AEGIS®

4th Edition

INDUSTRIAL **BEARING PROTECTION** HANDBOOK

Best Practices for Bearing Protection in New and Repaired Motors, Testing In-Service Motors, and Inspecting Damaged Motor Bearings



Electro Static Technology™
An ITW Company

Company Information

Electro Static Technology, an ITW Company, is a global manufacturer and the inventor of AEGIS® Shaft Grounding Rings, used in electric motors and other rotating equipment to safely discharge stray voltage to ground. AEGIS® Shaft Grounding Ring technology is installed in all ranges of motors, up to thousands of kW, used in virtually all commercial and industrial applications.

AEGIS® Shaft Grounding Rings use 360° of conductive contact to reliably protect bearings from electrical discharges that cause frosting and fluting damage. AEGIS® technology uses proprietary conductive microfibers arranged circumferentially around the motor shaft and secured in our patented AEGIS® FiberLock™ channel, protecting them during operation. The following US patents apply: 8199453, 8169766, 7193836, 7136271, 7528513, 7339777, and other patents pending.

Electro Static Technology is proud to be an ISO 9001:2015 company. Certificate Number: 17116

This is the 4th Edition of the AEGIS® Industrial Bearing Protection Handbook. For electric vehicle applications, see **est-aegis.com/applications/electric-vehicle-solutions**

2-YEAR EXTENDED WARRANTY

Electro Static Technology (EST, AEGIS®) guarantees that AC induction motor bearings will not fail from electrical fluting damage when AEGIS® Shaft Grounding Rings have been installed with new bearings in accordance with EST's recommended best practices, as published in the AEGIS® Bearing Protection Handbook (current edition). See page **50** for more information about the 2-Year Extended Warranty, or visit **est-aegis.com/warranty**.

Units are guaranteed for one year from date of purchase against defective materials and workmanship. Replacement will be made except for defects caused by abnormal use or mishandling. All statements and technical information contained herein, or presented by the manufacturer or their representative are rendered in good faith. User must assume responsibility to determine suitability of the product for intended use. The manufacturer shall not be liable for any injury, loss, or damage, direct or consequential, arising from the use, or attempted use, of the product.

⚠ SAFETY

Follow all workplace safety policies and procedures applicable to electric motor repair and for all hazardous operations. Wear all applicable personal protective equipment (PPE) required by the applicable law. Employees should be informed of the relevant safety rules and employers should enforce compliance. EST shall not be liable for any injury, loss or damage, direct or consequential arising out of the use, or attempted use, of the product or procedures described in this manual.

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The Electro•Mechanical Authority

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MANAGEMENT SYSTEMS CERTIFICATION BODY

ELECTRIC MOTOR CONTROL BY VARIABLE FREQUENCY DRIVES

Variable frequency drives (VFDs) are widely used to control electric motors in applications from HVAC to manufacturing to electric vehicles. Current estimates suggest that up to 30% of electric motors are controlled by VFD. These drives can run motors at a wide range of speeds. This enables precise control, and also significant energy savings in variable torque applications (fans, pumps, etc.).

Three Phase Power

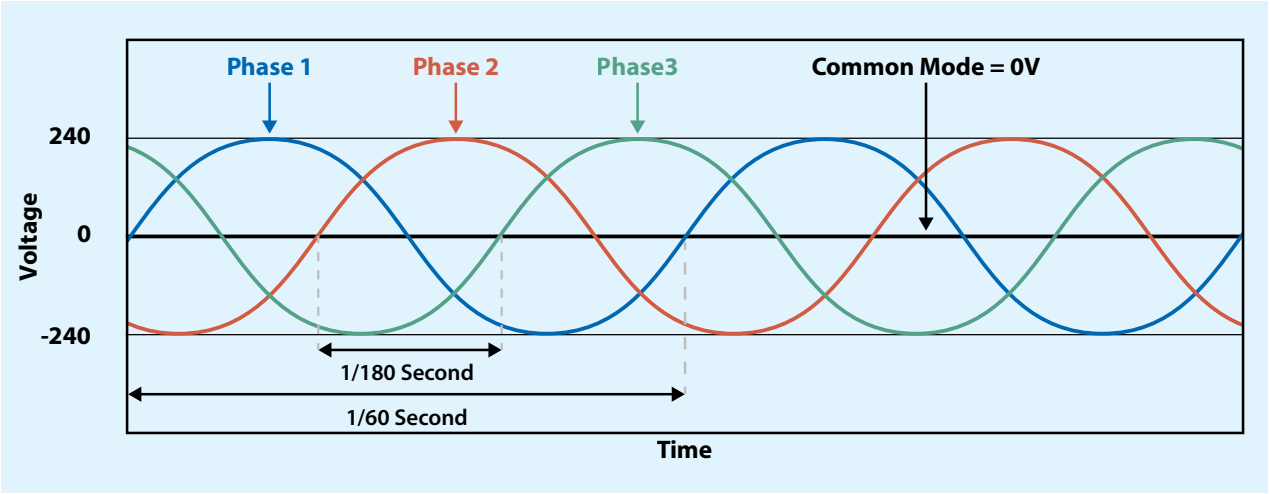


Figure 1

VFDs do this by a process called pulse width modulation (PWM), rectifying AC voltage from the mains (Figure 1), storing it in the DC bus, and then releasing precisely timed pulses of voltage to simulate a sinusoidal waveform (Figure 2). The pulses are typically controlled by IGBTs, a type of diode with very high switching speeds (around 100 nanoseconds, or one ten-millionth of a second).

Common Mode Voltage (CMV)

With line power, the voltage of the three phases always adds to zero (black line in Figure 1). This is not the case with PWM voltage. The "common mode voltage," the average of the three phase voltages (Figure 3), has peak values of hundreds of volts. Additionally, modern drives have very high switching speeds, which leads to rapid changes in voltage, or high dv/dt. The large CMV, in combination with the high dv/dt, produces stray high frequency (HF) currents in electric motors by charging internal capacitances.

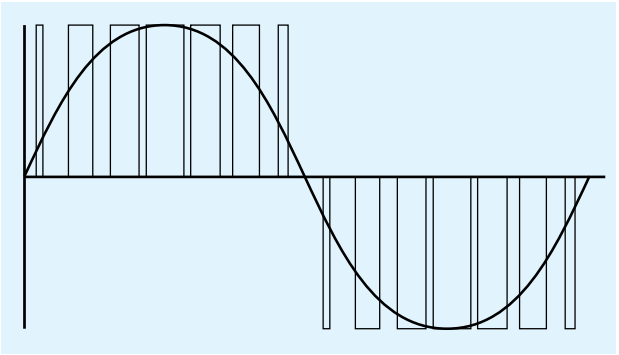


Figure 2

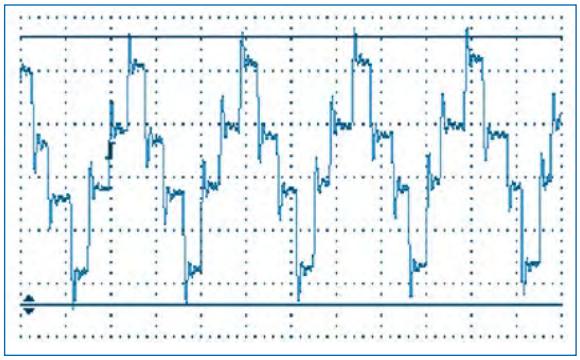
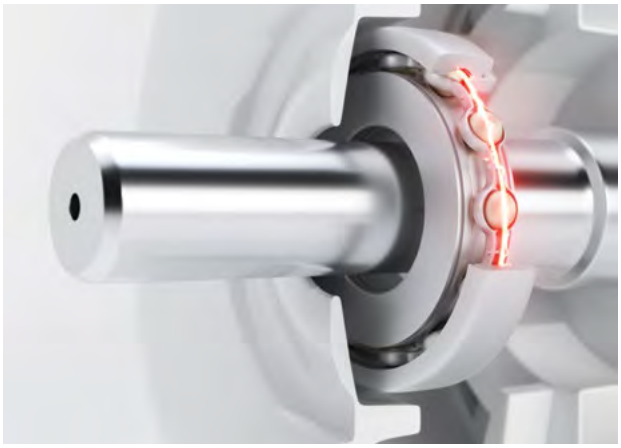
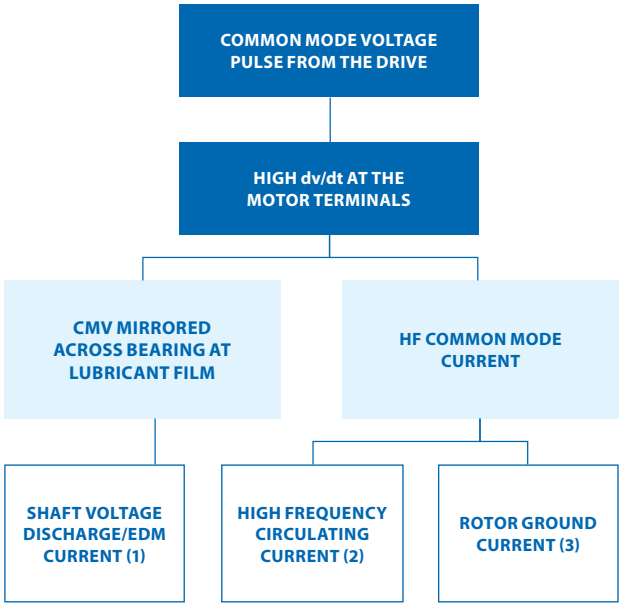


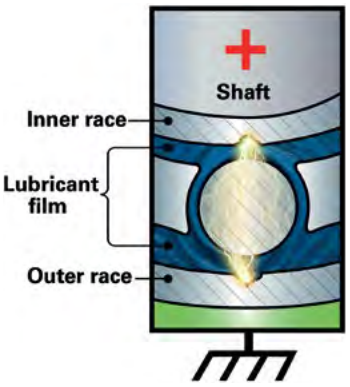
Figure 3

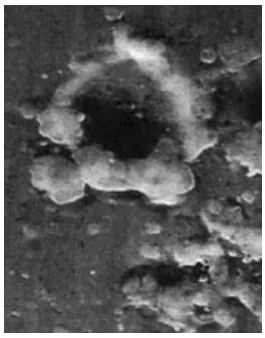
VFD-SOURCED BEARING CURRENTS

The large CMV and dv/dt can drive HF current through the bearings of the motor (and potentially also the driven equipment). When current arcs through the bearing lubricant, it melts the bearing steel, creating microscopic pits through electrical discharge machining (EDM). Over time, these pits accumulate to produce "frosting" of the bearing. As the damage progresses, the bearing race develops a "picket-fence" pattern called fluting. By the time fluting develops, failure is imminent.

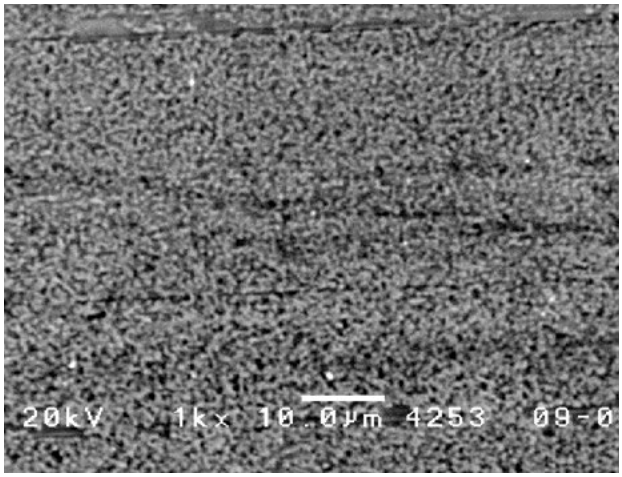




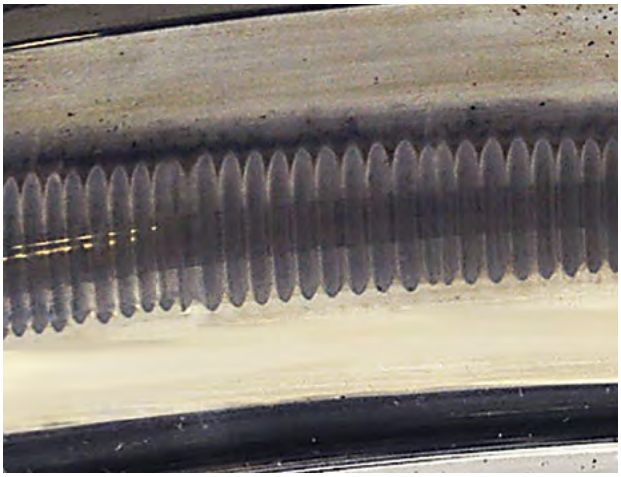




EDM Pit, ~ 0.5 micron



Frosted Bearing Race, scale 10 microns



Fluted Outer Bearing Race

BEARING CURRENT 1: SHAFT VOLTAGE DISCHARGE/EDM CURRENT

The common mode voltage from the VFD charges the rotor by capacitive coupling, or electrostatic induction (Figure 1). Voltage builds up on the rotor, because when the motor is running, there is no conductive path from the rotor to ground. In the motor bearings, a thin layer of lubricant separates the rolling elements and raceways. The lubricant is an insulator, like air. But like air breaking down in a lightning strike, lubricant will break down and conduct electricity if the voltage across it gets high enough.

If the shaft voltage gets high enough, it will discharge by arcing through the bearing [Figure 2]· This has two main deleterious effects:

- It blasts out microscopic pits in the smooth surfaces of the bearing (EDM)
- It contaminates the lubricant with microscopic metal debris

Although the damage from one individual discharge is small, the damage is cumulative, and these arcs may occur thousands of times per second. Damaged grease and roughened bearings will cause increasing heat, noise, and vibration. Premature bearing failure is likely if protective measures are not taken.

Our recommended best practice is to install one AEGIS® Shaft Grounding Ring on all motors controlled by variable frequency drives. An AEGIS® ring provides a path of least resistance to electrical charge/voltage on the shaft, so instead of arcing through the bearing, it flows harmlessly through the ring to the motor frame, and then back to the drive.

Insulating both motor bearings can also protect them from shaft voltage discharge. However, without shaft grounding, the shaft voltage will still be present. This can lead to the shaft voltage discharging through the bearings or gear teeth of coupled equipment. So insulating the motor bearings without grounding the shaft can simply transfer the damage to the driven equipment.



Best Practice: One AEGIS Shaft Grounding Ring

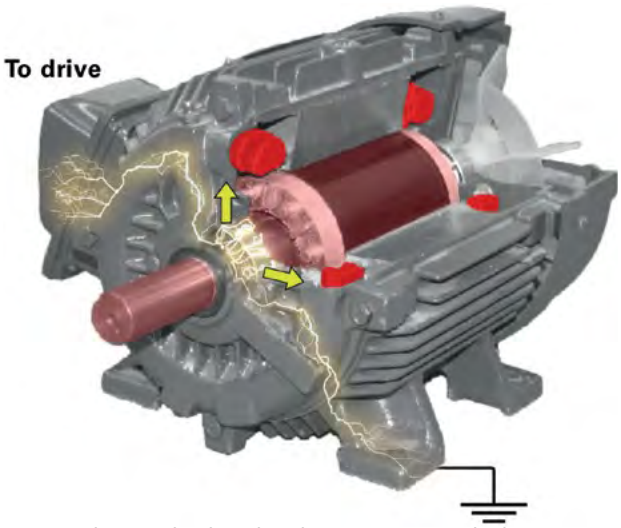


Figure 1: The CMV (bright red) in the stator capacitively charges the rotor, producing a shaft voltage (pink). If the shaft voltage builds up high enough, it will discharge by arcing through the bearing.

The energy released when shaft voltage discharges is $E = \frac{1}{2} CV_2$, where C is the bearing's capacitance and V is the shaft voltage. This means that if the shaft voltage is doubled, the discharge energy is quadrupled. So, a discharge at 10V may be four times as destructive as a 5V discharge.

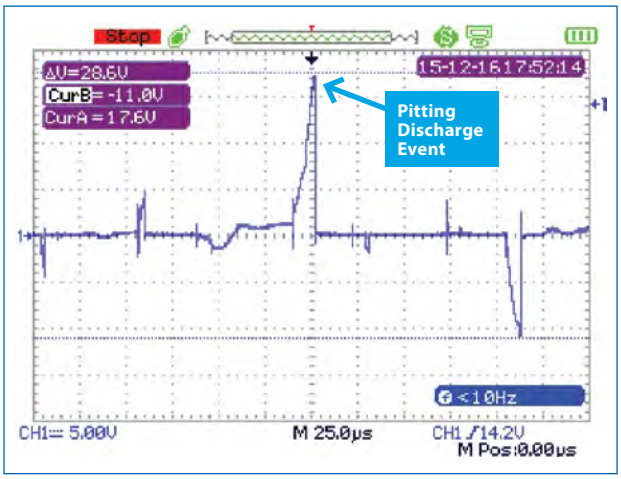


Figure 2. The capacitively coupled shaft voltage discharges by arcing through a bearing

COMMON MODE CURRENT (CMC)

Every time the drive switches a phase between positive and negative, the CMV abruptly changes. This changing voltage drives a HF current through the motor's internal capacitances, according to $i_{cap} = C\frac{dv}{dt}$, where i_{cap} is the current through a capacitor, C is its capacitance, and dv/dt is the rate of voltage change across the capacitor. The common mode current (CMC) is the sum of i_{cap} through all of the stray capacitances in the motor-drive system.

Some of the CMC flows onto the rotor. Without shaft grounding, this causes a buildup of charge (voltage) that leads to EDM current, as we have seen.

Most of the CMC flows through the larger capacitance between the stator windings and the frame. Because the frame is grounded, or otherwise electrically bonded back to the drive, voltage does not typically build up as it does on the rotor. Instead, current moving into the frame flows back to the drive through any available paths.

The HF current's flow through the stator and back to the drive can cause bearing damage in two ways.

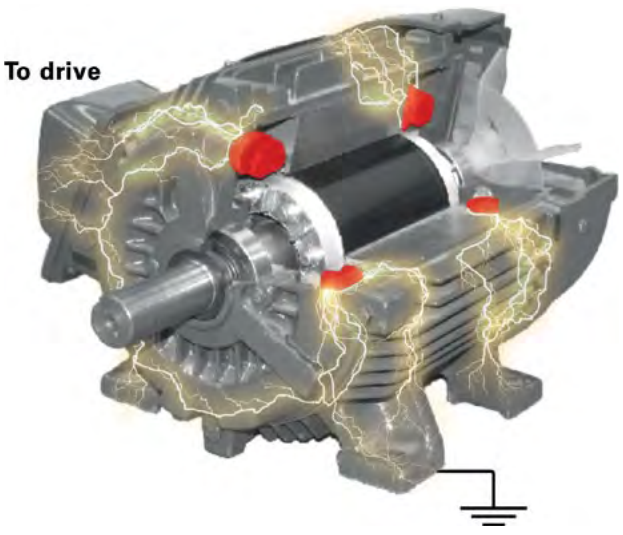


Figure 3: CMC flows capacitively from the stator windings to the frame and makes its way back to the drive by way of the motor power cable and/or ground.

Figure 1

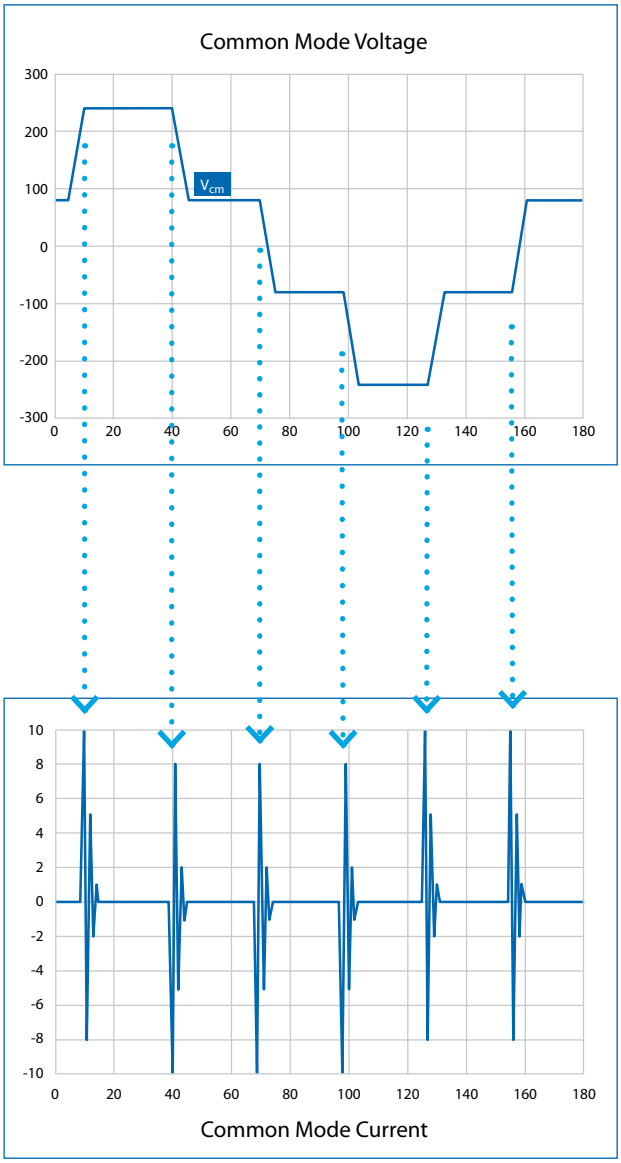


Figure 2

BEARING CURRENT 2: HIGH FREQUENCY CIRCULATING CURRENT (HFCC)

The CMC flowing through the stator windings into the frame creates a high frequency magnetic flux inside the motor. This flux induces an end-to-end shaft voltage, which drives HF circulating bearing current (Figure 1).

HFCC arcs through both bearings, in opposite directions. The total current path is down the shaft, through one bearing, into and through the frame, and then back to the shaft through the other bearing (Figure 2).

The longer the motor shaft, the larger the induced current. So HFCC is mainly a problem only for larger motors on drives, over 75 kW.

The best defense against HFCC is a hybrid/ceramic bearing at one end, to interrupt the current's flow. In practice, an insulated bearing or sleeve is usually a good enough defense, but ceramic bearings are the gold standard.

HFCC is mainly a problem in larger motors, but these motors are also subject to EDM current, as discussed. Using an AEGIS® Ring at one end and bearing insulation at the opposite end provides good protection against both Bearing Currents 1 and 2.

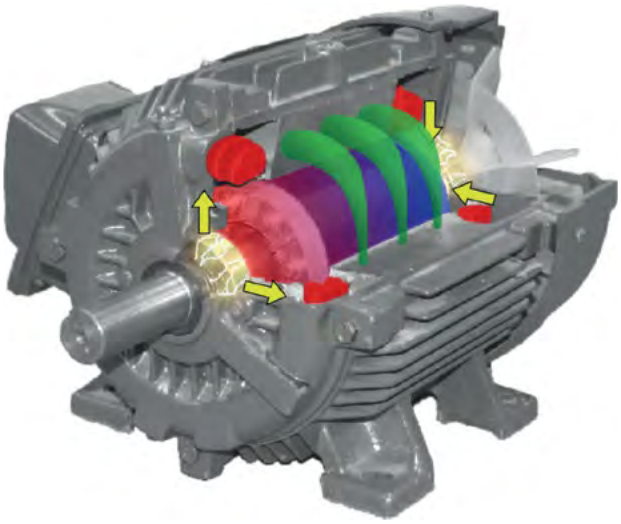


Figure 1: The CMC creates unbalanced magnetic flux (green) that induces an end-to-end shaft voltage (red +/blue -). This drives current to circulate through the bearings from shaft to frame and back.

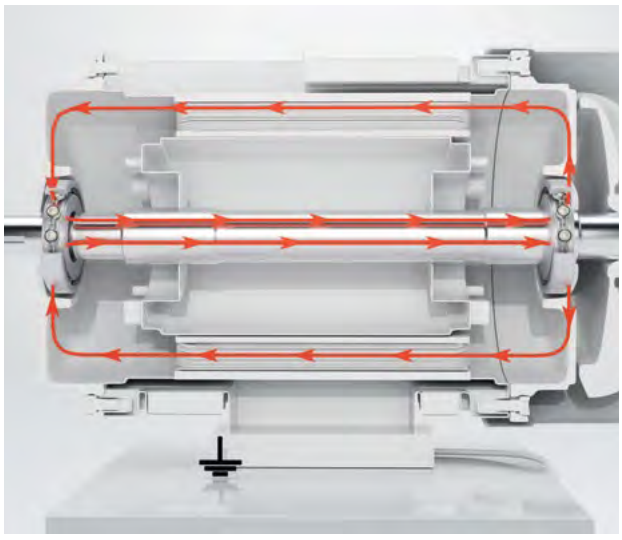
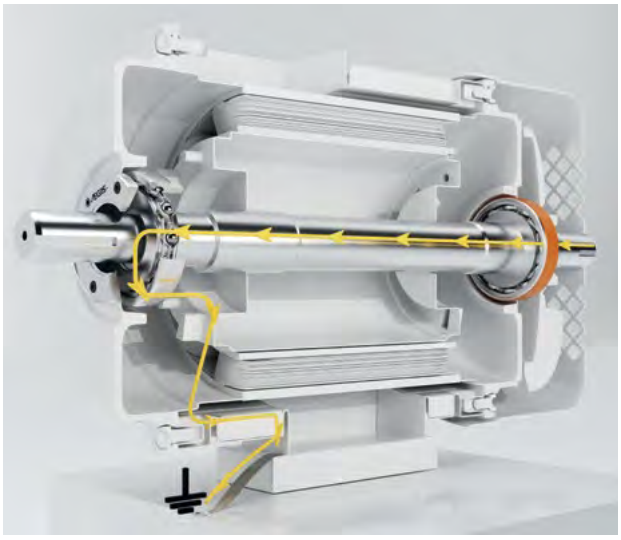


Figure 2: The path of HF circulating current between shaft, bearings, and frame



Best Practice: One insulated bearing and one AEGIS Shaft Grounding Ring at the opposite end

BEARING CURRENT 3: ROTOR GROUND CURRENT

Common mode current moves from the stator windings to the motor frame, and returns to the drive. This may be through the ground conductors or shielding of the power cable, or through the facility ground. These are safe paths. But if the cable is not suitable, or is improperly installed, or the motor is poorly grounded, voltage will build up on the frame (Figure 1), and the current will seek other return paths.

If the motor's driven equipment is better grounded than the motor itself, rotor ground current may be a problem. In rotor ground current, common mode current in the frame arcs through a motor bearing to the shaft, travels through the shaft to the coupled equipment, arcs through the equipment bearings, and then goes to ground/returns to the drive. So rotor ground current damages the motor and the load bearings simultaneously.

The single best way to avoid Bearing Current 3 is by using proper VFD cable. Typically, that means shielded cable, with symmetrically arranged conductors within. But VFD cable can be very expensive. As with HFCC, common mode chokes can combat this bearing current as well. Common mode chokes, however, do not reduce Bearing Current 1/EDM Current.

A more affordable way to avoid rotor ground current is to bond the motor frame to the equipment frame with a high frequency grounding strap, like the AEGIS® HFGS. These are tin-plated braided copper straps with very low impedance to high frequency current. The destructive path through the bearings has higher impedance. So with a grounding strap, if the equipment is better-grounded than the motor, the stray current will get to the equipment through the strap, instead of arcing through the bearings.

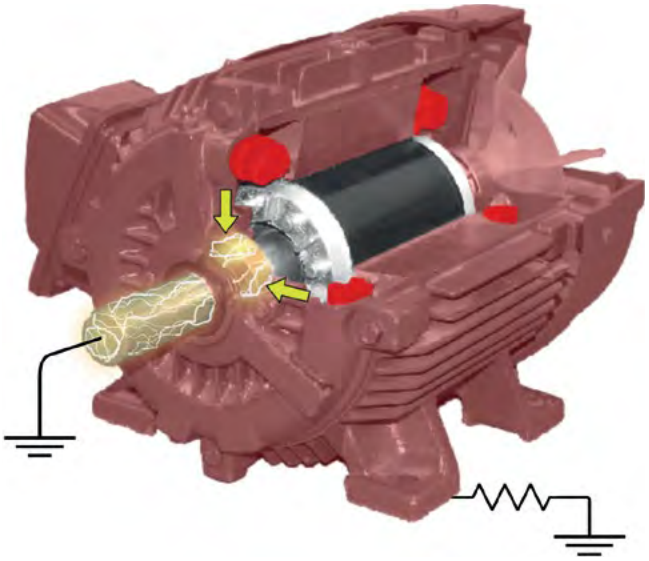
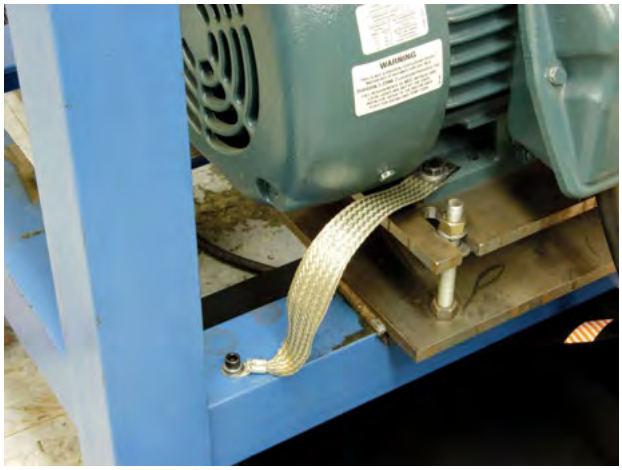
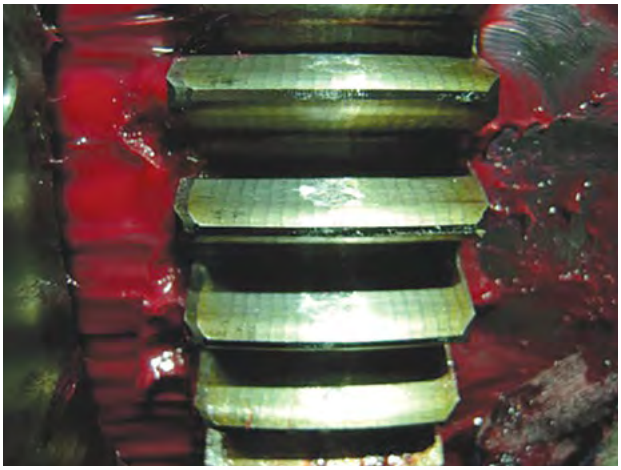


Figure 1: A motor with poor grounding will have voltage (pink) build up on the frame. If the driven equipment is better grounded, rotor ground current may arc from the frame through the motor bearings to the shaft, then through the load bearings and to ground.



Motor frame bonded to its support by a high frequency grounding strap

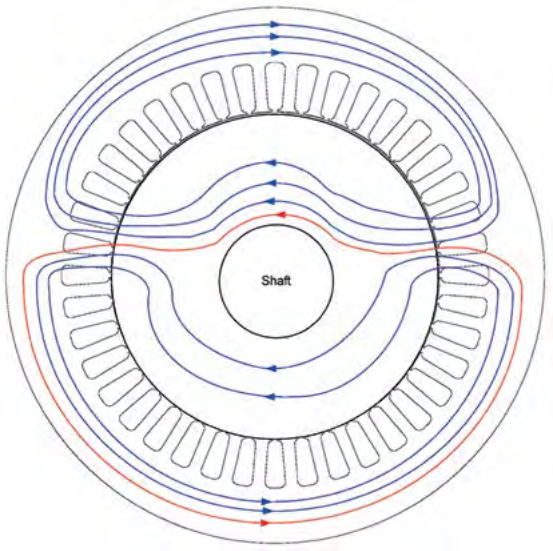


Tiger striping on the teeth of a gearbox caused by rotor ground current

BEARING CURRENT 4: CLASSICAL BEARING CURRENT (LOW FREQUENCY CIRCULATING CURRENT)

Motors on drives are subject to high frequency circulating current. Motors run on line power can be damaged by a low frequency circulating current, sometimes called classical bearing current. This arises from slight asymmetries in the motor. Modern manufacturing methods and tight tolerances have led to more-symmetrical motors. Nowadays, this bearing current usually only occurs in very large motors and generators (5000 frame and higher).

Asymmetry in the motor's construction leads to imbalanced magnetic flux inside the motor. This is shown at right: More flux lines are passing through the upper half of the shaft and rotor than through the lower half.



As with high-frequency circulating currents, this imbalance induces an end-to-end shaft voltage that drives circulating current.

Like HFCC, LFCC can be interrupted with an insulated bearing. To prevent the end-to-end shaft voltage from driving current through downstream equipment, it is also recommended to install an AEGIS ring at the opposite end from the insulated bearing.

BEARING CURRENT SUMMARY

Type	1. Shaft Voltage Discharge	2. High-Frequency Circulating	3. Rotor-Ground	Low Frequency Circulating Current
Cause	Capacitive charging by CMV	Unbalanced flux caused by CMC	CMC and poor motor grounding	Magnetic imbalance from asymmetry in motor
Motors at risk	All motors on drives	Motors on drives over 75 kW	Motors on drives without VFD-rated cable	Large motors and generators (5000+ frame), both on drives and on line power
Mitigation	Shaft grounding	Insulated bearing VFD output filter	Improve HF grounding/ bonding VFD cabling VFD output filter	Insulated bearing
AEGIS Best Practice	Shaft Grounding Ring	Insulated bearing, Shaft Grounding Ring at opposite end	HF grounding strap from motor to equipment frame, Shaft Grounding Ring	Insulated bearing, Shaft Grounding Ring at opposite end

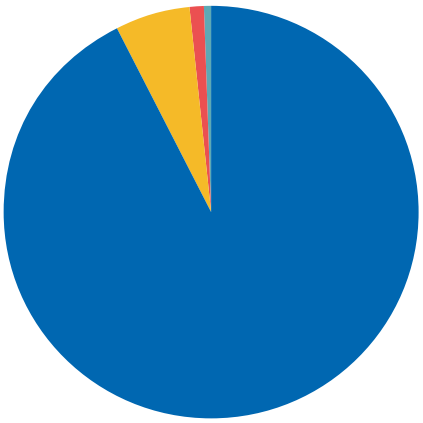
ELECTRICAL BEARING PROTECTION FOR MOTORS ON VFD



VFD-driven motors can fail prematurely

The bearing currents described in the previous section cause electrical bearing damage that can lead to motor failure in as little as three months. In a critical motor, this failure can cost hundreds of thousands of dollars due to unplanned downtime.

The chart to the right breaks down the total cost of premature motor failure. Motor repair or replacement is not cheap, but this expense is dwarfed by the cost of ceasing production. The economics are clear: In the face of these potential costs, it makes good sense to spend money up front to avoid such catastrophic losses of revenue.



Protect Motor Bearings with AEGIS®

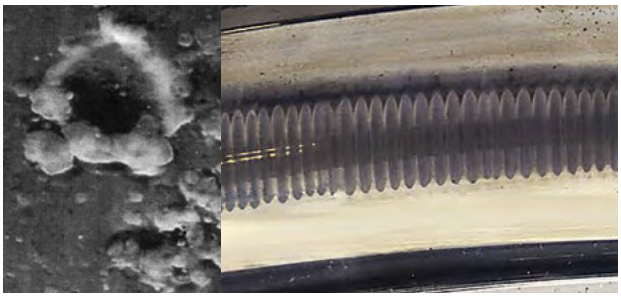
Shaft Grounding Rings
AEGIS Shaft Grounding Rings mitigate the risk of premature bearing failure by dissipating shaft voltage. They provide a low impedance path from the motor shaft to the frame, safely channeling current off the shaft before it builds up enough to discharge through, and damage, the motor bearings.

In the following pages, we will describe AEGIS® technology.

Bearing Protection Best Practices
This Handbook details best practices for protecting VFD-driven motors from electrical bearing damage and preventing costly repairs, downtime, and lost production.

Learn about:

- Bearing currents and shaft voltage
- AEGIS® technology
- Shaft voltage testing
- Installation best practices



Prevent EDM Pitting and Fluting Damage

AEGIS® SHAFT GROUNDING RINGS PROVIDE 360° OF SHAFT GROUNDING

The Only Product of its Kind



AEGIS® Shaft Grounding Ring Uses 360 Degree Conductive Contact

- 360 degrees circumferential conductive microfiber ring
- Multiple row design – greatest reliability
- Ensures unmatched shaft grounding and performance

Proprietary Conductive Microfibers Last for the Service Life of the Motor

The AEGIS® Shaft Grounding Ring's unique design features hundreds of thousands to millions of specially engineered conductive microfibers that encircle the motor shaft. With so many electrical transfer points the ring provides continuous electrical contact.



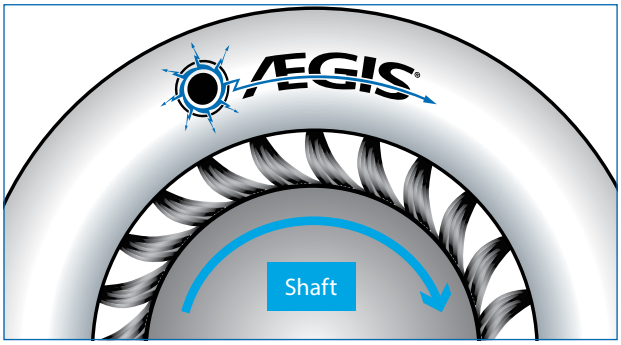
Conductive microfibers lining an AEGIS® ring



A single AEGIS® microfiber, with U.S. dime for scale

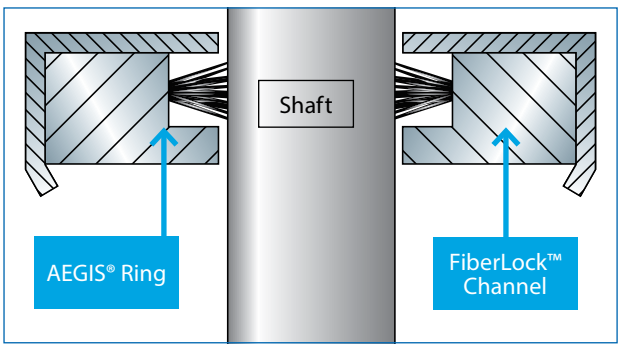
Conductive Microfibers: Low Mechanical Wear

AEGIS® Shaft Grounding Rings were designed to provide long-term protection with long-lived conductive microfibers. Lab testing of AEGIS® rings subjected to a 10,000 hour mechanical wear test on a 3600 rpm continuous motor, and AEGIS® rings subjected to 2 million direction reversals from ±1800 rpm, have shown minimal mechanical wear to the microfibers and no adverse effects.



Patented FiberLock™ Channel Secures and Protects Fibers

AEGIS's patented, protective FiberLock™ channel locks the ring's conductive microfibers securely in place around the motor shaft, allowing them to flex without breaking.



MANUFACTURER'S SPECIFICATION FOR INDUSTRIAL AEGIS® RINGS

Expected Service Life	Wear rates vary depending on application conditions, but the conductive microfibers are expected to maintain contact with the shaft for longer than the normal service life of the bearings.
Replacement	Install a new AEGIS® Shaft Grounding Ring whenever bearings are replaced on inverter-driven motors.
Maintenance Requirements	The AEGIS® Ring does not require maintenance. The shaft surface must remain conductive for the ring to function.
Shaft Surface Conductivity	Coating the shaft with AEGIS® Colloidal Silver Shaft Coating (CS015) is recommended, to enhance surface conductivity and help prevent rust/corrosion.
Shaft Surface Finish	Ra 3.3 micron finish or better.
Oil and Grease on Motor Shaft	Small amounts of oil and/or grease are acceptable if the shaft surface remains conductive. The fibers are designed to cut through thin layers of grease to maintain contact with the motor shaft.
Dirt/Dust	Small amounts of dust and/or small particles are acceptable if the shaft surface remains conductive. Fibers "sweep" particles from shaft surface during operation.
Maximum Surface Rate/RPM	No maximum rating - There is no theoretical RPM limit as there is virtually no frictional contact with the shaft at high RPM. Verify specific applications with AEGIS® engineering.
Directional Rotation	Motor may be operated in clockwise or counterclockwise rotation. Motor may change directional rotation without limitation.
Mounting Eccentricity	Concentric mounting is the recommended best practice, but the AEGIS® ring tolerates eccentric mounting.
Shaft Eccentricity	0.25mm Total Indicated Runout in area where AEGIS® ring is installed.
Temperature Rating	Continuous rating: -80° to 149° C Verify application-specific temperatures with AEGIS® engineering.
Humidity	Continuous rating: 0 to 90% RH Verify application-specific acceptable humidity with AEGIS® engineering.
Fiber Arrangement	Multiple rows of fiber are distributed 360° around the shaft for maximal conduction and protection.
Friction	Negligible - AEGIS® microfibers exert undetectably low frictional drag on the motor shaft.
Hazardous Areas	Class 1 Division 1/Zone 1: May be installed inside an explosion-proof (XP) enclosure (per IEEE Std 303-2004) or inside an XP motor. Class 1 Division 2/Zone 2: May be installed provided that incendivity calculations (as outlined in (IEEE Std 1341-2021 Appendix G-3) show the maximum shaft voltage discharge energy is less than the minimum ignition energy.
CE and UL Requirements	The AEGIS® Ring is classified as a "component" and as such is not subject to the requirements of any Directive. The application of the CE or UL mark is not applicable to this component.
RoHS	All materials used in manufacture of AEGIS® Rings are in compliance with Directive 2002/95/ EC, Restriction of the use of certain hazardous substances in electrical and electronic equipment. No RoHS banned substances are present in excess of the maximum concentration values (MCV). Note: For RoHS Certification Letter, write sales@est-aegis.com or call 1-866-738-1857

est-aegis.com/resources/specifying-aegis/

AEGIS® SGR FOR LOW VOLTAGE AND AEGIS® PRO SERIES FOR MEDIUM VOLTAGE MOTORS

Low Voltage Motors UP TO 375 kW

Supply voltage: 600 VAC or less
Recommended Technology: AEGIS® SGR



AEGIS® SGR

Description:

- Design Type: AEGIS® SGR
- Circumferential Conductive MicroFiber rows in FiberLock™ Channel
- Rows of fiber: 2
- Fiber overlaps shaft 0.030" / 0.76mm
- OAL: 0.295" / 7.5mm
- OD: listed in AEGIS® Parts List

Mounting:

- Internal or External
- Select based on shaft diameter
- Split and Solid versions available
- Custom brackets optional

Medium Voltage motors and LOW Voltage motors > 375kW

Recommended Technology: AEGIS® PRO Series



AEGIS® PRO

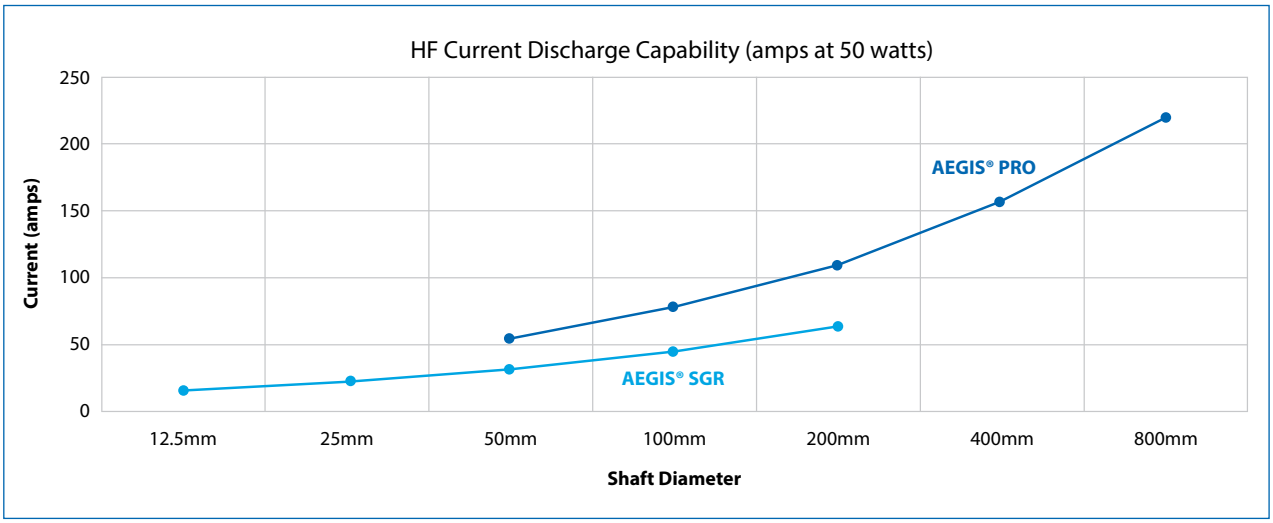
Description:

- Design Type: AEGIS® PRO Series
- Circumferential Conductive MicroFiber rows in FiberLock™ Channel
- Rows of fiber: 2
- Fiber overlaps shaft 0.030" / 0.76mm
- Varies by PRO Ring style
- OD: Shaft + (refer to drawing)

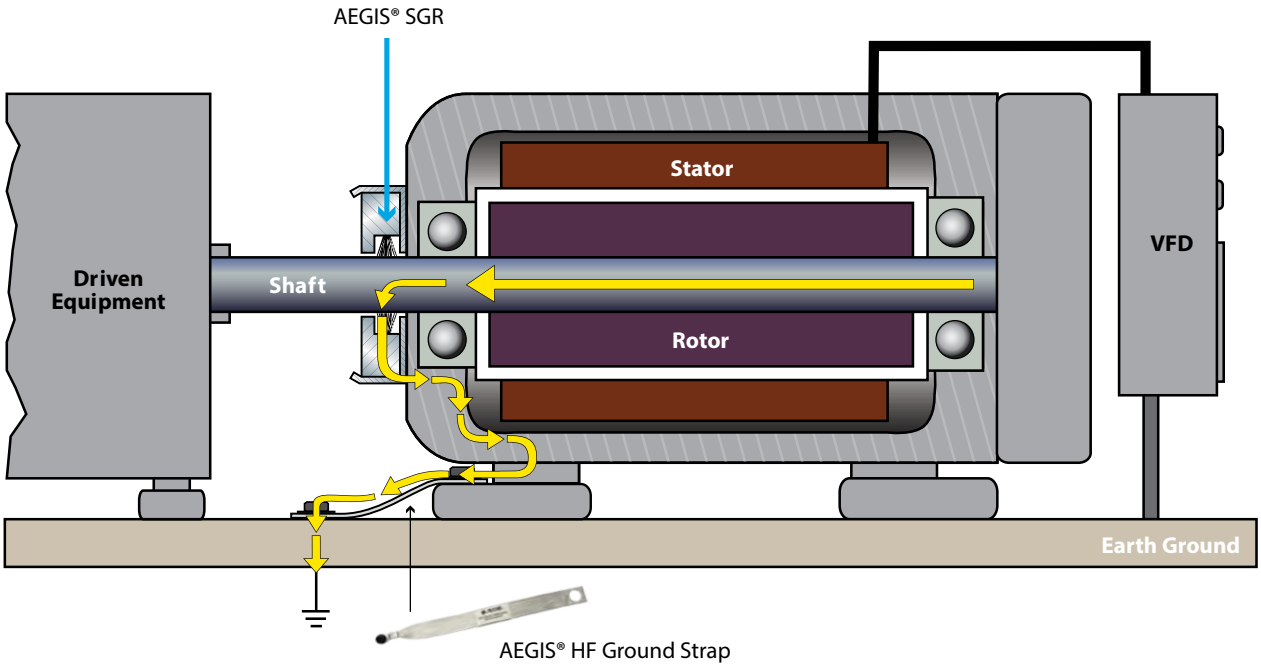
Mounting:

- Internal or External
- Select based on shaft diameter
- Split and Solid versions available
- Custom brackets optional

Current Capability Chart – Peak Current Capacity of SGR and PRO Rings



LOW VOLTAGE HORIZONTAL MOTORS



Low Voltage Motors:

General recommendations: For induction motors operated on PWM IGBT VFD's either foot mounted, C-face or D-flange mounted motors with single row radial ball bearings on both ends of the motor. Motors may be installed either horizontally or vertically in the customer's application.

- Install one AEGIS® SGR Bearing Protection Ring on either the drive end or the non-drive end of the motor to discharge capacitive induced shaft voltage.
- AEGIS® SGR may be installed either internally or externally.
- For motors over 75kW, we also recommend bearing insulation at the opposite end from the SGR. A hybrid (ceramic) bearing is best, but an alumina coating is acceptable.
- **Recommended:** AEGIS® Colloidal Silver Shaft Coating (PN CS015) on the motor shaft where the fibers touch.
- **Recommended:** AEGIS® HF Ground Strap to bond motor frame to earth ground or foot of driven equipment.

Product recommendation: AEGIS® SGR

⚠ Follow all safety precautions. SDS available for download at **est-aegis.com/sds**



AEGIS® SGR

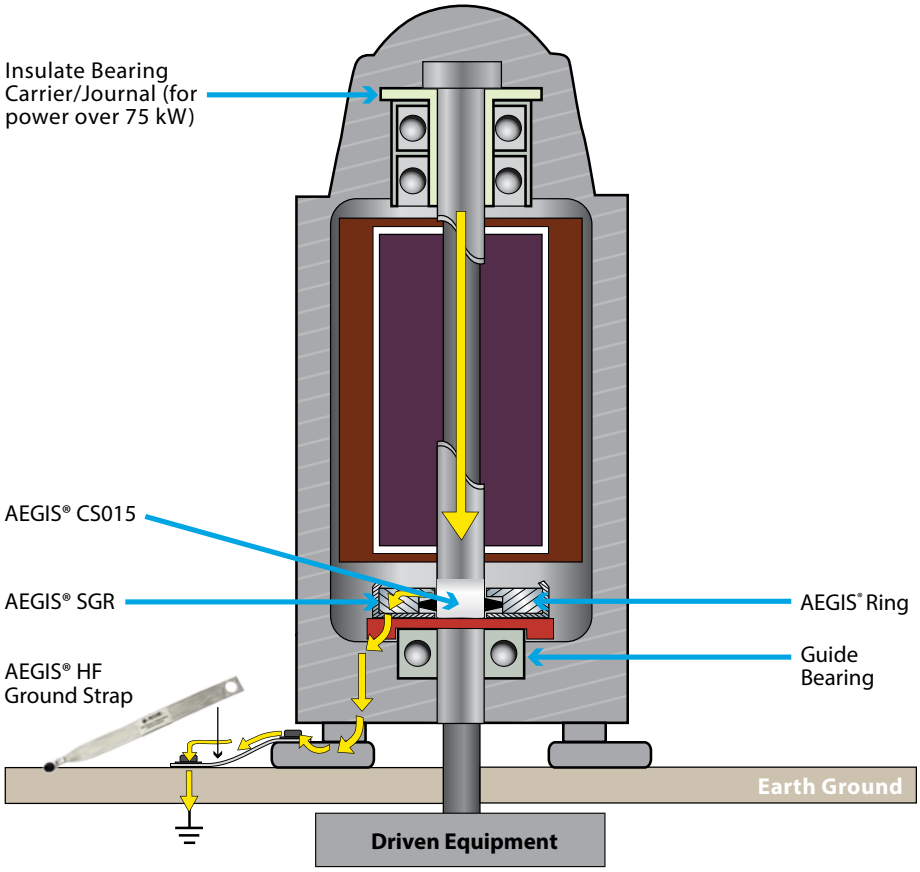


AEGIS® CS015



Ground Strap

VERTICAL (HOLLOW & SOLID SHAFT) THRUST HANDLING MOTORS UP TO AND INCLUDING 75KW



Low Voltage Motors:

- Lower Bearing: Install one AEGIS® SGR Shaft Grounding Ring.
- AEGIS® SGR can be installed internally on the back of the bearing cap.
- Above 75kW, the upper bearing carrier or journal should be isolated, or an insulated/hybrid ceramic bearing should be installed.
- **Recommended:** AEGIS Colloidal Silver Shaft Coating (PN CS015) is strongly recommended on the shaft where the fibers touch.
- **Recommended:** AEGIS® HF Ground Strap to bond motor frame to earth ground or foot of driven equipment.

Product recommendation: AEGIS® SGR

⚠ Follow all safety precautions. SDS available for download at **est-aegis.com/sds**

Note: For external installation, the AEGIS® Ring must run on the motor or pump shaft at the lower bearing.

Ring must not be mounted around the steady bushing.

Upper bearing may be isolated with insulated bearing carrier for added protection.

AEGIS® PRO SERIES – SHAFT GROUNDING RINGS FOR MAXIMUM BEARING PROTECTION

The AEGIS® PRO Series design provides reliable shaft grounding for high-power (over 375 kW) motors, generators, & turbines, to protect the equipment's bearings by dispersing stray current to ground. Install the AEGIS® PRO on the DE and insulate the bearing on the opposite end (NDE) for best results. Large motors and generators often have much higher induced shaft voltage and bearing current. The six circumferential rows of conductive microfiber provide the extra protection for these high current applications.

Generators may experience current surges and stray voltage from the exciter, which can cause electrical arcing in their bearings and associated equipment. The AEGIS® PRO Rings have a high ampacity design and can dissipate high levels of stray current and voltage.

Designed for:

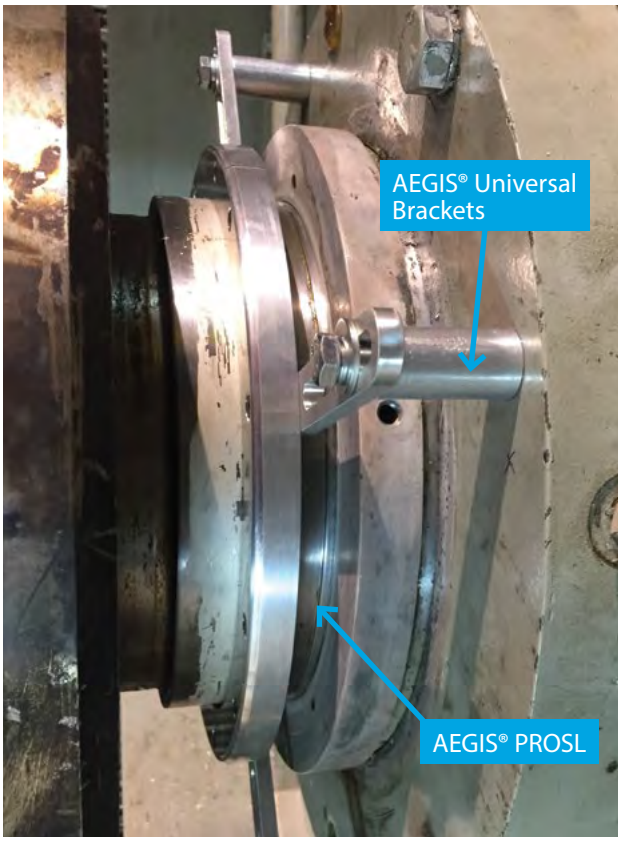
- Large frame low-voltage motors:
  – Intermittent duty, 375kW or greater
  – Continuous duty, 225kW or greater
- Medium voltage motors (600V or greater)
- DC motors: 225kW or greater

Specifications:

- Available in shaft diameters from 63.5mm to 762mm
- Circumferential Conductive MicroFiber rows in FiberLock™ Channel
- Rows of fiber: 6
- Fiber overlaps shaft 0.76mm
- Ships with CS015 AEGIS® Colloidal Silver Shaft Coating

Options:

- Solid and split ring designs
- Monitoring ring option for voltage monitoring
- Stock brackets and stand-off kits
- Custom brackets available

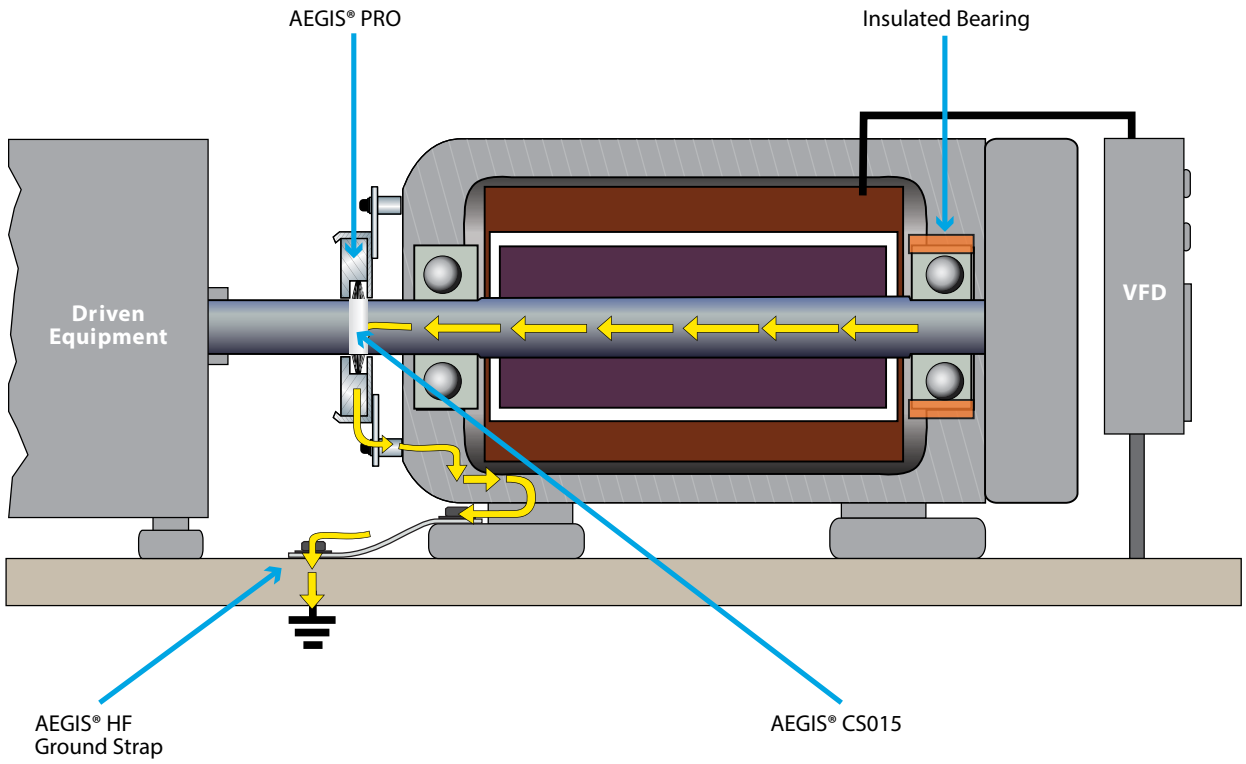


AEGIS® PROSL with Universal Brackets



6 rows of Conductive MicroFiber

MEDIUM VOLTAGE AND HIGH POWER MOTORS:



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

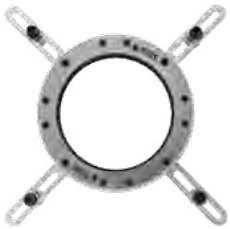
- Non-Drive end: Bearing housing must be isolated with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.
- Drive end: Install one AEGIS® Shaft Grounding Ring.
- AEGIS® Ring can be installed internally on the back of the bearing cap or externally on the motor end bracket.

Recommended: AEGIS® Colloidal Silver Shaft Coating (PN CS015) is highly recommended on the motor shaft where the fibers touch.

Product recommendation:

- **AEGIS® PRO Series**

⚠ Follow all safety precautions. SDS available for download at **est-aegis.com/sds**



AEGIS®PRO Series – external (shown) or internal installation



Sleeve



Ground Strap



AEGIS® CS015



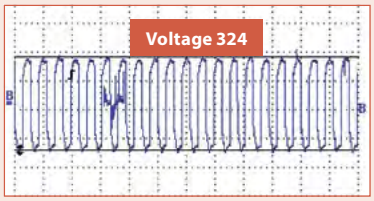
Insulated bearing

AEGIS® SHAFT GROUNDING FOR DC MOTORS

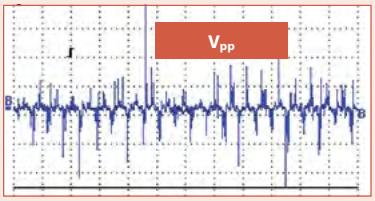
DC motors operated by drives also require bearing protection from capacitive shaft voltage. Capacitively induced shaft voltage may reach hundreds of volts peak-to-peak, and depending on the drive topology, may increase in size as the motor speed is increased. Additionally, circulating current from magnetic dissymmetry may exist in DC motors over 7.5kW.

DC Motor – Before and After Testing with AEGIS® Installed

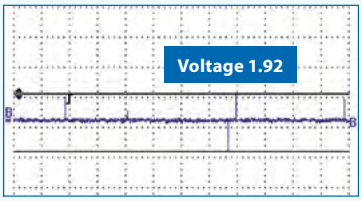
262kW DC Motor – DC Inverter Drive.



Capacitive induced shaft voltage before bearing current discharge through the bearings. Square wave from DC SCR drive.



No Shaft Grounding
Volts: 65.2 V pk-pk Bearing discharges (EDM)



AEGIS® Shaft Grounding
Volts: 1.92 V pk-pk Discharge through AEGIS® Shaft Grounding Ring

BEST PRACTICES FOR DC MOTOR BEARING PROTECTION

Install one AEGIS® SGR Shaft Grounding Ring on either the drive end or the non-drive end of the motor to discharge induced shaft voltage.

AEGIS® SGR should be installed internal to the motor if possible but may also be attached externally to the motor's end bracket.

Recommended: AEGIS® Colloidal Silver Shaft Coating (PN CS015) on the shaft where the fibers touch.

Motors over 7.5kW should also include one insulated bearing, at the end opposite from the AEGIS® Ring.

Product recommendation:

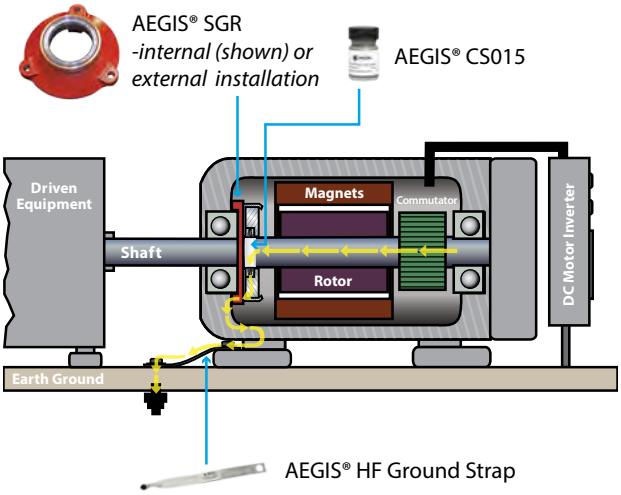
Motor power rating under 225kW:

- **AEGIS® SGR**

Motor power 225kW or greater:

- **AEGIS® PRO Series**

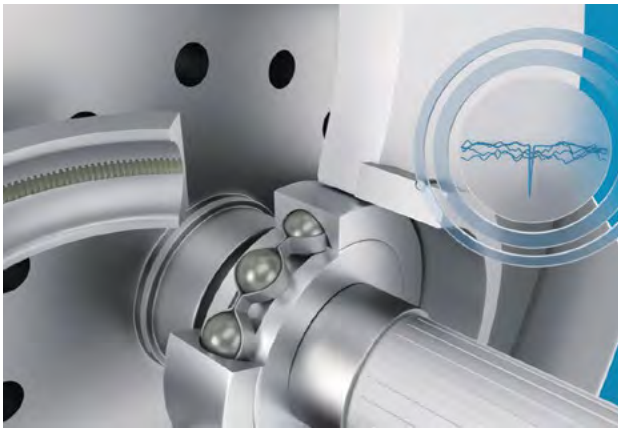
⚠ Follow all safety precautions. SDS available for download at **est-aegis.com/sds**



AEGIS® SHAFT GROUNDING FOR ELECTRIC VEHICLES

Electric vehicles (EVs) are inherently variable speed applications. Although different makes and models of EV use different traction motor topologies (induction, synchronous permanent magnet, etc.), they all control the motors' speed with inverter drives. Hence, all EV motors need protection from electrical bearing damage from capacitive shaft voltage discharge. As with industrial motors, AEGIS® Shaft Grounding Rings are an effective long-term solution to this problem.

Additionally, drive operation in EVs may cause electromagnetic compatibility (EMC) problems with other vehicle systems. Electromagnetic interference/radio frequency interference (EMI/RFI) can be problems with in-vehicle sensors, controls, and communications. EMI/RFI can be suppressed by grounding the traction motor shafts.



Shaft voltage discharge in an EV motor bearing



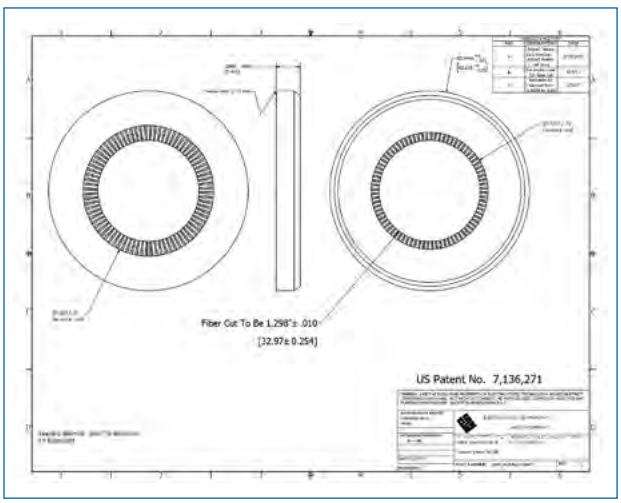
Systems affected by EMI/RFI



Shaft voltage buildup is prevented by an AEGIS EV Ring

BEST PRACTICES FOR EV SHAFT GROUNDING

Standard AEGIS® Shaft Grounding Rings are not recommended for use in EVs. Instead, we recommend specialized AEGIS® EV Rings. EV designers should contact Electro Static Technology's Engineering department early in the design phase to facilitate proper integration of AEGIS® shaft grounding into the drivetrain.



HIGH-FREQUENCY BONDING MITIGATES RISK OF ROTOR GROUND CURRENT

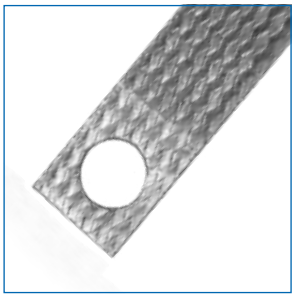
An AEGIS® Ring protects motor bearings from damage from shaft voltage buildup and discharge. A High Frequency Grounding Strap (HFGS) provides a low-impedance path between system components, and mitigates the risk of motor and equipment bearing damage by rotor ground current and other stray currents.

Proper high-frequency (HF) bonding of VFD-driven motor systems is vital to prevent voltage differences between system components. It is especially critical in applications involving a motor and coupled equipment that are not mounted to a common baseplate. In such cases, effective HF bonding of all system components is necessary to equalize the potential between equipment frames and to prevent ground loops between the motor and coupled equipment. If the motor and driven equipment frames are at different potential, rotor ground current can flow, damaging both motor and equipment bearings.

HF bonding straps are efficient means of bonding for high frequency current, and are recommended by major motor and drive manufacturers. AEGIS® High-Frequency Ground Straps ensure a very-low impedance path for VFD-sourced HF currents from the motor frame, either to the coupled equipment's frame or to ground. Used in conjunction with AEGIS® Rings, which provide a safe path for damaging VFD-induced current around the motor's bearings to its frame, AEGIS® HFGS bonding straps protect the driven equipment's bearings.

AEGIS® HFGS are designed with a tinned hole on one end (size based on NEMA/IEC frame) and a ring terminal on the opposite end to fit a 8mm screw. Standard lengths are available in 305mm and 610mm increments. Also available is a universal strap which includes a ring terminal on both ends. Longer straps and other terminations are available upon request. See page **48** for parts list.





tinned end

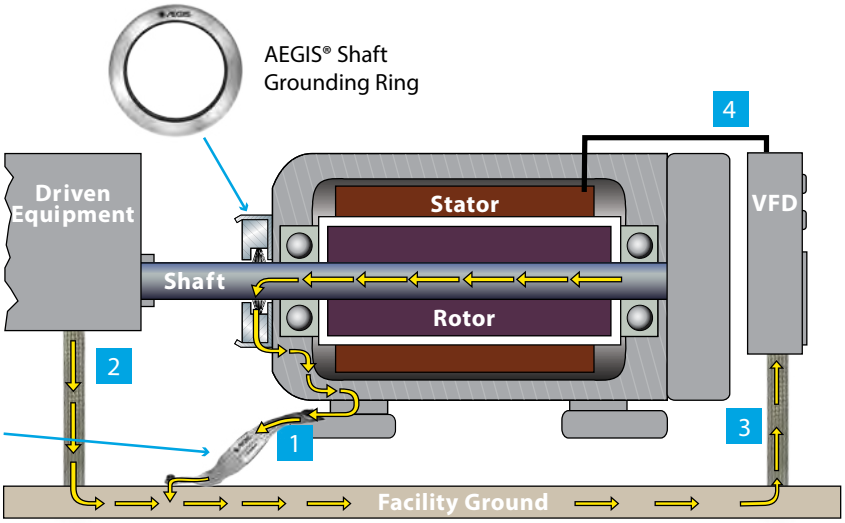


ring terminal

1. Motor foot to facility ground
2. Driven equipment to motor or common facility ground
3. Motor foot/facility ground to VFD ground bus
4. Motor frame to metal conduit; VFD ground to metal conduit



AEGIS® HF Ground Strap



MOTORS WITH AEGIS® SHAFT GROUNDING FACTORY INSTALLED

AEGIS® Shaft Grounding Rings can be retrofit to new or repaired electric motors, and the next section gives best practices for installing them.

But they can also be installed by the motor manufacturer on general purpose and specialized motors ranging from vertical hollow shaft to explosion proof.

AEGIS® Rings come standard on hundreds of motor models, and are available as a mod on most others.

The advantages of factory-installation include:

- **Saving time**
  There's no need to find the part number for the AEGIS® ring, and no need to install it yourself.
- **Saving money**
  The cost of the motor with AEGIS® installed is less than the cost of the motor and an AEGIS® ring separately. You also save the cost of installing it yourself.
- **Wide choice of motor manufacturers**
  Manufacturers like Baldor (ABB), GE Industrial Motors (Wolong), LEESON and Marathon (Regal Rexnord), U.S. MOTORS (Nidec), TECO-Westinghouse, and WEG Electric provide AEGIS® rings on stock motor lines. Others, including ABB, Fuji, Siemens, and Toshiba offer AEGIS® Rings as an option.
- **Minimal risk of improper installation**
  Motor manufacturers have installed hundreds of thousands of shaft grounding rings. They know exactly how to install AEGIS® rings according to best practices.

Accept No Substitutes

When ordering a motor with shaft grounding factory-installed, be sure to specify AEGIS® Shaft Grounding Rings.



General purpose



Vertical hollow shaft



Explosion proof motors

AEGIS® INSTALLATION – INTERNAL

AEGIS® Shaft Grounding Rings are ideally installed on the inside of the motor to provide protection from ingress of dirt and dust. Motor manufacturers commonly use this installation as a best practice in stock catalog motors equipped with AEGIS® rings.

⚠ Follow all safety precautions. SDS available for download at **est-aegis.com/sds**

ℹ Follow AEGIS® best practices for motor shaft preparation and ring installation. Use AEGIS® Colloidal Silver Shaft Coating when installing AEGIS® rings to enhance the shaft conductivity and help prevent oxidation.

Press Fit Installation:

- Press into bearing retainer
- Press into custom bracket
- Ring OD tolerance +0 / -0.025mm
- Bore tolerance +0.025 / -0mm



Bolt-through installation:

- Drill into bearing retainer
- Drill into custom bracket

Drill/tap holes per AEGIS® Ring drawing location

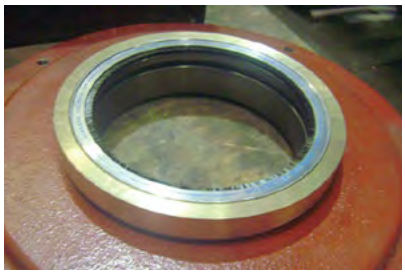
- Flat head cap screws
- Socket head cap screws/lock washer

STOP Do not use non-conductive thread-lock

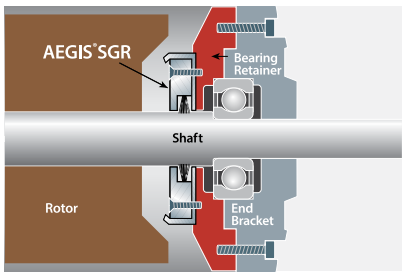


In some motors it may be desirable to attach an additional machined spacer to locate the ring further away from the bearing grease cavity.

A grease seal may be added to reduce grease ingress to the fibers.



AEGIS® Rings are commonly installed internal to the motor on the bearing retainer. This is typically done with bolt through hardware.



AEGIS® INSTALLATION – EXTERNAL

AEGIS® Shaft Grounding Rings may be installed on the outside of the motor but care must be taken to protect the ring from excessive ingress of dirt and dust.

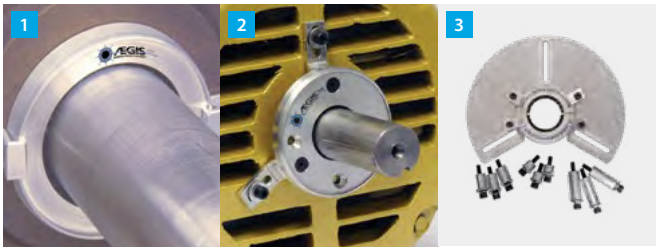
Follow AEGIS® best practices for motor shaft preparation and ring installation. Use AEGIS® Colloidal Silver Shaft Coating when installing AEGIS® rings to enhance the shaft conductivity and help prevent oxidation.

An O-ring or V-slinger may be installed against the AEGIS® Ring to help prevent excessive ingress of dirt, dust or liquid.

Standard bracket or uKIT bracket Installation:

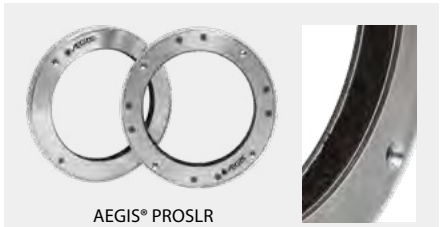
1. Standard Brackets (3 or 4 depending on ring size)
2. uKIT includes various bracket options
3. Custom brackets available

For the full AEGIS® product line, see the **parts list** at the end of this Handbook, or visit **catalog.est-aegis.com**.



Large Severe Duty AC and DC Motors: These motors are operated in severe environmental conditions where there is debris, powder, dirt, liquids, lubricants or other contaminants which can collect around the shaft of the motor. For these applications the AEGIS® PROSLR incorporates a rubber dust and debris barrier to prevent ingress of these materials. See page **43**.

Note: Major seal manufacturers such as Flowserve and Garlock provide bearing isolators with AEGIS® Rings installed inside.


AEGIS® PROSLR

Bolt-through installation into:

- End Bracket
- Custom Bracket

Drill/tap holes per AEGIS® Ring drawing location

- Flat head cap screws
- Socket head cap screws/lock washer

Do not use non-conductive thread-lock

CAUTION: Be careful not to drill into the grease passage. This can cause debris contamination on regreasing, leading to premature bearing failure.



Epoxy Mounting – External

Motor end bracket must be clean & free of any coatings, paint, or other nonconductive material where AEGIS® SGR will be mounted using conductive epoxy. This is the discharge path to ground therefore metal to metal contact is essential.

Curing can be achieved in 4 hours at or above 24°C. For faster curing times and maximum adhesion, heat the bond to between 66°-121° C for 10 minutes and allow to cool.

Pot-life is approximately 10 minutes at 24° C.

AEGIS® Conductive Epoxy was specially developed and tested to stringent vibration and pull test requirements to ensure a strong and reliable long term adhesive bond.

Do not use a substitute epoxy as only the AEGIS® EP2400 has been tested and approved for AEGIS® ring installation.



SHAFT PREPARATION FOR INTERNAL AND EXTERNAL INSTALLATION

AEGIS® Rings should not operate over a keyway or balancing hole because the edges are very sharp. For proper performance:

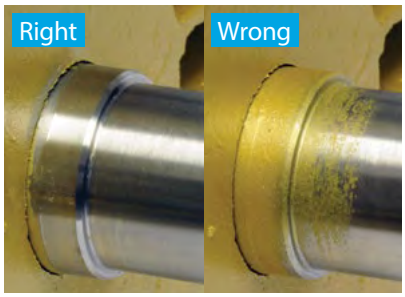
Adjust or change spacer and screw lengths to avoid the keyway or balancing hole (preferred); or

Fill the keyway (in the area where the AEGIS® microfibers will be in contact with the shaft) with a fast-curing epoxy putty such as Devcon® Plastic Steel® 5 Minute® Putty(SF). Slightly overfill the keyway and then buff it down to round with emery tape, making sure to eliminate the sharp edge.



Required: Motor shaft must be conductive

Shaft must be clean and free of any coatings, paint, or other nonconductive material (clean to bare metal). Depending on the condition of the shaft, this may require using emergy cloth or Scotch-Brite™. Small defects filled as above are acceptable. If the shaft is visibly clean, a non petroleum based solvent may be used to remove any residue. If possible, check the conductivity of the shaft using a multimeter or ohmmeter.



Recommended: Conductive shaft surface test

Place the positive and negative meter leads on the shaft at a place where the microfibers will contact the shaft. Each motor will have a different reading but in general you should have a maximum reading of less than 2 ohms. If the reading is higher, clean the shaft again and retest.



Recommended: Colloidal silver shaft coating

Colloidal Silver Shaft Coating (CS015) is recommended for all applications (we don't recommend any substitutions). The silver enhances the conductivity of the shaft and also lessens the amount of corrosion that can impede the grounding path.

1. Treating the shaft of the motor prior to installing the AEGIS® Ring:
2. Shaft must be clean and free of any coatings, paint, or other nonconductive material. The shaft must be clean to bare metal.
3. If possible, gently warm the shaft where the AEGIS® CS015 will be applied. This helps the CS015 cure faster. Allow CS015 to come to room temperature prior to opening.
4. Apply a thin, uniform coat of the AEGIS® Colloidal Silver Shaft Coating to the area where the AEGIS® microfibers will be in contact with the motor shaft. Apply all around the shaft. Wait for the first coat to dry to a tack free surface. Drying can be accelerated with the use of gentle heat from a heat gun, but don't exceed 93°C while curing.
5. Apply a 2nd thin, uniform coat of CS015.
6. Allow CS015 to dry to a tack free surface before installing the AEGIS® Ring.
7. Allow the CS015 to cure completely before running the motor. The coating will cure at room temperature in 16-20 hours or in about 60 minutes at 93°C.

⚠ Follow all safety precautions. SDS available for download at **est-aegis.com/sds**







Colloidal Silver Shaft Coating PN# CS015

SHAFT PREPARATION – CONTINUED

Centering the AEGIS® ring

Install the AEGIS® SGR so that the aluminum frame maintains an even clearance around the shaft. AEGIS® conductive microfibers must be in contact with conductive metal surface of the shaft.

STOP Do not use thread lock to secure the mounting screws as it may compromise the conductive path to ground.



Ring-motor electrical continuity test

After installation, test for electrical continuity using a multimeter or ohmmeter. Place one probe on metal frame of AEGIS® SGR and one probe on motor frame.

Motor must be grounded to common earth ground with drive according to applicable standards.



Optional: Debris protection

Where the AEGIS® Ring is exposed to excessive debris, protection of the AEGIS® fibers may be necessary.

Install a rubber shroud against the ring.



For medium voltage and higher power motors in severe duty environments, the AEGIS® PRO SLR incorporates two specially customized rubber shrouds to shield the fibers from excessive dirt and grease.

For custom applications, contact AEGIS® Customer Service/Engineering for assistance.



SHAFT VOLTAGE TESTING – MEASURING SHAFT VOLTAGE



Shaft Voltage Test Report

Measuring the shaft voltage on VFD driven motors provides the user with valuable information to determine if there is a risk of bearing damage from electrical discharge. Surveying and documenting shaft voltage levels and waveforms will help determine the appropriate mitigation method.

Note: The best time for shaft voltage measurements is during initial start-up in new or repaired motors operated by the VFD. Shaft voltage measurements should be incorporated into preventive and predictive maintenance programs and may be combined with vibration analysis, thermography, or other services.

Report template available at: **est-aegis.com/reports**

Recommended Testing Equipment:

AEGIS® Shaft Voltage Tester™ 100 MHz Digital Oscilloscope with a 10:1 Shaft Voltage Probe™ kit. We recommend a minimum 100MHz bandwidth to accurately measure the high frequency transitions associated with bearing discharge and VFD waveforms.

Recommended Product: PN: AEGIS-OSC-9200MB-W2

- Two 1X/10X probes, one with Shaft Voltage Probe™ SVP Tip attached
- 1000V CAT III multimeter test leads
- AEGIS® One-Touch™ instant image capture feature
- USB flash drive for waveform recording
- 5 hour+ rechargeable Li-ion battery
- Carrying case



AEGIS-OSC-9200MB-W2

AEGIS® SVP Shaft Voltage Probe™

The AEGIS® SVP Shaft Voltage Probe™ tip attaches to an oscilloscope voltage probe to easily and accurately measure the voltage on a rotating shaft. The high density of conductive microfibers ensures continuous contact with the rotating shaft. The SVP-KIT-9100MB includes replacement tips, extender rods, a magnetic base/probe holder, and AEGIS® Ring simulator.

Caution: Use appropriate safety procedures near rotating equipment.



PN: SVP-KIT-9100MB

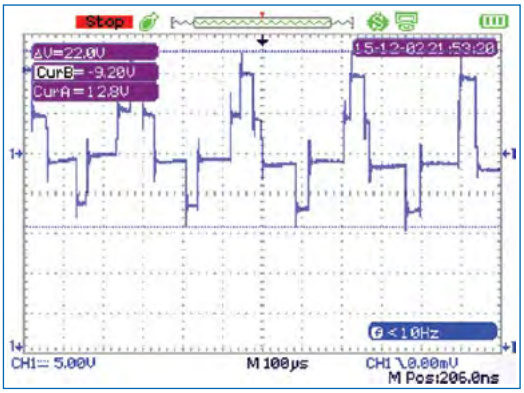


EXAMPLES OF SHAFT VOLTAGE READINGS

High Peak to Peak common mode voltage

Typically 20 to 120 volts peak to peak (10 to 60 volts peak). The waveform at right shows the capacitive coupled common mode voltage on the shaft of the motor. The "six-step" wave form is the result of the 3 phases of pulses from the VFD. The timing of the pulse width modulation (PWM) pulses to the motor from the drive determines what the waveform looks like. Sometimes it will look like a square wave.

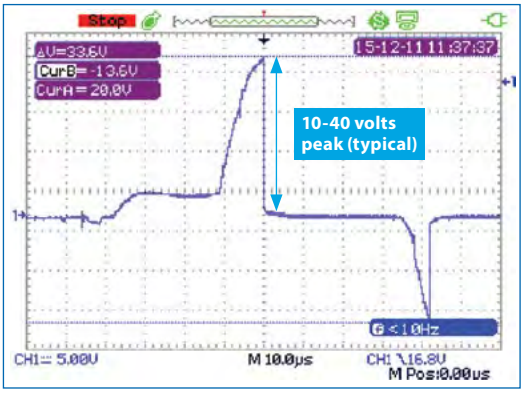
This six-step or square wave is what is seen when there is no bearing discharge and the peak to peak shaft voltage is at its maximum level. The voltage may eventually overcome the dielectric in non-isolated bearings and begin discharging.



High amplitude EDM discharge pattern

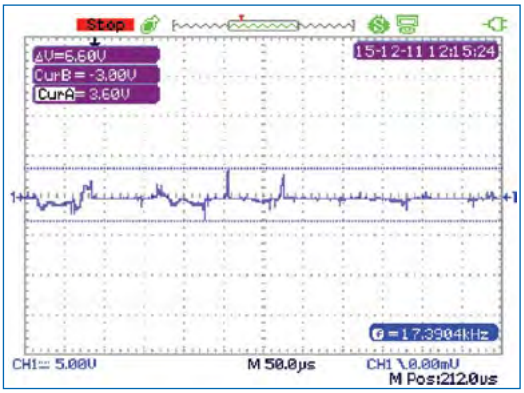
Typically EDM discharges can occur from 20 to 80 volts peak to peak (10 to 40 volts peak) depending on the motor, the type of bearing, the age of the bearing, and other factors. The waveform at right shows an increase in voltage on the shaft and then a sharp vertical line indicating a voltage discharge. This can occur thousands of times in a second, based on the carrier frequency of the drive. The sharp vertical discharge at the trailing edge of the voltage is an ultra high frequency dv/dt with a typical "discharge frequency" of 1 to 125 MHz (based on testing results in many applications).

Reference: NEMA MG1 Section 31.4.4.3



Low amplitude voltage discharge pattern

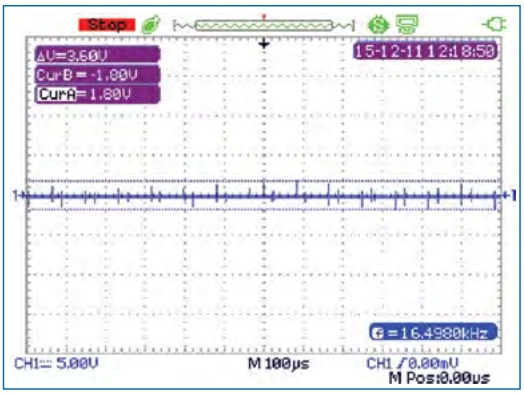
Typically the shaft voltage is 4 to 15V peak to peak (2 to 8 volts peak). The waveform shows a more continuous discharge pattern with lower dv/dt frequencies. This condition is usually found in motors that have been in operation for months or years. As discharge occurs in the bearings, the lubrication is contaminated with carbon and metal particles. This lowers the impedance of the grease. The lower shaft voltage in this condition may be due to greater current flow in the bearings, or could be a function of the drive, speed, loading, and other factors.



Peak to Peak voltage with AEGIS® ring installed

With an AEGIS® ring installed, a bare steel shaft will typically show shaft voltage of 2 to 10 volts peak to peak (1 to 5 volts peak) depending on the power of the motor, ground noise, the conductivity of the shaft, and other factors. The voltage may be decreased further with the application of AEGIS® Colloidal Silver Shaft Coating to increase the shaft surface conductivity.

The waveform at right shows low peak to peak shaft voltage of a motor with an AEGIS® ring installed and discharging shaft voltage normally.



AEGIS® SVP TIP INSTALLATION

AEGIS® Meter Probe PP510 Note: The AEGIS® meter comes with one SVP probe tip already installed)

1. The probe has an insulated sleeve over the tip. Do not remove this cover.



2. Set the probe to 10X.



3. Secure the probe tip using the thumb screw. Be careful not to overtighten.



4. Connect the probe to Channel 1 (CH 1).



DEFAULT SETTINGS FOR SHAFT VOLTAGE TESTING

1. Press **DEFAULT**
2. Press **DEFAULT** again to confirm

Default parameters include:

- DC Coupling
- 10:1 (10X) in both channels
- 5V/div voltage scale
- 50us/div time scale

For the full list of factory settings, see the user manual included on the flash drive

USING THE DIAL

When using the menu buttons (CH1, Cursors, Measure, etc.) you choose and select options using the scope's dial. Move between options by turning the dial, and make your selection by pressing the button in the middle of the dial.

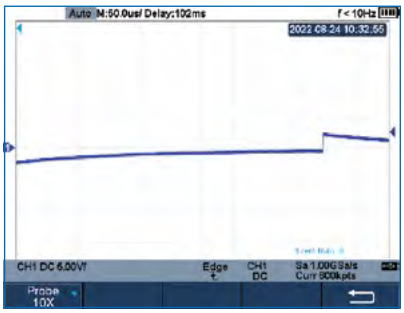


10:1 ATTENUATION

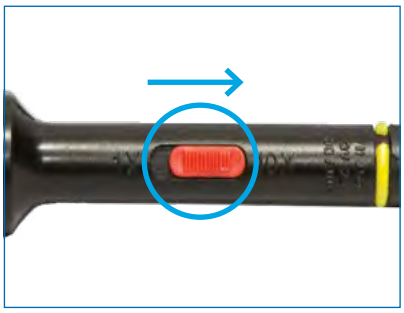
The Default settings include 10:1 attenuation on Channel I. If you somehow lose those settings and need to set them manually:



Press **CH1** to bring up the **CH1** menu on Page 1/3. (If a different page pops up, press **F5** to cycle back to Page 1/3). Press **F4 Probe**



Press **F1** and use the dial to choose 10X. Then press **F5** to go back. Press **Menu** to collapse the **CH1** menu.



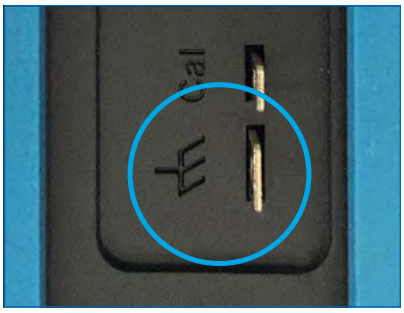
Make sure the probe is also set to 10X

TUNING THE PROBE (COMPENSATION)

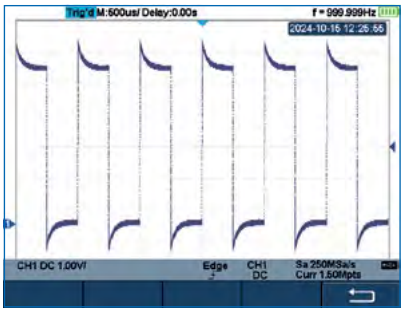
Now the scope is set up to fine-tune the probe. The AEGIS-OSC-9200 includes two prongs (under the right-side flap) that generate a square wave to help you fine-tune the probe's compensation for maximum accuracy. This calibration must be done the first time a new probe is used, and should be checked periodically to ensure accurate waveform measurements.



Clamp the probe ground lead to the lower prong (labelled) and touch the SVP Tip to the upper prong ("Cal").



NOTE: Lower prong is labelled with this icon:

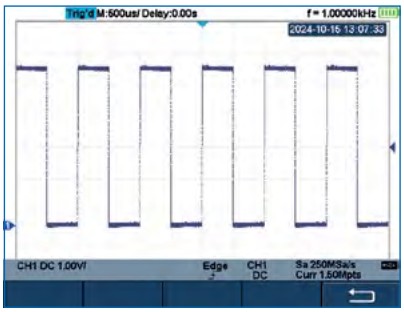


1. Press **Auto Setup**. The scope will display a train of approximately square waves of amplitude about 6V and frequency 1 kHz.



2. The probe has a calibration screw that is either near the probe tip or the BNC connector. The envelope the probe came in includes a small plastic screwdriver to adjust the calibration screw. Adjust the screw until the waves are shown with straight edges. The probe is now ready to use.

3. Pressing **Auto Setup** changed the scope's voltage and time scales from the Default values. Press Default twice more to restore them.

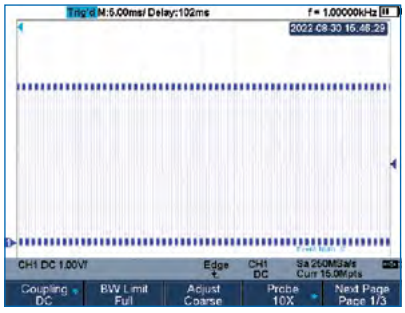


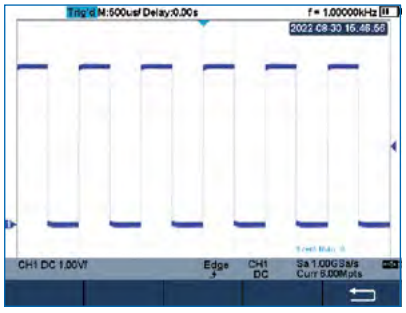
MENUS & THE MENU BUTTON

Here is the **CH1** menu. On this and all menus, you select an item by pushing the F key **(F1-F5)** beneath it. Pressing **MENU** hides the current menu, and pressing **MENU** again opens it back up. Generally, the **MENU** button opens (or closes) the last menu viewed.

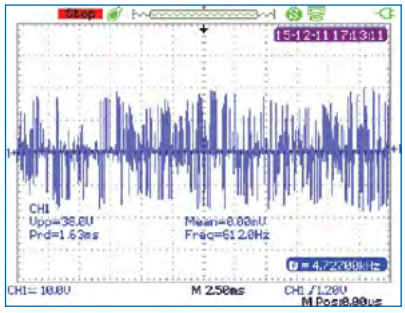


AUTO BUTTON





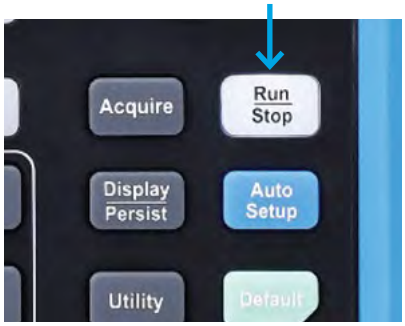
When viewing a waveform, pressing **AUTO** resizes the voltage and time scales to fit the waveform...



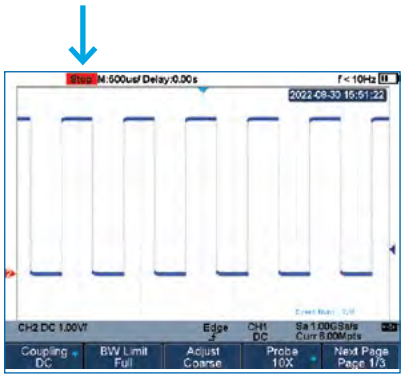
Caution: Shaft voltages are highly random so using **AUTO** mode may give too large a timescale. This can be adjusted. See Setting Time Period below.

Note: Noise from the VFD may also cause CH2 to be displayed – even if no probe is plugged into the CH2 BNC. If this occurs, press **CH2** until the red trace disappears, and find V_{pp} using **Measure** or **Cursors**.

RUN/STOP BUTTON



While making measurements, **RUN/STOP** freezes the screen. When stopped, the word STOP will appear in the upper left of the screen.



This enables you to analyze the waveform more easily and save if desired.



Pressing **RUN/STOP** again resumes measurement. The message in the upper left will change to "Trig'd" or "Auto".

SETTING VOLTAGE SCALE (V/div)



An EDM discharge pattern will show a climb in voltage and then a sharp vertical line. The sharp vertical line shows the moment of discharge to ground. To get a good image of a discharge, you may need to adjust the display scale.

Control the vertical scale of the displayed signal by adjusting the volts per division. The entire signal, from peak to peak, should all be displayed on the screen. 5V is a good place to start, and then adjust up or down based on the conditions. The setting selected in volts per division is shown in the lower left of the screen.

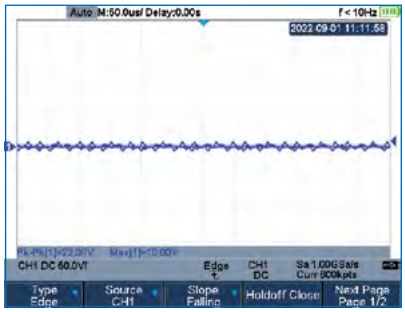
Press "V" to increase vertical scale (shorter waveforms)

Press "mV" to decrease vertical scale (taller waveforms)





Amplitude will need to be adjusted according to the conditions. Set V/div to show complete wave from top peak to bottom peak.



In this example the vertical scale is too large. Press **mV** to shrink the scale and show more detail.



In this example the vertical scale is too small. Press **V** to enlarge the scale and show the whole waveform.

SETTING HORIZONTAL SCALE (s/div)



Control the horizontal scale of the displayed signal by adjusting the time scale. 500µs (microseconds) is a good place to start and then adjust the time based on the conditions. The selected seconds per division setting is shown at the bottom center of the screen. The EDM waveforms are best displayed at a setting of 50us/ div or less. Adjust the time setting to show the desired waveform.

Press "s" to increase horizontal scale (narrower waveforms)

Press "ns" to decrease horizontal scale (wider waveforms)





The image at left has a timescale of 20 µs/div. It clearly shows a rise in voltage and an abrupt, sharp discharge (third peak).

ADJUSTING WAVEFORM POSITION

Some waveforms may display too high or low on the screen. This often happens when using the **Measure** function.



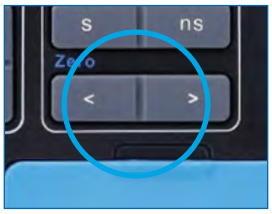
The waveform's onscreen position can be adjusted by offsetting the voltage.



The up arrow moves the waveform higher onscreen and the down arrow moves it lower. The current offset level is indicated by the blue 1 and arrow at the extreme left of the screen.



The time can also be offset. The arrows under the s/ns buttons similarly move waveforms left and right.

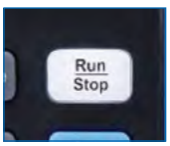


SCREEN CAPTURE: SAVING IMAGES TO FLASH DRIVE

Plug in a USB flash drive. A message will pop up: "USB flash drive detected."

1. Push Print. This automatically captures the screen and saves it to the flash drive. You can view the images on any computer with a USB port when you're finished making images.

Screen capture may be done either while actively collecting data or while collection is paused:



1. Press **RUN/STOP** to pause the screen. Voltage & time scales can be changed while screen is paused.
2. Pressing **RUN/STOP** will resume data collection



PEAK TO PEAK VOLTAGE (V_{PP}) WITH MEASURE

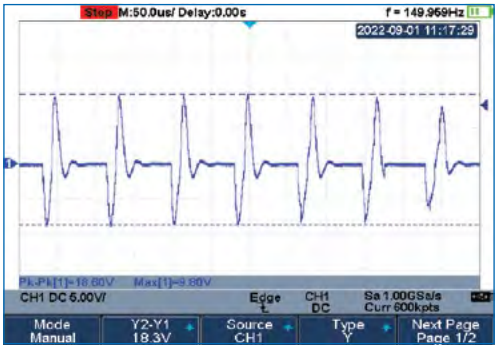
The AEGIS-OSC-9200 offers two main methods to measure peak to peak voltage (Vpp): **Measure**, and **Cursor**.

Press **Measure** and make sure Source = CH1.

Press **F2** for Type. This brings up a list of all available properties to Measure (Peak-Peak is first). You can select up to four measurements with the dial. You can also choose to display statistics onscreen.



Press **F2** again to collapse the Type menu. The measurements you selected are displayed at the bottom of the screen, along with statistics for each (if selected).



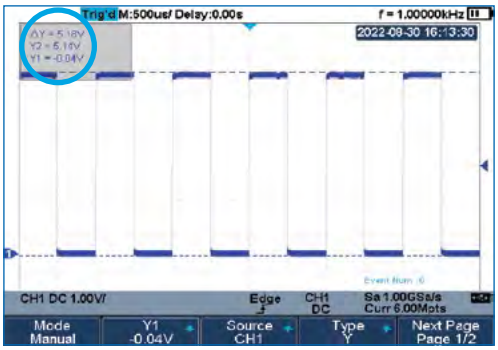
PEAK TO PEAK VOLTAGE WITH CURSORS

Press Cursors and make sure Type is Y or XY. If not, press **F4** and use the dial to change it to Y.

Press **F1** for Mode and then select Manual.

The selected cursor (Y1/Y2) is listed over **F2**. Move it up or down using the dial, and then press **F2** and switch to the other cursor, and position it.

The difference between the cursors is displayed at top left. DY = Y2 – Y1, so position the Y2 cursor at the top of the waveform, and Y1 at the bottom.

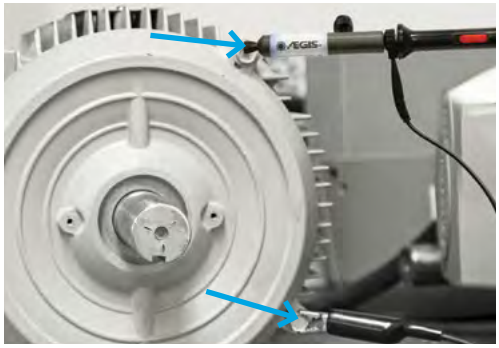


TAKING THE MEASUREMENTS – EMI

Ground Reference Reading: EMI

Before measuring the shaft voltage, take an EMI reading of electrical noise on the motor frame as a baseline. This noise may remain after installing the AEGIS® Ring. This reading will show ground noise or EMI being produced by the motor/drive system, or other systems in the area.

1. Find 2 ground points on the motor. Must be bare metal and conductive.
2. Place the SVP on one of the points and the probe grounding clip on the other point.
3. Measurements will vary depending on the motor size and conditions.



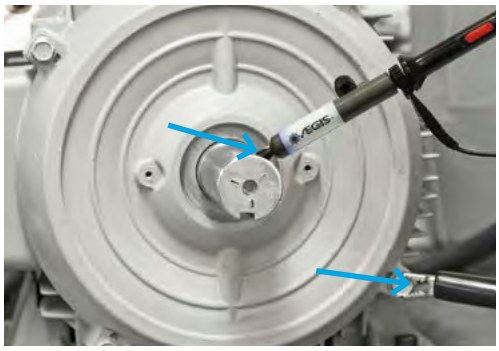


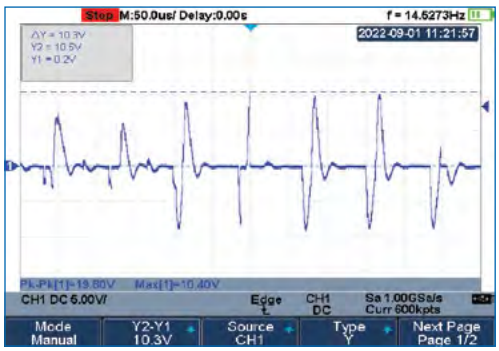
TAKING THE MEASUREMENTS – SHAFT VOLTAGE

Shaft Voltage Reading

1. Shaft must be clean & free of any coatings, paint, or other nonconductive material.
2. Secure the probe in place with magnetic base.
3. Align AEGIS® SVP on shaft end or side ensuring continuous contact. Avoid keyway if possible.
4. Place oscilloscope ground lead on bare metal of motor ensuring conductive path to ground.
5. If this test is to be used in a report, save an image to a USB drive.

⚠ Follow all safety precautions when working with rotating equipment.

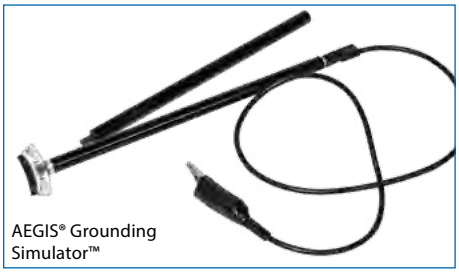




MEASUREMENTS USING THE AEGIS® GROUNDING SIMULATOR™

The AEGIS® Grounding Simulator™ can be used to simulate how the shaft voltage will change after an AEGIS® Ring is installed. It is a quick way of showing a "Before & After". Since only a small number of conductive microfibers are touching the shaft the shaft voltage may be higher than when the circumferential AEGIS® Ring is installed.

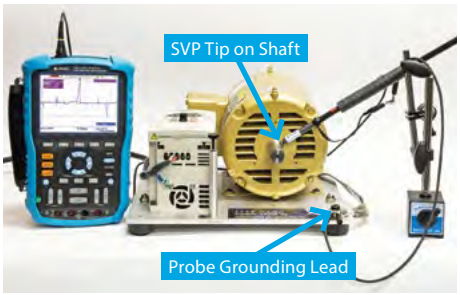
1. Take a shaft voltage reading without shaft grounding.
2. Take a shaft voltage reading with the AEGIS® Grounding Simulator.



AEGIS® Grounding Simulator™

First Take the Shaft Voltage Reading without Shaft Grounding

1. Shaft must be clean & free of any coatings, paint, or other nonconductive material.
2. Secure the probe in place with magnetic base.
3. Align AEGIS® SVP™ on shaft end or side ensuring continuous contact. Avoid keyway if possible.
4. Place probe grounding lead on bare metal of motor ensuring conductive path to ground.
5. Freeze the screen and save the image.



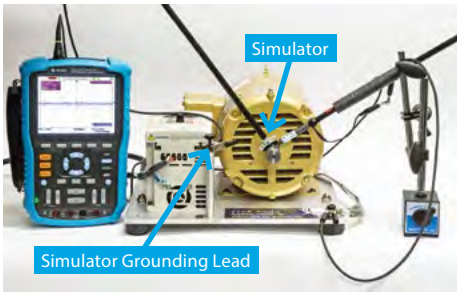
The voltage measurement of 28.6V peak to peak is an example of the shaft voltage discharging through the bearings without AEGIS® shaft grounding.



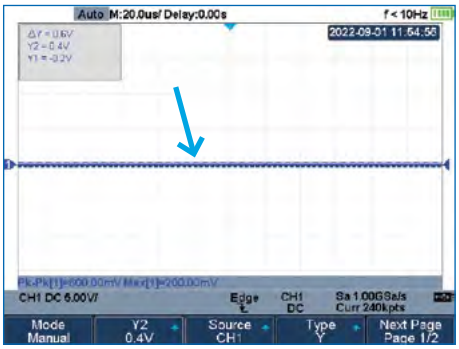
⚠ Follow all safety precaution when working with rotating equipment.

Next Take the Shaft Voltage Reading with the Grounding Simulator™ Touching the Shaft

1. Maintain the same setup as above.
2. Place the AEGIS® Grounding Simulator™ grounding lead on bare metal of motor ensuring conductive path to ground.
3. Place the Simulator against the shaft to simulate the AEGIS® SGR Shaft Grounding Ring.
4. Freeze the screen and save the image.



The voltage measurement of 2.2V peak to peak is an example of the shaft voltage discharging through the AEGIS® Grounding Simulator to ground. To achieve long term shaft grounding with equal or better performance, install an AEGIS® Shaft Grounding Ring.



⚠ Follow all safety precautions when working with rotating equipment.

TESTING & INSPECTION



Cutting and inspecting every bearing in motors that come in for repair, especially motors operated on variable frequency drives, will often provide vital information to make the best repair recommendation and thus improve the machine's overall lifetime performance.

Report template available at: est-aegis.com/reports

1. **Inspect the outside and the inside of both bearings** and retain a sample of the lubricant for analysis. Look for:
   a. Contamination
   b. Signs of excessive heat
   c. Hardening of grease
   d. Abnormal coloration (blackened grease)
   e. Excess grease and oil escaping the bearing



2. **Cut the outer race into halves.** Remove seals or shields prior to cutting.

⚠ Follow established safety precautions and use personal protective equipment including eye protection, hearing protection, face shield, gloves, and protective clothing.



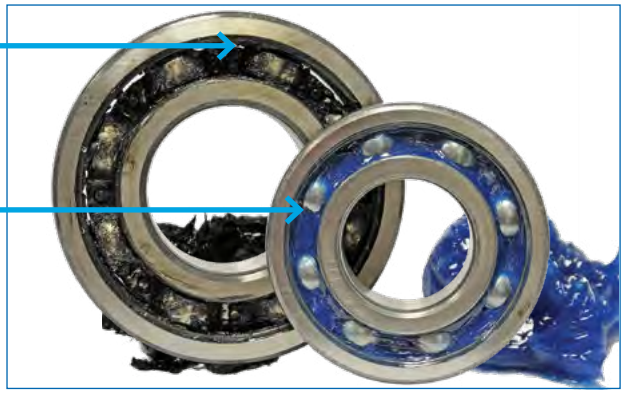
3. **Inspect the grease** and any contamination in the bearing.
   a. **Burnt Grease:** Continuous electrical arcing in the motor bearings will often rapidly deteriorate the lubricating capability of the grease and cause bearing race damage. When an arc occurs, the oil component of the grease is heated beyond its temperature capacity.
   b. **Contamination:** In addition to the burnt grease, the arcing causes small metal particles to detach from the bearing races/balls, which then get distributed throughout the grease. These particles are abrasive and will cause the bearing to prematurely wear.



Bearing Inspection

Burnt bearing grease is blackened and oftentimes contaminated with metal particles.

New bearing grease is available in many colors. Blue grease (as shown) is Polyrex EM. It is commonly found in electric motor bearings.



4. **Clean the bearing's** components using a degreaser or solvent.

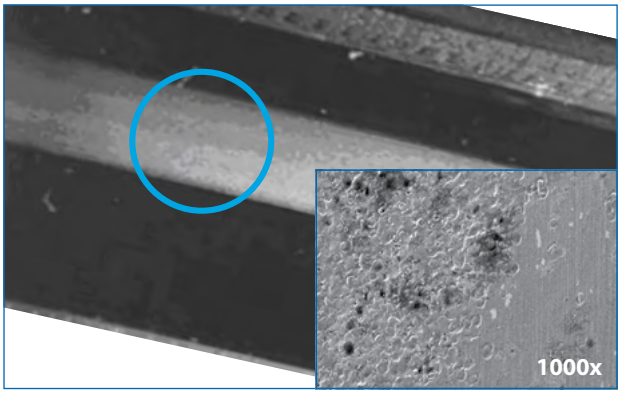
   ⚠ Follow all safety precautions.

5. **Inspect for evidence of Electrical Discharge Machining (EDM):** EDM damage is millions of microscopic electrical pits that are created when current arcs through the motor's bearings. The shaft voltage overcomes the dielectric of the bearing lubrication and arcs through the inner race, through the rolling elements and to the outer race. The individual pits are usually between 5 and 10 microns in diameter.



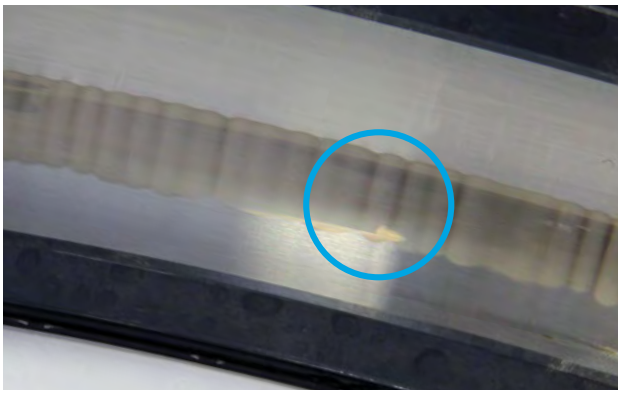
6. **Frosting:** This will appear to be a grey discolored line around all or part of the bearing race and may be evident in both the inner and outer race. The discoloration may be caused by mechanical wear or by EDM. Examination under a microscope may be required to determine if the line is EDM or of mechanical origin. If the motor was operated on a VFD with no bearing protection there is a high likelihood that the frosting is from EDM.

7. **Fluting Damage:** Identified by a distinctive washboard pattern. Fluting can be identified with the naked eye or with 10x magnification. Fluting is sometimes confused with mechanical bearing damage such as brinelling/false brinelling, so care should be taken to correctly assign electrical fluting damage to the pattern observed.



In addition to using this manual, please refer to other bearing failure analysis experts in order to determine the root cause of failure.

Install new AEGIS® Ring whenever bearings are replaced on an inverter-driven motor.

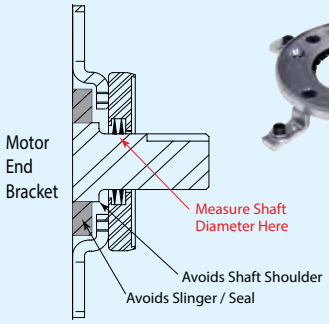


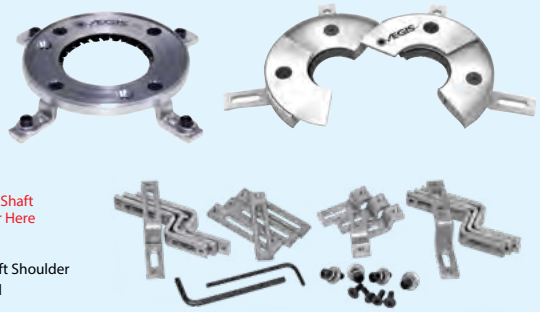
For standard NEMA or IEC frame motors, the AEGIS® uKIT is the best option. It avoids most shaft shoulders and slingers/seals.

Question to ask:
Does the motor have a shaft shoulder?

The AEGIS® uKIT includes 4 different bracket sizes to suit most situations.

If YES or NOT SURE, then the AEGIS® uKIT is the easiest option because it avoids the shaft shoulder area, any slingers/seals or irregular shaped end bracket.



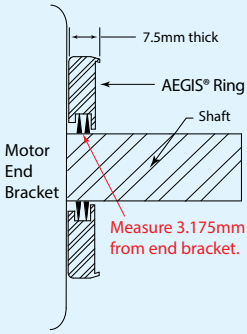


The AEGIS® uKIT is attached to the motor with screws/washers provided or with conductive epoxy. AEGIS® EP2400 Conductive Epoxy sold separately.

See the **AEGIS® online catalog** for bolt hole circle and installation instructions.

See page **44** for more details.

If NO, the ring can be mounted directly to the end bracket using screws or conductive epoxy.



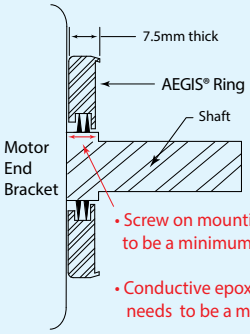
Measure the shaft diameter at a point 3.2mm from motor end bracket. Then refer to the parts list to locate the correct part number and mounting option of your choosing.



Example shaft measurement 11.30mm fits between

Solid Ring Catalog Number	Split Ring Catalog Number	Bolt Through Catalog Number	Solid Ring with Conductive Epoxy	Split Ring with Conductive Epoxy	Min. Shaft Diameter (mm)	Max. Shaft Diameter (mm)
SGR-9.0-2	SGR-9.0-2A4	SGR-9.0-3FH	SGR-9.0-0AW	SGR-9.0-0A4W	10.06	11.05
SGR-10.1-2	SGR-10.1-2A4	SGR-10.1-3FH	SGR-10.1-0AW	SGR-10.1-0A4W	11.07	12.20
SGR-11.2-2	SGR-11.2-2A4	SGR-11.2-3FH	SGR-11.2-0AW	SGR-11.2-0A4W	12.03	13.21

If YES and you want to mount the ring to fit the shaft shoulder then you need to measure the length of the shoulder. See note in red below. If still applicable, measure shaft shoulder diameter then refer to parts list (as shown above) to locate the correct SGR part number.



- Screw on mounting - shaft length needs to be a minimum of 9.5mm.
- Conductive epoxy mounting - shaft length needs to be a mimimum of 10.03mm.

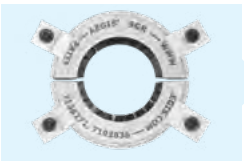
If the shaft shoulder is less than 9.5mm, please refer to the appropriate uKIT based on frame size. If there is no standard uKIT available for the motor's frame size, please contact Customer Service at **+1-866-738-1857** or **sales@est-aegis.com**

AEGIS® PARTS LIST



Page 41-42

Standard Mounting Clamps (-2)
Shaft diameters: 7.9 to 152.9mm
3 to 4 mounting clamps, M3 x 0.5 x 8mm cap screws and washers
Quick and easy installation to most surfaces



Page 41-42

Split Ring (-2A4)
Shaft diameter: 7.9 to 152.9mm
4 to 6 mounting clamps, M3 x 0.5 x 8mm cap screws and washers
Installs without decoupling motor



Page 41-42

Bolt Through Mounting (-3FH)
Shaft diameters: 7.9 to 152.9mm
M3 x 12mm flat head screws
2 mounting holes up to shaft size 86.2mm
4 mounting holes for larger sizes



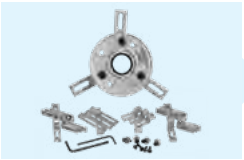
Page 41-42

Conductive Epoxy Mounting (-0AW, -0A4W)
Shaft diameters: 7.9 to 152.9mm
Solid and Split Ring
Quick and easy installation to metal motor frame
Conductive Epoxy Included



Page 43

Press Fit Mounting (-0A6)
Shaft diameters: 7.9 to 152.9mm
Clean dry press fit
Custom sizes available



Page 44

uKIT – SGR with Universal Mounting Bracket
Sized for NEMA and IEC Frame motors
Solid and Split Ring
Can be mounted with hardware or conductive epoxy



Page 45-46

AEGIS® PRO Series
6 rows of conductive microfiber
AEGIS® PRO Series



Page 47

AEGIS® Shaft Voltage Tester™
AEGIS® Shaft Voltage Tester™
SVP – AEGIS® Shaft Voltage Probe



Page 48

Accessories
HFGS – High-Frequency Ground Strap
CS015 – AEGIS® Colloidal Silver Shaft Coating
EP2400 – AEGIS® Conductive Epoxy

Solid Ring, Split Ring, and Bolt Through Mounting for Low Voltage Motors to 375kW

Solid Ring Catalog Number	Split Ring Catalog Number	Bolt Through Catalog Number	Solid Ring with Conductive Epoxy	Split Ring* with Conductive Epoxy	Min. Shaft Diameter (mm)	Max. Shaft Diameter (mm)	Outside Diameter (mm)	Thickness Max (mm)
SGR-6.9-2	SGR-6.9-2A4	SGR-6.9-3MFH	SGR-6.9-0AW	SGR-6.9-0A4W	7.9	9	40.6	7.5
SGR-8.0-2	SGR-8.0-2A4	SGR-8.0-3MFH	SGR-8.0-0AW	SGR-8.0-0A4W	9.1	10	40.6	7.5
SGR-9.0-2	SGR-9.0-2A4	SGR-9.0-3MFH	SGR-9.0-0AW	SGR-9.0-0A4W	10.1	11	40.6	7.5
SGR-10.1-2	SGR-10.1-2A4	SGR-10.1-3MFH	SGR-10.1-0AW	SGR-10.1-0A4W	11.1	12.2	40.6	7.5
SGR-11.2-2	SGR-11.2-2A4	SGR-11.2-3MFH	SGR-11.2-0AW	SGR-11.2-0A4W	12.3	13.2	40.6	7.5
SGR-12.2-2	SGR-12.2-2A4	SGR-12.2-3MFH	SGR-12.2-0AW	SGR-12.2-0A4W	13.3	14.2	40.6	7.5
SGR-13.2-2	SGR-13.2-2A4	SGR-13.2-3MFH	SGR-13.2-0AW	SGR-13.2-0A4W	14.3	15.4	40.6	7.5
SGR-14.4-2	SGR-14.4-2A4	SGR-14.4-3MFH	SGR-14.4-0AW	SGR-14.4-0A4W	15.5	16.4	40.6	7.5
SGR-15.4-2	SGR-15.4-2A4	SGR-15.4-3MFH	SGR-15.4-0AW	SGR-15.4-0A4W	16.5	17.4	53.3	7.5
SGR-16.4-2	SGR-16.4-2A4	SGR-16.4-3MFH	SGR-16.4-0AW	SGR-16.4-0A4W	17.5	18.5	53.3	7.5
SGR-17.6-2	SGR-17.6-2A4	SGR-17.6-3MFH	SGR-17.6-0AW	SGR-17.6-0A4W	18.6	19.7	53.3	7.5
SGR-18.7-2	SGR-18.7-2A4	SGR-18.7-3MFH	SGR-18.7-0AW	SGR-18.7-0A4W	19.8	20.7	53.3	7.5
SGR-19.7-2	SGR-19.7-2A4	SGR-19.7-3MFH	SGR-19.7-0AW	SGR-19.7-0A4W	20.8	21.7	53.3	7.5
SGR-20.7-2	SGR-20.7-2A4	SGR-20.7-3MFH	SGR-20.7-0AW	SGR-20.7-0A4W	21.8	22.7	53.3	7.5
SGR-21.7-2	SGR-21.7-2A4	SGR-21.7-3MFH	SGR-21.7-0AW	SGR-21.7-0A4W	22.8	23.7	53.3	7.5
SGR-22.8-2	SGR-22.8-2A4	SGR-22.8-3MFH	SGR-22.8-0AW	SGR-22.8-0A4W	23.8	24.9	53.3	7.5
SGR-23.9-2	SGR-23.9-2A4	SGR-23.9-3MFH	SGR-23.9-0AW	SGR-23.9-0A4W	25	25.9	53.3	7.5
SGR-24.9-2	SGR-24.9-2A4	SGR-24.9-3MFH	SGR-24.9-0AW	SGR-24.9-0A4W	26	26.9	53.3	7.5
SGR-25.9-2	SGR-25.9-2A4	SGR-25.9-3MFH	SGR-25.9-0AW	SGR-25.9-0A4W	27	28.1	53.3	7.5
SGR-27.1-2	SGR-27.1-2A4	SGR-27.1-3MFH	SGR-27.1-0AW	SGR-27.1-0A4W	28.2	29.1	53.3	7.5
SGR-28.1-2	SGR-28.1-2A4	SGR-28.1-3MFH	SGR-28.1-0AW	SGR-28.1-0A4W	29.2	30.1	53.3	7.5
SGR-29.1-2	SGR-29.1-2A4	SGR-29.1-3MFH	SGR-29.1-0AW	SGR-29.1-0A4W	30.2	31.2	53.3	7.5
SGR-30.3-2	SGR-30.3-2A4	SGR-30.3-3MFH	SGR-30.3-0AW	SGR-30.3-0A4W	31.3	32.3	53.3	7.5
SGR-31.3-2	SGR-31.3-2A4	SGR-31.3-3MFH	SGR-31.3-0AW	SGR-31.3-0A4W	32.4	33.3	53.3	7.5
SGR-32.3-2	SGR-32.3-2A4	SGR-32.3-3MFH	SGR-32.3-0AW	SGR-32.3-0A4W	33.4	34.4	53.3	7.5
SGR-33.4-2	SGR-33.4-2A4	SGR-33.4-3MFH	SGR-33.4-0AW	SGR-33.4-0A4W	34.5	35.4	53.3	7.5
SGR-34.4-2	SGR-34.4-2A4	SGR-34.4-3MFH	SGR-34.4-0AW	SGR-34.4-0A4W	35.5	36.4	68.1	7.5
SGR-35.5-2	SGR-35.5-2A4	SGR-35.5-3MFH	SGR-35.5-0AW	SGR-35.5-0A4W	36.5	37.6	68.1	7.5
SGR-36.6-2	SGR-36.6-2A4	SGR-36.6-3MFH	SGR-36.6-0AW	SGR-36.6-0A4W	37.7	38.6	68.1	7.5
SGR-37.6-2	SGR-37.6-2A4	SGR-37.6-3MFH	SGR-37.6-0AW	SGR-37.6-0A4W	38.7	39.6	68.1	7.5
SGR-38.6-2	SGR-38.6-2A4	SGR-38.6-3MFH	SGR-38.6-0AW	SGR-38.6-0A4W	39.7	40.8	68.1	7.5
SGR-39.8-2	SGR-39.8-2A4	SGR-39.8-3MFH	SGR-39.8-0AW	SGR-39.8-0A4W	40.9	41.8	68.1	7.5
SGR-40.8-2	SGR-40.8-2A4	SGR-40.8-3MFH	SGR-40.8-0AW	SGR-40.8-0A4W	41.9	42.8	68.1	7.5
SGR-41.8-2	SGR-41.8-2A4	SGR-41.8-3MFH	SGR-41.8-0AW	SGR-41.8-0A4W	42.9	43.9	68.1	7.5
SGR-43.0-2	SGR-43.0-2A4	SGR-43.0-3MFH	SGR-43.0-0AW	SGR-43.0-0A4W	44	45	68.1	7.5
SGR-44.0-2	SGR-44.0-2A4	SGR-44.0-3MFH	SGR-44.0-0AW	SGR-44.0-0A4W	45.1	46	68.1	7.5
SGR-45.0-2	SGR-45.0-2A4	SGR-45.0-3MFH	SGR-45.0-0AW	SGR-45.0-0A4W	46.1	47.1	68.1	7.5
SGR-46.1-2	SGR-46.1-2A4	SGR-46.1-3MFH	SGR-46.1-0AW	SGR-46.1-0A4W	47.2	48.1	68.1	7.5
SGR-47.1-2	SGR-47.1-2A4	SGR-47.1-3MFH	SGR-47.1-0AW	SGR-47.1-0A4W	48.2	49.1	68.1	7.5
SGR-48.2-2	SGR-48.2-2A4	SGR-48.2-3MFH	SGR-48.2-0AW	SGR-48.2-0A4W	49.2	50.3	68.1	7.5
SGR-49.3-2	SGR-49.3-2A4	SGR-49.3-3MFH	SGR-49.3-0AW	SGR-49.3-0A4W	50.4	51.3	68.1	7.5
SGR-50.3-2	SGR-50.3-2A4	SGR-50.3-3MFH	SGR-50.3-0AW	SGR-50.3-0A4W	51.4	52.3	78.7	7.5
SGR-51.3-2	SGR-51.3-2A4	SGR-51.3-3MFH	SGR-51.3-0AW	SGR-51.3-0A4W	52.4	53.5	78.7	7.5
SGR-52.5-2	SGR-52.5-2A4	SGR-52.5-3MFH	SGR-52.5-0AW	SGR-52.5-0A4W	53.6	54.5	78.7	7.5
SGR-53.5-2	SGR-53.5-2A4	SGR-53.5-3MFH	SGR-53.5-0AW	SGR-53.5-0A4W	54.6	55.5	78.7	7.5
SGR-54.5-2	SGR-54.5-2A4	SGR-54.5-3MFH	SGR-54.5-0AW	SGR-54.5-0A4W	55.6	56.6	78.7	7.5
SGR-55.7-2	SGR-55.7-2A4	SGR-55.7-3MFH	SGR-55.7-0AW	SGR-55.7-0A4W	56.7	57.7	78.7	7.5
SGR-56.7-2	SGR-56.7-2A4	SGR-56.7-3MFH	SGR-56.7-0AW	SGR-56.7-0A4W	57.8	58.7	78.7	7.5
SGR-57.7-2	SGR-57.7-2A4	SGR-57.7-3MFH	SGR-57.7-0AW	SGR-57.7-0A4W	58.8	59.8	78.7	7.5
SGR-58.8-2	SGR-58.8-2A4	SGR-58.8-3MFH	SGR-58.8-0AW	SGR-58.8-0A4W	59.9	60.8	78.7	7.5
SGR-59.8-2	SGR-59.8-2A4	SGR-59.8-3MFH	SGR-59.8-0AW	SGR-59.8-0A4W	60.9	61.8	91.4	7.5
SGR-60.9-2	SGR-60.9-2A4	SGR-60.9-3MFH	SGR-60.9-0AW	SGR-60.9-0A4W	61.9	63	91.4	7.5
SGR-62.0-2	SGR-62.0-2A4	SGR-62.0-3MFH	SGR-62.0-0AW	SGR-62.0-0A4W	63.1	64	91.4	7.5
SGR-63.0-2	SGR-63.0-2A4	SGR-63.0-3MFH	SGR-63.0-0AW	SGR-63.0-0A4W	64.1	65	91.4	7.5
SGR-64.0-2	SGR-64.0-2A4	SGR-64.0-3MFH	SGR-64.0-0AW	SGR-64.0-0A4W	65.1	66.2	91.4	7.5
SGR-65.2-2	SGR-65.2-2A4	SGR-65.2-3MFH	SGR-65.2-0AW	SGR-65.2-0A4W	66.3	67.2	91.4	7.5
SGR-66.2-2	SGR-66.2-2A4	SGR-66.2-3MFH	SGR-66.2-0AW	SGR-66.2-0A4W	67.3	68.2	91.4	7.5
SGR-67.2-2	SGR-67.2-2A4	SGR-67.2-3MFH	SGR-67.2-0AW	SGR-67.2-0A4W	68.3	69.3	91.4	7.5
SGR-68.4-2	SGR-68.4-2A4	SGR-68.4-3MFH	SGR-68.4-0AW	SGR-68.4-0A4W	69.4	70.4	91.4	7.5
SGR-69.4-2	SGR-69.4-2A4	SGR-69.4-3MFH	SGR-69.4-0AW	SGR-69.4-0A4W	70.5	71.4	91.4	7.5
SGR-70.4-2	SGR-70.4-2A4	SGR-70.4-3MFH	SGR-70.4-0AW	SGR-70.4-0A4W	71.5	72.5	91.4	7.5
SGR-71.5-2	SGR-71.5-2A4	SGR-71.5-3MFH	SGR-71.5-0AW	SGR-71.5-0A4W	72.6	73.5	91.4	7.5
SGR-72.5-2	SGR-72.5-2A4	SGR-72.5-3MFH	SGR-72.5-0AW	SGR-72.5-0A4W	73.6	74.5	104.1	7.5
SGR-73.6-2	SGR-73.6-2A4	SGR-73.6-3MFH	SGR-73.6-0AW	SGR-73.6-0A4W	74.6	75.7	104.1	7.5
SGR-74.7-2	SGR-74.7-2A4	SGR-74.7-3MFH	SGR-74.7-0AW	SGR-74.7-0A4W	75.8	76.7	104.1	7.5
SGR-75.7-2	SGR-75.7-2A4	SGR-75.7-3MFH	SGR-75.7-0AW	SGR-75.7-0A4W	76.8	77.7	104.1	7.5
SGR-76.7-2	SGR-76.7-2A4	SGR-76.7-3MFH	SGR-76.7-0AW	SGR-76.7-0A4W	77.8	78.9	104.1	7.5
SGR-77.9-2	SGR-77.9-2A4	SGR-77.9-3MFH	SGR-77.9-0AW	SGR-77.9-0A4W	79	79.9	104.1	7.5
SGR-78.9-2	SGR-78.9-2A4	SGR-78.9-3MFH	SGR-78.9-0AW	SGR-78.9-0A4W	80	80.9	104.1	7.5
Custom Part – No Return				Custom Part – No Return				

AEGIS® Parts List

Note: Use PRO Series Rings for Low Voltage Motors Greater than 375kW and All Medium Voltage Motors See page 45

Solid Ring Catalog Number	Split Ring Catalog Number	Bolt Through Catalog Number	Solid Ring with Conductive Epoxy	Split Ring* with Conductive Epoxy	Min. Shaft Diameter (mm)	Max. Shaft Diameter (mm)	Outside Diameter (mm)	Thickness Max (mm)
SGR-79.9-2	SGR-79.9-2A4	SGR-79.9-3MFH	SGR-79.9-0AW	SGR-79.9-0A4W	81	82	104.1	7.5
SGR-81.1-2	SGR-81.1-2A4	SGR-81.1-3MFH	SGR-81.1-0AW	SGR-81.1-0A4W	82.1	83.1	104.1	7.5
SGR-82.1-2	SGR-82.1-2A4	SGR-82.1-3MFH	SGR-82.1-0AW	SGR-82.1-0A4W	83.2	84.1	104.1	7.5
SGR-83.1-2	SGR-83.1-2A4	SGR-83.1-3MFH	SGR-83.1-0AW	SGR-83.1-0A4W	84.2	85.2	104.1	7.5
SGR-84.2-2	SGR-84.2-2A4	SGR-84.2-3MFH	SGR-84.2-0AW	SGR-84.2-0A4W	85.3	86.2	104.1	7.5
SGR-85.2-2	SGR-85.2-2A4	SGR-85.2-3MFH	SGR-85.2-0AW	SGR-85.2-0A4W	86.3	87.2	116.8	7.5
SGR-86.3-2	SGR-86.3-2A4	SGR-86.3-3MFH	SGR-86.3-0AW	SGR-86.3-0A4W	87.3	88.4	116.8	7.5
SGR-87.4-2	SGR-87.4-2A4	SGR-87.4-3MFH	SGR-87.4-0AW	SGR-87.4-0A4W	88.5	89.4	116.8	7.5
SGR-88.4-2	SGR-88.4-2A4	SGR-88.4-3MFH	SGR-88.4-0AW	SGR-88.4-0A4W	89.5	90.4	116.8	7.5
SGR-89.4-2	SGR-89.4-2A4	SGR-89.4-3MFH	SGR-89.4-0AW	SGR-89.4-0A4W	90.5	91.6	116.8	7.5
SGR-90.6-2	SGR-90.6-2A4	SGR-90.6-3MFH	SGR-90.6-0AW	SGR-90.6-0A4W	91.7	92.6	116.8	7.5
SGR-91.6-2	SGR-91.6-2A4	SGR-91.6-3MFH	SGR-91.6-0AW	SGR-91.6-0A4W	92.7	93.6	116.8	7.5
SGR-92.6-2	SGR-92.6-2A4	SGR-92.6-3MFH	SGR-92.6-0AW	SGR-92.6-0A4W	93.7	94.7	116.8	7.5
SGR-93.8-2	SGR-93.8-2A4	SGR-93.8-3MFH	SGR-93.8-0AW	SGR-93.8-0A4W	94.8	95.8	116.8	7.5
SGR-94.8-2	SGR-94.8-2A4	SGR-94.8-3MFH	SGR-94.8-0AW	SGR-94.8-0A4W	95.9	96.8	116.8	7.5
SGR-95.8-2	SGR-95.8-2A4	SGR-95.8-3MFH	SGR-95.8-0AW	SGR-95.8-0A4W	96.9	97.9	116.8	7.5
SGR-96.9-2	SGR-96.9-2A4	SGR-96.9-3MFH	SGR-96.9-0AW	SGR-96.9-0A4W	98	98.9	116.8	7.5
SGR-97.9-2	SGR-97.9-2A4	SGR-97.9-3MFH	SGR-97.9-0AW	SGR-97.9-0A4W	99	99.9	129.5	7.5
SGR-99.0-2	SGR-99.0-2A4	SGR-99.0-3MFH	SGR-99.0-0AW	SGR-99.0-0A4W	100	101.1	129.5	7.5
SGR-100.1-2	SGR-100.1-2A4	SGR-100.1-3MFH	SGR-100.1-0AW	SGR-100.1-0A4W	101.2	102.1	129.5	7.5
SGR-101.1-2	SGR-101.1-2A4	SGR-101.1-3MFH	SGR-101.1-0AW	SGR-101.1-0A4W	102.2	103.1	129.5	7.5
SGR-102.1-2	SGR-102.1-2A4	SGR-102.1-3MFH	SGR-102.1-0AW	SGR-102.1-0A4W	103.2	104.3	129.5	7.5
SGR-103.3-2	SGR-103.3-2A4	SGR-103.3-3MFH	SGR-103.3-0AW	SGR-103.3-0A4W	104.4	105.3	129.5	7.5
SGR-104.3-2	SGR-104.3-2A4	SGR-104.3-3MFH	SGR-104.3-0AW	SGR-104.3-0A4W	105.4	106.3	129.5	7.5
SGR-105.3-2	SGR-105.3-2A4	SGR-105.3-3MFH	SGR-105.3-0AW	SGR-105.3-0A4W	106.4	107.4	129.5	7.5
SGR-106.5-2	SGR-106.5-2A4	SGR-106.5-3MFH	SGR-106.5-0AW	SGR-106.5-0A4W	107.5	108.5	129.5	7.5
SGR-107.5-2	SGR-107.5-2A4	SGR-107.5-3MFH	SGR-107.5-0AW	SGR-107.5-0A4W	108.6	109.5	129.5	7.5
SGR-108.5-2	SGR-108.5-2A4	SGR-108.5-3MFH	SGR-108.5-0AW	SGR-108.5-0A4W	109.6	110.6	129.5	7.5
SGR-109.6-2	SGR-109.6-2A4	SGR-109.6-3MFH	SGR-109.6-0AW	SGR-109.6-0A4W	110.7	111.6	129.5	7.5
SGR-110.6-2	SGR-110.6-2A4	SGR-110.6-3MFH	SGR-110.6-0AW	SGR-110.6-0A4W	111.7	112.6	142.2	7.5
SGR-111.7-2	SGR-111.7-2A4	SGR-111.7-3MFH	SGR-111.7-0AW	SGR-111.7-0A4W	112.7	113.8	142.2	7.5
SGR-112.8-2	SGR-112.8-2A4	SGR-112.8-3MFH	SGR-112.8-0AW	SGR-112.8-0A4W	113.9	114.8	142.2	7.5
SGR-113.8-2	SGR-113.8-2A4	SGR-113.8-3MFH	SGR-113.8-0AW	SGR-113.8-0A4W	114.9	115.8	142.2	7.5
SGR-114.8-2	SGR-114.8-2A4	SGR-114.8-3MFH	SGR-114.8-0AW	SGR-114.8-0A4W	115.9	117	142.2	7.5
SGR-116.0-2	SGR-116.0-2A4	SGR-116.0-3MFH	SGR-116.0-0AW	SGR-116.0-0A4W	117.1	118	142.2	7.5
SGR-117.0-2	SGR-117.0-2A4	SGR-117.0-3MFH	SGR-117.0-0AW	SGR-117.0-0A4W	118.1	119	142.2	7.5
SGR-118.0-2	SGR-118.0-2A4	SGR-118.0-3MFH	SGR-118.0-0AW	SGR-118.0-0A4W	119.1	120.1	142.2	7.5
SGR-119.2-2	SGR-119.2-2A4	SGR-119.2-3MFH	SGR-119.2-0AW	SGR-119.2-0A4W	120.2	121.2	142.2	7.5
SGR-120.2-2	SGR-120.2-2A4	SGR-120.2-3MFH	SGR-120.2-0AW	SGR-120.2-0A4W	121.3	122.2	142.2	7.5
SGR-121.2-2	SGR-121.2-2A4	SGR-121.2-3MFH	SGR-121.2-0AW	SGR-121.2-0A4W	122.3	123.3	142.2	7.5
SGR-122.3-2	SGR-122.3-2A4	SGR-122.3-3MFH	SGR-122.3-0AW	SGR-122.3-0A4W	123.4	124.3	142.2	7.5
SGR-123.3-2	SGR-123.3-2A4	SGR-123.3-3MFH	SGR-123.3-0AW	SGR-123.3-0A4W	124.4	125.3	154.9	7.5
SGR-124.4-2	SGR-124.4-2A4	SGR-124.4-3MFH	SGR-124.4-0AW	SGR-124.4-0A4W	125.4	126.5	154.9	7.5
SGR-125.5-2	SGR-125.5-2A4	SGR-125.5-3MFH	SGR-125.5-0AW	SGR-125.5-0A4W	126.6	127.5	154.9	7.5
SGR-126.5-2	SGR-126.5-2A4	SGR-126.5-3MFH	SGR-126.5-0AW	SGR-126.5-0A4W	127.6	128.5	154.9	7.5
SGR-127.5-2	SGR-127.5-2A4	SGR-127.5-3MFH	SGR-127.5-0AW	SGR-127.5-0A4W	128.6	129.7	154.9	7.5
SGR-128.7-2	SGR-128.7-2A4	SGR-128.7-3MFH	SGR-128.7-0AW	SGR-128.7-0A4W	129.8	130.7	154.9	7.5
SGR-129.7-2	SGR-129.7-2A4	SGR-129.7-3MFH	SGR-129.7-0AW	SGR-129.7-0A4W	130.8	131.7	154.9	7.5
SGR-130.7-2	SGR-130.7-2A4	SGR-130.7-3MFH	SGR-130.7-0AW	SGR-130.7-0A4W	131.8	132.8	154.9	7.5
SGR-131.9-2	SGR-131.9-2A4	SGR-131.9-3MFH	SGR-131.9-0AW	SGR-131.9-0A4W	132.9	133.9	154.9	7.5
SGR-132.9-2	SGR-132.9-2A4	SGR-132.9-3MFH	SGR-132.9-0AW	SGR-132.9-0A4W	134	134.9	154.9	7.5
SGR-133.9-2	SGR-133.9-2A4	SGR-133.9-3MFH	SGR-133.9-0AW	SGR-133.9-0A4W	135	136	154.9	7.5
SGR-135.0-2	SGR-135.0-2A4	SGR-135.0-3MFH	SGR-135.0-0AW	SGR-135.0-0A4W	136.1	137	154.9	7.5
SGR-136.0-2	SGR-136.0-2A4	SGR-136.0-3MFH	SGR-136.0-0AW	SGR-136.0-0A4W	137.1	138	167.6	7.5
SGR-137.1-2	SGR-137.1-2A4	SGR-137.1-3MFH	SGR-137.1-0AW	SGR-137.1-0A4W	138.1	139.2	167.6	7.5
SGR-138.2-2	SGR-138.2-2A4	SGR-138.2-3MFH	SGR-138.2-0AW	SGR-138.2-0A4W	139.3	140.2	167.6	7.5
SGR-139.2-2	SGR-139.2-2A4	SGR-139.2-3MFH	SGR-139.2-0AW	SGR-139.2-0A4W	140.3	141.2	167.6	7.5
SGR-140.2-2	SGR-140.2-2A4	SGR-140.2-3MFH	SGR-140.2-0AW	SGR-140.2-0A4W	141.3	142.4	167.6	7.5
SGR-141.4-2	SGR-141.4-2A4	SGR-141.4-3MFH	SGR-141.4-0AW	SGR-141.4-0A4W	142.5	143.4	167.6	7.5
SGR-142.4-2	SGR-142.4-2A4	SGR-142.4-3MFH	SGR-142.4-0AW	SGR-142.4-0A4W	143.5	144.4	167.6	7.5
SGR-143.4-2	SGR-143.4-2A4	SGR-143.4-3MFH	SGR-143.4-0AW	SGR-143.4-0A4W	144.5	145.5	167.6	7.5
SGR-144.6-2	SGR-144.6-2A4	SGR-144.6-3MFH	SGR-144.6-0AW	SGR-144.6-0A4W	145.6	146.6	167.6	7.5
SGR-145.6-2	SGR-145.6-2A4	SGR-145.6-3MFH	SGR-145.6-0AW	SGR-145.6-0A4W	146.7	147.6	167.6	7.5
SGR-146.6-2	SGR-146.6-2A4	SGR-146.6-3MFH	SGR-146.6-0AW	SGR-146.6-0A4W	147.7	148.7	167.6	7.5
SGR-147.7-2	SGR-147.7-2A4	SGR-147.7-3MFH	SGR-147.7-0AW	SGR-147.7-0A4W	148.8	149.7	167.6	7.5
SGR-148.7-2	SGR-148.7-2A4	SGR-148.7-3MFH	SGR-148.7-0AW	SGR-148.7-0A4W	149.8	150.7	180.3	7.5
SGR-149.8-2	SGR-149.8-2A4	SGR-149.8-3MFH	SGR-149.8-0AW	SGR-149.8-0A4W	150.8	151.9	180.3	7.5
SGR-150.9-2	SGR-150.9-2A4	SGR-150.9-3MFH	SGR-150.9-0AW	SGR-150.9-0A4W	152	152.9	180.3	7.5

Custom Part – No Return

Custom Part – No Return

AEGIS® SGR – PRESS FIT MOUNTING FOR LOW VOLTAGE MOTORS TO 375KW

Note: Use PRO Series Rings for Low Voltage Motors Greater than 375kW and All Medium Voltage Motors See page 45

Catalog Number	Min. shaft diameter (mm)	Max. shaft diameter (mm)	SGR OD Tolerance +0,025/-0	Thickness Max (mm)	Bore Tolerance +0,025/-0
SGR-6.9-0A6	7.9	9	40,132	7.5	40,030
SGR-8.0-0A6	9.1	10	40,132	7.5	40,030
SGR-9.0-0A6	10.1	11	40,132	7.5	40,030
SGR-10.1-0A6	11.1	12.2	40,132	7.5	40,030
SGR-11.2-0A6	12.3	13.2	40,132	7.5	40,030
SGR-12.2-0A6	13.3	14.2	40,132	7.5	40,030
SGR-13.2-0A6	14.3	15.4	40,132	7.5	40,030
SGR-14.4-0A6	15.5	16.4	40,132	7.5	40,030
SGR-15.4-0A6	16.5	17.4	52,832	7.5	52,730
SGR-16.4-0A6	17.5	18.5	52,832	7.5	52,730
SGR-17.6-0A6	18.6	19.7	52,832	7.5	52,730
SGR-18.7-0A6	19.8	20.7	52,832	7.5	52,730
SGR-19.7-0A6	20.8	21.7	52,832	7.5	52,730
SGR-20.7-0A6	21.8	22.7	52,832	7.5	52,730
SGR-21.7-0A6	22.8	23.7	52,832	7.5	52,730
SGR-22.8-0A6	23.8	24.9	52,832	7.5	52,730
SGR-23.9-0A6	25	25.9	52,832	7.5	52,730
SGR-24.9-0A6	26	26.9	52,832	7.5	52,730
SGR-25.9-0A6	27	28.1	52,832	7.5	52,730
SGR-27.1-0A6	28.2	29.1	52,832	7.5	52,730
SGR-28.1-0A6	29.2	30.1	52,832	7.5	52,730
SGR-29.1-0A6	30.2	31.2	52,832	7.5	52,730
SGR-30.3-0A6	31.3	32.3	52,832	7.5	52,730
SGR-31.3-0A6	32.4	33.3	52,832	7.5	52,730
SGR-32.3-0A6	33.4	34.4	52,832	7.5	52,730
SGR-33.4-0A6	34.5	35.4	52,832	7.5	52,730
SGR-34.4-0A6	35.5	36.4	67,564	7.5	67,462
SGR-35.5-0A6	36.5	37.6	67,564	7.5	67,462
SGR-36.6-0A6	37.7	38.6	67,564	7.5	67,462
SGR-37.6-0A6	38.7	39.6	67,564	7.5	67,462
SGR-38.6-0A6	39.7	40.8	67,564	7.5	67,462
SGR-39.8-0A6	40.9	41.8	67,564	7.5	67,462
SGR-40.8-0A6	41.9	42.8	67,564	7.5	67,462
SGR-41.8-0A6	42.9	43.9	67,564	7.5	67,462
SGR-43.0-0A6	44	45	67,564	7.5	67,462
SGR-44.0-0A6	45.1	46	67,564	7.5	67,462
SGR-45.0-0A6	46.1	47.1	67,564	7.5	67,462
SGR-46.1-0A6	47.2	48.1	67,564	7.5	67,462
SGR-47.1-0A6	48.2	49.1	67,564	7.5	67,462
SGR-48.2-0A6	49.2	50.3	67,564	7.5	67,462
SGR-49.3-0A6	50.4	51.3	67,564	7.5	67,462
SGR-50.3-0A6	51.4	52.3	78,232	7.5	78,130
SGR-51.3-0A6	52.4	53.5	78,232	7.5	78,130
SGR-52.5-0A6	53.6	54.5	78,232	7.5	78,130
SGR-53.5-0A6	54.6	55.5	78,232	7.5	78,130
SGR-54.5-0A6	55.6	57.5	78,232	7.5	78,130
SGR-55.7-0A6	56.7	57.7	78,232	7.5	78,130
SGR-56.7-0A6	57.8	58.7	78,232	7.5	78,130
SGR-57.7-0A6	58.8	59.8	78,232	7.5	78,130
SGR-58.8-0A6	59.9	60.8	78,232	7.5	78,130
SGR-59.8-0A6	60.9	61.8	90,932	7.5	90,830
SGR-60.9-0A6	61.9	63	90,932	7.5	90,830
SGR-62.0-0A6	63.1	64	90,932	7.5	90,830
SGR-63.0-0A6	64.1	65	90,932	7.5	90,830
SGR-64.0-0A6	65.1	66.2	90,932	7.5	90,830
SGR-65.2-0A6	66.3	67.2	90,932	7.5	90,830
SGR-66.2-0A6	67.3	68.2	90,932	7.5	90,830
SGR-67.2-0A6	68.3	69.3	90,932	7.5	90,830
SGR-68.4-0A6	69.4	70.4	90,932	7.5	90,830
SGR-69.4-0A6	70.5	71.4	90,932	7.5	90,830
SGR-70.4-0A6	71.5	72.5	90,932	7.5	90,830
SGR-71.5-0A6	72.6	73.5	90,932	7.5	90,830
SGR-72.5-0A6	73.6	74.5	103,632	7.5	103,530
SGR-73.6-0A6	74.6	75.7	103,632	7.5	103,530
SGR-74.7-0A6	75.8	76.7	103,632	7.5	103,530
SGR-75.7-0A6	76.8	77.7	103,632	7.5	103,530
SGR-76.7-0A6	77.8	78.9	103,632	7.5	103,530
SGR-77.9-0A6	79	79.9	103,632	7.5	103,530
SGR-78.9-0A6	80	80.9	103,632	7.5	103,530
Custom Part – No Return					

Catalog Number	Min. shaft diameter (mm)	Max. shaft diameter (mm)	SGR OD Tolerance +0,025/-0	Thickness Max (mm)	Bore Tolerance +0,025/-0
SGR-79.9-0A6	81	82	103,632	7.5	103,530
SGR-81.1-0A6	82.1	83.1	103,632	7.5	103,530
SGR-82.1-0A6	83.2	84.1	103,632	7.5	103,530
SGR-83.1-0A6	84.2	85.2	103,632	7.5	103,530
SGR-84.2-0A6	85.3	86.2	103,632	7.5	103,530
SGR-85.2-0A6	86.3	87.2	116,332	7.5	116,230
SGR-86.3-0A6	87.3	88.4	116,332	7.5	116,230
SGR-87.4-0A6	88.5	89.4	116,332	7.5	116,230
SGR-88.4-0A6	89.5	90.4	116,332	7.5	116,230
SGR-89.4-0A6	90.5	91.6	116,332	7.5	116,230
SGR-90.6-0A6	91.7	92.6	116,332	7.5	116,230
SGR-91.6-0A6	92.7	93.6	116,332	7.5	116,230
SGR-92.6-0A6	93.7	94.7	116,332	7.5	116,230
SGR-93.8-0A6	94.8	95.8	116,332	7.5	116,230
SGR-94.8-0A6	95.9	96.8	116,332	7.5	116,230
SGR-95.8-0A6	96.9	97.9	116,332	7.5	116,230
SGR-96.9-0A6	98	98.9	116,332	7.5	116,230
SGR-97.9-0A6	99	99.9	129,032	7.5	128,930
SGR-99.0-0A6	100	101.1	129,032	7.5	128,930
SGR-100.1-0A6	101.2	102.1	129,032	7.5	128,930
SGR-101.1-0A6	102.2	103.1	129,032	7.5	128,930
SGR-102.1-0A6	103.2	104.3	129,032	7.5	128,930
SGR-103.3-0A6	104.4	105.3	129,032	7.5	128,930
SGR-104.3-0A6	105.4	106.3	129,032	7.5	128,930
SGR-105.3-0A6	106.4	107.4	129,032	7.5	128,930
SGR-106.5-0A6	107.5	108.5	129,032	7.5	128,930
SGR-107.5-0A6	108.6	109.5	129,032	7.5	128,930
SGR-108.5-0A6	109.6	110.6	129,032	7.5	128,930
SGR-109.6-0A6	110.7	111.6	129,032	7.5	128,930
SGR-110.6-0A6	111.7	112.6	141,732	7.5	141,630
SGR-111.7-0A6	112.7	113.8	141,732	7.5	141,630
SGR-112.8-0A6	113.9	114.8	141,732	7.5	141,630
SGR-113.8-0A6	114.9	115.8	141,732	7.5	141,630
SGR-114.8-0A6	115.9	117	141,732	7.5	141,630
SGR-116.0-0A6	117.1	118	141,732	7.5	141,630
SGR-117.0-0A6	118.1	119	141,732	7.5	141,630
SGR-118.0-0A6	119.1	120.1	141,732	7.5	141,630
SGR-119.2-0A6	120.2	121.2	141,732	7.5	141,630
SGR-120.2-0A6	121.3	122.2	141,732	7.5	141,630
SGR-121.2-0A6	122.3	123.3	141,732	7.5	141,630
SGR-122.3-0A6	123.4	124.3	141,732	7.5	141,630
SGR-123.3-0A6	124.4	125.3	154,432	7.5	154,330
SGR-124.4-0A6	125.4	126.5	154,432	7.5	154,330
SGR-125.5-0A6	126.6	127.5	154,432	7.5	154,330
SGR-126.5-0A6	127.6	128.5	154,432	7.5	154,330
SGR-127.5-0A6	128.6	129.7	154,432	7.5	154,330
SGR-128.7-0A6	129.8	130.7	154,432	7.5	154,330
SGR-129.7-0A6	130.8	131.7	154,432	7.5	154,330
SGR-130.7-0A6	131.8	132.8	154,432	7.5	154,330
SGR-131.9-0A6	132.9	133.9	154,432	7.5	154,330
SGR-132.9-0A6	134	134.9	154,432	7.5	154,330
SGR-133.9-0A6	135	136	154,432	7.5	154,330
SGR-135.0-0A6	136.1	137	154,432	7.5	154,330
SGR-136.0-0A6	137.1	138	167,132	7.5	167,030
SGR-137.1-0A6	138.1	139.2	167,132	7.5	167,030
SGR-138.2-0A6	139.3	140.2	167,132	7.5	167,030
SGR-139.2-0A6	140.3	141.2	167,132	7.5	167,030
SGR-140.2-0A6	141.3	142.4	167,132	7.5	167,030
SGR-141.4-0A6	142.5	143.4	167,132	7.5	167,030
SGR-142.4-0A6	143.5	144.4	167,132	7.5	167,030
SGR-143.4-0A6	144.5	145.5	167,132	7.5	167,030
SGR-144.6-0A6	145.6	146.6	167,132	7.5	167,030
SGR-145.6-0A6	146.7	147.6	167,132	7.5	167,030
SGR-146.6-0A6	147.7	148.7	167,132	7.5	167,030
SGR-147.7-0A6	148.8	149.7	167,132	7.5	167,030
SGR-148.7-0A6	149.8	150.7	179,832	7.5	179,730
SGR-149.8-0A6	150.8	151.9	179,832	7.5	179,730
SGR-150.9-0A6	152	152.9	179,832	7.5	179,730
Custom Part – No Return					

AEGIS® UKIT WITH UNIVERSAL MOUNTING IEC MOTORS

for Low Voltage Motors to 375kW

- Kit is designed to avoid any slinger or shaft shoulder. Order based on IEC Frame size.
- Install with 3 or 4 brackets depending on motor end bracket design.
- uKIT can be attached to motor with screws/washers provided or with conductive epoxy. AEGIS® EP2400 Conductive Epoxy sold separately.
- See uKIT brochures for bolt hole circle and installation: **est-aegis.com/uKIT**



Solid Ring



Split Ring



AEGIS® EP2400 Conductive Epoxy installation



Solid Ring with 3 brackets

IEC uKIT – Solid Ring Catalog Number	IEC uKIT – Split Ring Catalog Number	Motor shaft diameter "d"	IEC Frame
SGR-28-UKIT	SGR-28-UKIT-2A4	28mm	IEC 100L, 112M (2, 4, 6, 8 pole)
SGR-38-UKIT	SGR-38-UKIT-2A4	38mm	IEC 132S, 132M (2, 4, 6, 8 pole)
SGR-42-UKIT	SGR-42-UKIT-2A4	42mm	IEC 160M, 160L (2, 4, 6, 8 pole)
SGR-48-UKIT	SGR-48-UKIT-2A4	48mm	IEC 180M, 180L (2, 4, 6, 8 pole)
SGR-55-UKIT	SGR-55-UKIT-2A4	55mm	IEC 200L (2, 4, 6, 8 pole), IEC 225S, 225M (2 pole)
SGR-60-UKIT	SGR-60-UKIT-2A4	60mm	IEC 225S, 225M (4, 6, 8 pole), IEC 250M (2 pole)
SGR-65-UKIT	SGR-65-UKIT-2A4	65mm	IEC 250M (4, 6, 8 pole), IEC 280M, 280S, 315S, 315M,315L (2 pole)
SGR-70-UKIT	SGR-70-UKIT-2A4	70mm	
SGR-75-UKIT	SGR-75-UKIT-2A4	75mm	IEC 280S, 280M (4, 6, 8 pole), IEC 355M, 355L (2 pole)
SGR-80-UKIT	SGR-80-UKIT-2A4	80mm	IEC 315S, 315M, 315L (4, 6, 8 pole)
SGR-85-UKIT	SGR-85-UKIT-2A4	85mm	
SGR-90-UKIT	SGR-90-UKIT-2A4	90mm	
SGR-95-UKIT	SGR-95-UKIT-2A4	95mm	IEC 335L, 335M, 355L, 355M (4, 6, 8, 10 pole)
SGR-100-UKIT	SGR-100-UKIT-2A4	100mm	
SGR-110-UKIT	SGR-110-UKIT-2A4	110mm	

Includes: AEGIS® SGR Shaft Grounding Ring, (4) universal brackets of each size – 16 total, (4) 5-40 x 3/8" flat head screws, (4) M4 x 10 socket head cap screws, (4) M4 split lock washers, (4) M4 flat washers, 5/64" allen wrench, 3mm allen wrench

AEGIS® PRO SERIES SHAFT GROUNDING RING

AEGIS® PROSL

The AEGIS® PROSL is a high current capable AEGIS® Shaft Grounding Ring for large motors, generators, and turbines operated by VFDs. The slim design and flexible installation options allow for adaptation to virtually all large motors.

Specifications

Designs: Solid, Split and Press Fit
Shaft Dia: 63.5mm to 400mm
OD: Shaft Dia + 47.24mm
OAL: 16.51mm MAX assembled with mounting screws
Mounting: Supplied with screws for bolt through mounting M4 x 0.7mm x 25mm Flat Head Cap Screws

Optional Universal Brackets for easy mounting.



AEGIS® PROSLR

Severe Duty motors are operated in general processing industry applications requiring protection from severe environmental operating conditions – often where there is debris, powder, dirt, liquids, lubricants, or other contaminants. For these applications the AEGIS® PROSLR incorporates a rubber dust and debris barrier to protect against ingress of materials that could interfere with the contact of the conductive microfibers to the motor's shaft.

Specifications

Designs: Solid and Split
Shaft Dia: 63.5mm to 400mm
OD: Shaft Dia + 47.24mm
OAL: 19.68mm assembled with mounting screws
Mounting: Supplied with screws for bolt through mounting Solid Ring M4 x 0.7mm x 25mm FHCS, Split Ring M4 x 0.7mm x 30mm FHCS

Optional Universal Brackets for easy mounting.



AEGIS® PROMAX

The AEGIS® PROMAX is designed for installation on the most critical and largest motors, generators, and turbines. The high current capable AEGIS® PROMAX Shaft Grounding Ring is custom engineered for each application to ensure the best bearing protection possible.

Specifications

Designs: Split Ring only
Shaft Dia: Typically over 400mm
OD: Shaft Dia + 76.2mm
OAL: 47.62mm assembled with mounting screws
Mounting: Supplied with screws for bolt through mounting (4) M8 x 1.25mm x 50mm Socket Head Cap Screws

Custom brackets available upon request



AEGIS® PRO SERIES SHAFT GROUNDING RING

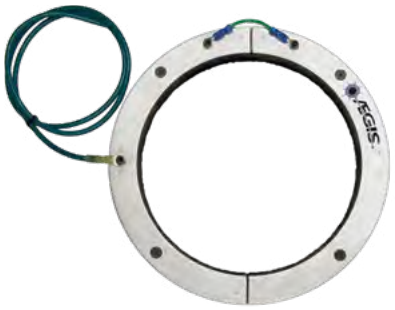
AEGIS® PROMR

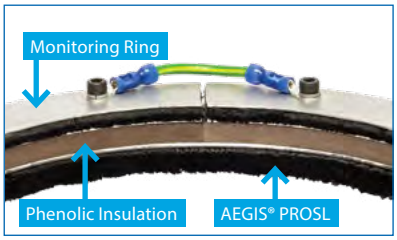
The AEGIS® PROMR combines the AEGIS® PROSL with an additional isolated SGR ring that can be used as a monitoring device. The PROSL discharges shaft voltage safely to ground while the monitoring SGR ring measures voltage on the shaft and is not grounded. A phenolic plate between the 2 rings is used to isolate the monitoring ring.

For shaft diameter of 63.5mm to 400mm.

Designs: Solid and Split
OD: Shaft Dia + 47.24mm
OAL: 33.32mm assembled with mounting screws
Mounting: Supplied with screws for bolt through mounting
M4 x 0.7mm x 25mm Flat Head Cap Screws

Optional Universal Brackets for easy mounting.





OPTIONAL MOUNTING BRACKETS FOR AEGIS® PRO SERIES

For AEGIS® PROSL, PROSLR, PROMR

AEGIS® PROSL Universal Brackets

Kit includes brackets, four different spacer lengths and hardware for each.





Custom Brackets/Installation Examples

Contact our Engineering Team for special mounting applications.



Custom Split Mounting Plate with tie bars



Bearing Cap Mounting



Custom Mounting Brackets

AEGIS® SHAFT VOLTAGE TESTER™

The AEGIS® Shaft Voltage Tester™ kit includes everything you need to start testing motor shaft voltage. At its core is a 2 channel, 100 MHz digital oscilloscope with a 140mm screen and easy screen capture.



	AEGIS-OSC-9200A	AEGIS-OSC-9200-W2	AEGIS-OSC-9200MB-W2	AEGIS-OSC-9200MB-W2-IC
AEGIS® Shaft Voltage Tester™ Digital Oscilloscope	●	●	●	●
AEGIS® Shaft Voltage Probe™ with Tip Installed	●	●	●	●
Spare 1X/10X Oscilloscope Probe	●	●	●	●
Multimeter Test Leads	●	●	●	●
Rechargeable Battery	●	●	●	●
Power Supply (9V, 4A DC; 120/240 VAC)	●	●	●	●
Compact Carrying Case	●	●	●	●
USB Flash drive, loaded with manual	●	●	●	●
AEGIS® Bearing Protection Handbook	●	●	●	●
Alligator Grounding Clips	1	1	2	2
Spare AEGIS® Shaft Voltage Probe™ Tips			3	3
AEGIS® Shaft Grounding Simulator™			●	●
Probe Holder			●	●
Magnetic Base			●	●
Universal Power Adapter				●
ISO 17025 Calibration				●
Warranty Length	90 days	2 years	2 years	2 years

Catalog Number	Includes:
SVP-KIT-9100MB	3 SVP tips, probe holder with two piece extension rod (total length of probe holder with extension rod is 455mm), AEGIS® Grounding Simulator with alligator ground clip, and magnetic base.
AEGIS-SVP-510	AEGIS® Shaft Voltage Probe™ PP510 with BNC connector. 1 AEGIS® SVP Tip 1 alligator ground clip
SVP-TIP-9100	3 SVP replacement tips only

SVP-KIT-9100MB AEGIS-SVP-510



AEGIS® HFGS AND ACCESSORIES

AEGIS® HFGS High-Frequency Ground Strap Length: 305mm and 610mm

Catalog Number	Terminations	Fits Frame Sizes
HFGS-T0410-R0312-12 305mm **HFGS-T0410-R0312-24** 610mm	**Term1: Punched hole** 10mm **Term 2: Ring terminal** 8 mm screws	**IEC** 80M5, 90S, 90L **NEMA**: 48, 48H, 56, 56H, 143T, 145T, 182T, 184T, 213T, 215T
HFGS-T0660-R0312-12 305mm **HFGS-T0660-R0312-24** 610mm	**Term1: Punched hole** 17mm **Term 2: Ring terminal** 8 mm screws	**IEC:** 100S, 100L, 112S, 112M, 132S, 132M, 160S, 160M, 160L, 180S, 180M, 180L **NEMA:** 254T, 256T, 284T, 284TS, 286T, 286TS, 324T, 324TS, 326T, 326TS, 364T, 364TS, 365T, 365TS
HFGS-T0940-R0312-12 305mm **HFGS-T0940-R0312-24** 610mm	**Term1: Punched hole** 24mm Term 2: Ring terminal 8 mm screws	**IEC:** 200S, 200M, 200L, 225S, 225M, 250S, 250M, 280S, 280M **NEMA:** 404T, 404TS, 405T, 405TS, 444T, 444TS, 445T, 445TS, 447T, 447TS, 449T, 449TS
HFGS-R0312-R0312-12 305mm **HFGS-R0312-R0312-24** 610mm	**Term 1: Ring terminal** 8 mm screws **Term 2: Ring terminal** 8 mm screws	**IEC/NEMA:** universal terminations

Screws included

Custom lengths and terminations available on request





AEGIS® Colloidal Silver Shaft Coating

Catalog Number	Coverage
CS015	20-25 applications based on a 76mm shaft diameter

Used to improve the conductivity of the steel shaft surface. Apply to any VFD driven motor shaft prior to installing the AEGIS® Shaft Grounding Ring.

Note: Application instructions in installation section. Shelf life is 6 months. SDS available at **est-aegis.com**



AEGIS® Conductive Epoxy

Catalog Number	Coverage
EP2400	2-3 applications

Used to install the AEGIS® Shaft Grounding Ring without drilling and tapping into the motor end bell.

Note: Application instructions in installation section. Shelf life is 9 months. SDS available at **est-aegis.com**



SAMPLE SPECIFICATION LANGUAGE

A. GENERAL REQUIREMENTS – SHAFT GROUNDING:

1. All motors operated on variable frequency drives shall be equipped with a maintenance-free conductive microfiber shaft grounding ring, with a minimum of two rows of circumferential microfibers, to dissipate shaft voltage and mitigate discharge through the bearings.

2. Application Note: Motors up to 75kW shall be provided with one shaft grounding ring, installed at either the drive end or non-drive end of the motor. Motors over 75kW shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end. Grounding rings shall be provided and installed by the motor manufacturer or contractor,
in accordance with the manufacturer's recommendations.

B. GENERAL REQUIREMENTS – HIGH-FREQUENCY BONDING:

1. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection. Alternatively, the ground strap may be connected between the frames of the motor and the driven load equipment.

2. Application Note: Proper grounding of motor frame for all inverter-driven induction motors

References:	ABB Technical Guide No. 5
	Nidec Motor Corporation Technical White Paper: Increased Reports of Bearing Damage in AC Motors Operating from Modern PWM VFD's
	Danfoss Engineering Guide – HVAC & Refrigeration applications – Facility services design and project engineering of electrical drives
Recommended parts:	AEGIS® SGR Shaft Grounding Ring
	AEGIS® HFGS High Frequency Ground Strap
Recommended source:	Electro Static Technology, an ITW Company Manufacturer of AEGIS® products Phone: +1-207-998-5140 US/CA: 1-866-738-1857 **info@est-aegis.com** **est-aegis.com**

est-aegis.com/resources/specifying-aegis/

Appendix – Warranty

REGISTER YOUR MOTOR FOR THE AEGIS® 2-YEAR WARRANTY AGAINST BEARING FLUTING DAMAGE



Electro Static Technology (EST, AEGIS®) guarantees that AC induction motor bearings will not fail from electrical fluting damage when AEGIS® Shaft Grounding Rings have been installed with new bearings in accordance with EST's recommended best practices, as published in the AEGIS® Bearing Protection Handbook (current edition).

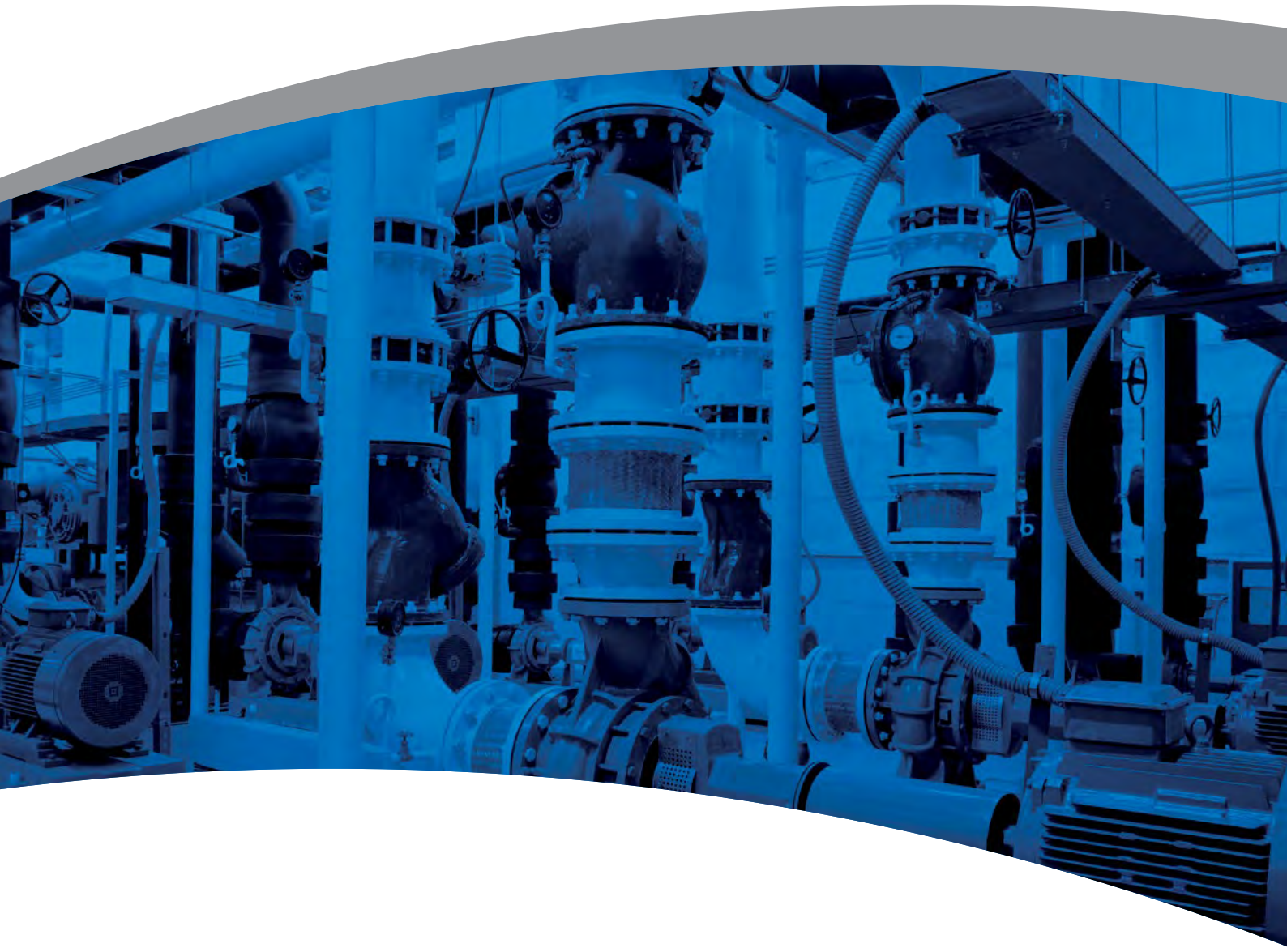
- The AC induction motor must meet the conditions listed below and new bearings must be installed at the time of AEGIS® Ring installation for the warranty to be approved.
- For repaired motors or for field installations: Upon registration and approval the warranty shall be for 2 years from the installation date of the new motor bearings and AEGIS® Ring.
- For new motors with AEGIS® rings installed by the motor manufacturer: Upon registration the warranty shall be for a 2 year period after the motor manufacturer's bearing warranty ends.
- If electrically induced bearing fluting damage occurs, EST will pay the current Vaughen's National Average Price for "Furnish/Install 2 Standard Ball Bearings" and will supply a new shaft grounding ring (SGR or PRO as appropriate) and CS015. The warranty shall apply to any AC induction motor whether new or repaired which conforms to the AEGIS® Bearing Protection Handbook's best practices.



Conditions:

1. For All Motors: New bearings MUST be installed at the time of AEGIS® Ring installation.
2. All Motors: For this warranty to be valid, the owner must register the motor within 30 days of receipt, by filling out and submitting the information at **est-aegis.com/warranty**.
3. For AC Induction motors up to 75kW: The warranty shall apply when AEGIS® Rings have been installed on the motor per the AEGIS® Bearing Protection Handbook's best practices.
4. AC Induction motors greater than 75kW: The warranty shall apply when AEGIS® Rings and insulated bearings/insulation have been installed on the motor per the AEGIS® Bearing Protection Handbook's best practices.
5. AC Induction motors greater than 375kW and ANY motor with supply voltage of greater than 600 VAC (medium/high voltage): The warranty shall only apply when AEGIS® PRO Series Rings and insulated bearings/insulation have been installed on the motor per the AEGIS® Bearing Protection Handbook's best practices.
6. The best practices shall apply per the current edition of the AEGIS® Bearing Protection Handbook at the time of installation.
7. Selection of the applicable ring (AEGIS® SGR or PRO Series) must conform to the requirements in the AEGIS® Bearing Protection Handbook.
8. The owner of the motor must verify that the installation of AEGIS® Rings and bearing insulation, if applicable, was per the AEGIS® Bearing Protection Handbook's best practices in order to receive approval for the warranty.
9. EST shall retain the sole authority to issue and approve the warranty for any application.
10. The warranty shall be activated and conferred to the motor owner upon the issuance by EST of an email or certificate confirming warranty acceptance.

Notes



AEGIS Trained Installer

AEGIS Master Distributor

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GmbH & Co. KG

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