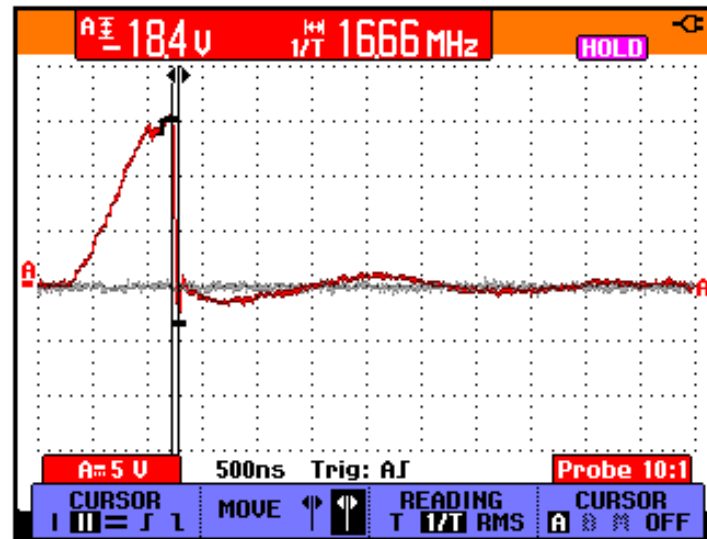
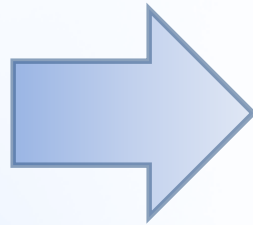


Fluke 199C Setting: 5 v/div; 100usec/div

250 HP Motor on VFD

VFD Induced Shaft Voltage

Reading 2: Bearing discharge waveform - 18.4 volt peak - slower voltage rise and sharp discharge trailing edge. The trailing edge voltage drop occurs when oil film breaks down. The 16.6 MHz ultra high frequency dv/dt event causes the EDM pit in the bearing race.

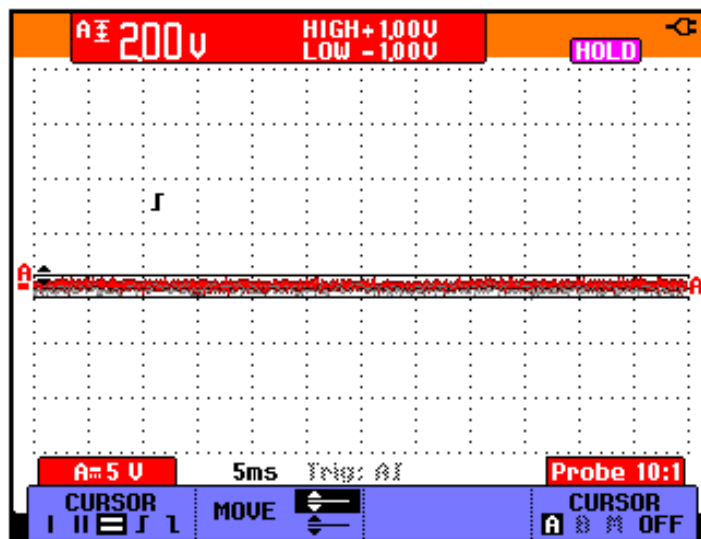
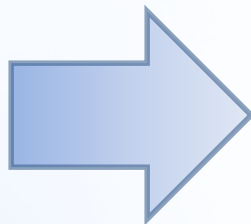


Reading: Shaft Voltage Reading DE Fluke 199C Setting: 5 v/div; 500 nsec/div

250 HP Motor on VFD

Shaft Grounded with AEGIS® Ring

Reading 3: 2.0 v pk-pk ground noise present on the motor shaft.
AEGIS® shaft grounding provides “path of least resistance.”
No bearing discharges.



Reading: Shaft Voltage Reading DE Fluke 199C Setting: 5 v/div; 5 msec/div

Shaft Voltage Measurement Before and after AEGIS® Shaft Grounding

Test results: System: 250 HP Chilled Water Pump

No Shaft Grounding:

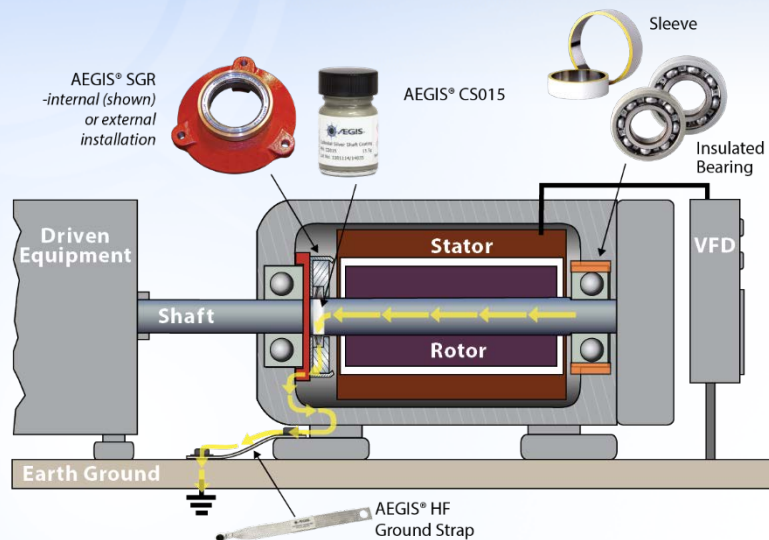
- **Reading 1:** 29.8 volts peak to peak
- **Reading 2:** 18.4 volts peak; 16.66 MHz dv/dt

With Shaft Grounding:

- **Reading 3:** 2.0 volts peak to peak
- Motor bearings protected with AEGIS® Shaft Grounding



Motors Greater than 100 HP (75 kW) - *Low Voltage*



Install AEGIS® Ring on opposite end from insulation



Product recommendation:

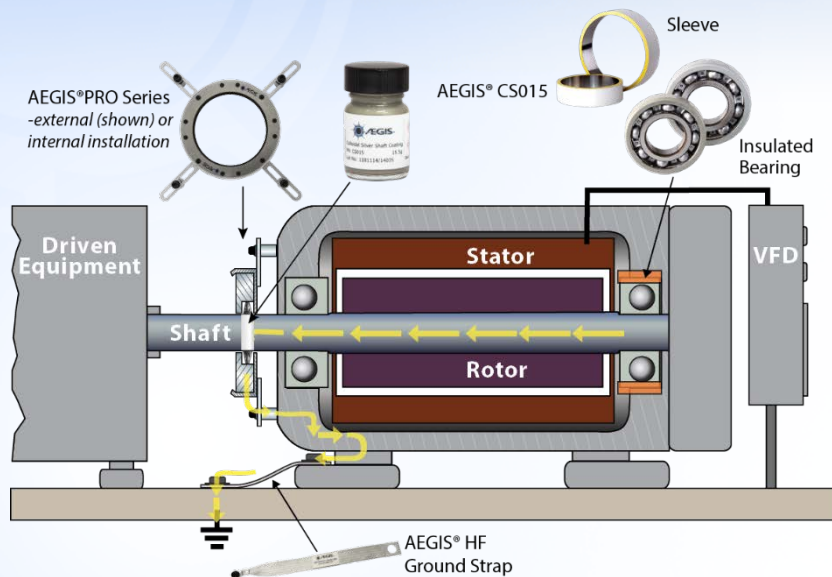
Motors up to 500HP: AEGIS® SGR

Motors over 500HP: AEGIS® PRO Series

For horizontally mounted motors with single row radial ball bearings on both ends of the motor:

- Non-Drive end: Bearing housing must be isolated with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.
- Drive end: Install one AEGIS® Bearing Protection Ring .
- AEGIS® Ring can be installed internally on the back of the bearing cap or externally on the motor end bracket.
- Use AEGIS® Colloidal Silver Shaft Coating (PN# CS015) on motor shaft where fibers touch.

Motors Greater than 100 HP (75 kW) - *Medium Voltage*



Install AEGIS® Ring on opposite end from insulation



Product recommendation: AEGIS® PRO Series

For horizontally mounted motors with single row radial ball bearings on both ends of the motor:

- Non-Drive end: Bearing housing must be isolated with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.
- Drive end: Install one AEGIS® Bearing Protection Ring .
- AEGIS® Ring can be installed internally on the back of the bearing cap or externally on the motor end bracket.
- Use AEGIS® Colloidal Silver Shaft Coating (PN# CS015) on motor shaft where fibers touch.

Conclusions

1. VFD driven motors have shaft voltages that may discharge in the motor bearings.
2. Bearing discharges cause pitting and “fluting” damage and catastrophic bearing failure.
3. Protecting motor bearings is essential in ensuring reliability and up-time.
4. AEGIS® Shaft Grounding Ring protects bearings from electrical bearing damage.



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