AERODYN ENGINEERING

VOLUME 1

SLIP RINGS

www.aerodyneng.com

Welcome to

AERODYN ENGINEERING INC.

Aerodyn Engineering Inc. (AEI) provides unparalleled customer services and support to Aerospace, Power Generation, Automotive, and Industrial customers with high-quality instrumentation, test services, and analysis that is ISO-9001:2008 Registered. We are dedicated to exceeding our customer's expectations for response and quality. We base our business on long-term relationships of trust and value.

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ISO-9001:2008 REGISTERED

SLIP RING MANUFACTURING

Aerodyn Engineering Inc. manufactures a premier line of high-speed data-quality slip rings for the transfer of sensor signals from rotating surfaces to stationary data systems. Our slip rings are used worldwide for development and experimental test of gas turbines and high-speed rotating machinery. Our designs provide clean and quiet signals, with long life and high-contact density. Typical applications include strain and temperature surveys, shaft torque and bending measurements, and power transfer on/off the rotor.

ENGINEERING CAPABILITIES

- Instrumentation and sensor
- Aeronautical
- Mechanical
- Finite element analysis
- Data acquisition
- Electrical
- CAD design and drafting
- Modal analysis

STANDARD FEATURES AND SPECIFICATIONS

- Low noise signal transfer <250 microvolts pk-pk noise at any discrete frequency (25mA drive current)
- Durability: >100 million revolutions
- Environmentally friendly coolants (non-CFC)
- Gold alloy contacts
- Grease or oil mist bearings
- Multi-pin mil-spec connectors
- Precision ground shafts
- Intermediate bearing assemblies for ease of installation and quick disconnect

SLIP RING SELECTION PROCESS

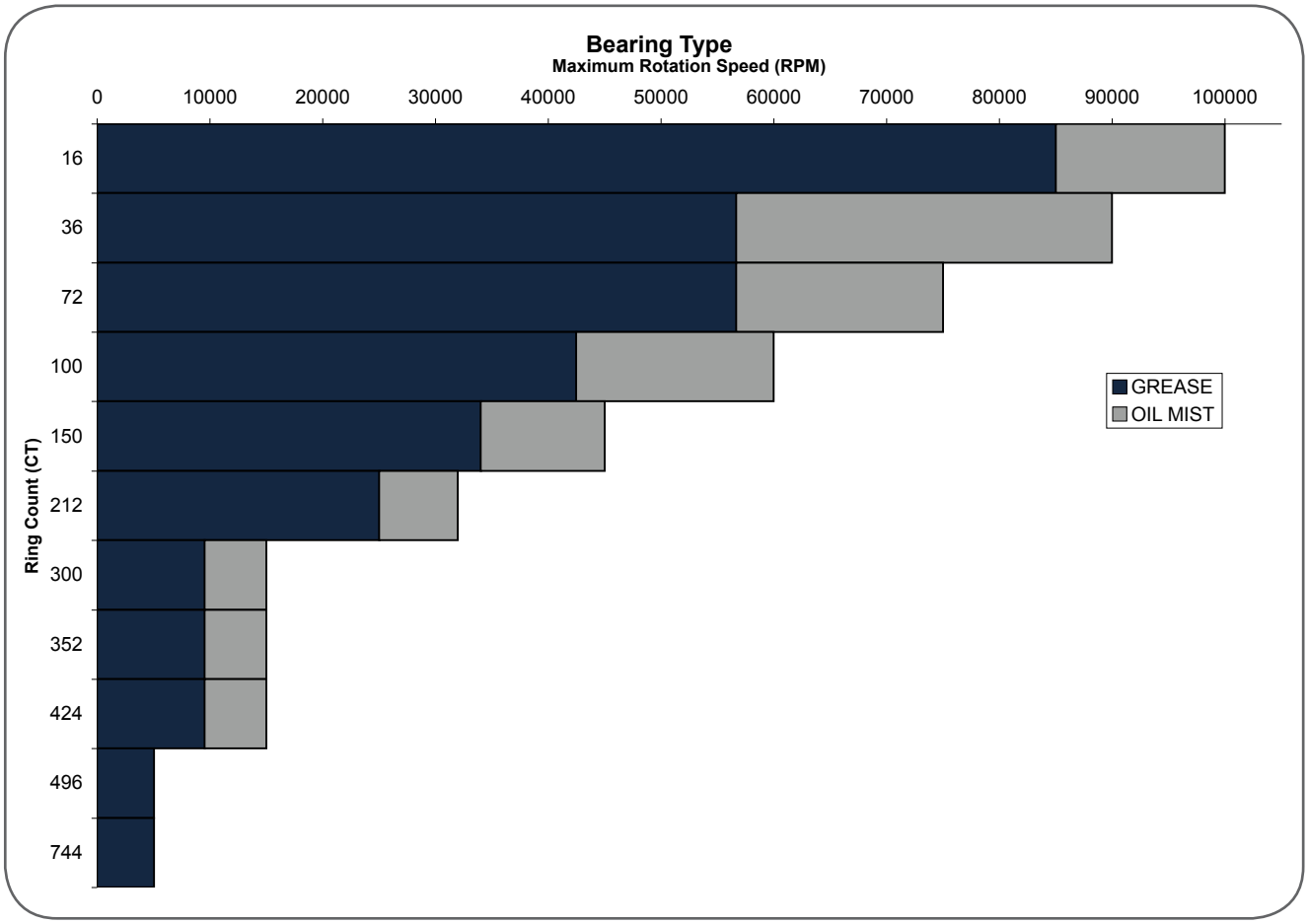
SELECTING SLIP RING SIZE

To begin selecting a slip ring size, rotating speed and sensor count requirements must be considered. The number of contacts will account for each wire going from a sensor to your data system. For example: if you need 106 sensors (assuming two wires per sensor), a 212-contact slip ring would be needed. If you require more channels than what is available on a slip ring, a switching mechanism may be needed. Additional contacts may be needed for rotating reference junctions or three- or four-wire sensors (e.g., static strain or pressure transducer).

Ring Count (CT)	Maximum Rotational Speed (RPM)
16	100,000
36	90,000
72	75,000
100	60,000
150	45,000
212	32,000
300	15,000
352	15,000
424	15,000
496	5,000
744	5,000

SELECTING SLIP RING BEARING

The speed the slip ring must operate also determines bearing lubrication options. You have a choice of oil air mist or grease pack bearings. Generally, grease pack bearings can operate up to about 400,000 dN (d is bearing bore in mm and N is rpm). For any application above this point, an oil air mist system must be utilized.



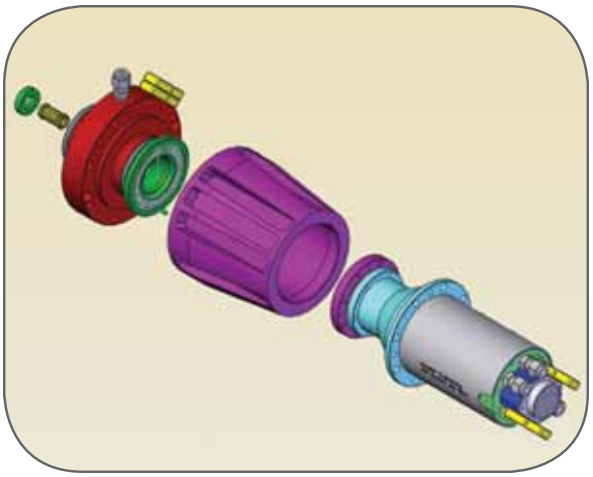
SELECTING SLIP RING STYLE

INTERMEDIATE BEARING ASSEMBLY (IBA)

An IBA allows you to terminate the sensors on a separate shaft supported by its own bearings. This allows you to operate the test article with or without the slip ring. It also allows quick removal and re-installation of the slip ring. A key feature of the IBA is the input connector rotating mass is decoupled from the test article.

An IBA consists of a rotor on two bearings in a precision housing. The rotor supports a printed circuit board (PCB) where the sensors are terminated. The slip ring is then easily installed using double-ended pins to make the connection between the IBA and slip ring. IBAs also allow flexibility on input configurations.

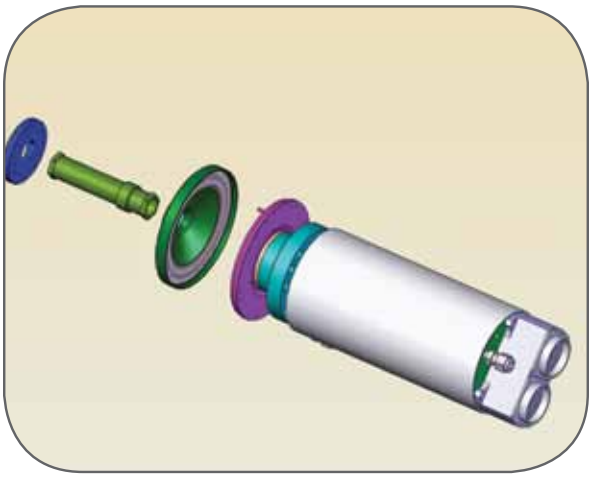
- Multiple termination capability (for example, 200 termination contacts monitored by a 100-contact slip ring)
- On-rotor multiplexing switches to monitor a greater number of channels



IBA

NOSECONE

A nosecone configuration can be used when space does not allow an IBA. A nosecone is a housing where the input PCB is located and is supported directly by the slip ring rotor bearings. In general, a nosecone configuration reduces speed capability of the system.



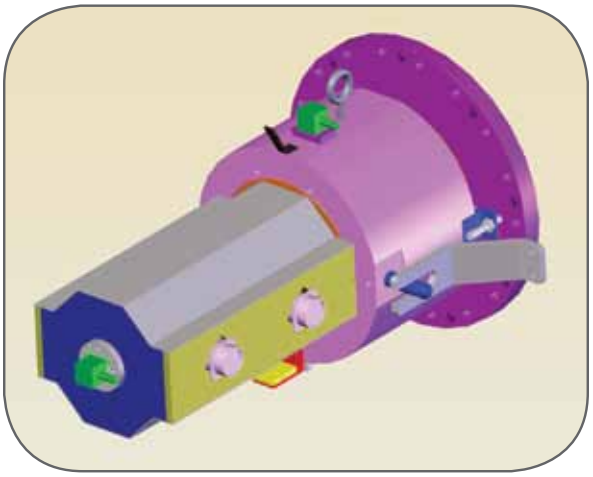
Nosecone

TETHERED

A tethered configuration can be used when the mass of the slip ring can be fully supported by the test article rotor. This virtually eliminates supporting static structure and allows large axial movements. In general, a tethered configuration reduces speed capability of the system.

THRU-BORE

A thru-bore design allows the slip ring to fit over a shaft or other centerline object that may have another purpose and cannot be modified. This is typically a custom configuration and very application specific.



Tethered

BEARING LUBRICATION

GREASE PACK

Grease pack bearings are preferred because they are sealed, maintenance free, and do not require a service line routed into the slip ring location. However, this typically has a lower speed capability. Also, environmental considerations such as temperature and pressures at the slip ring location need to be considered. High ambient temperatures may preclude the use of grease pack bearings, and locations where pressure differentials exist need to be carefully considered.

OIL AIR MIST

Oil air mist installations are more complicated because they require external lubrication systems, additional service lines, and venting of the bearing cavity. However, they allow the slip ring to operate at its maximum speed and in elevated temperature and pressure locations.

Thermocouples are built into the bearing housing and placed in direct contact with the outer bearing race. This allows continuous monitoring of the bearing temperature so the predetermined maximum temperatures are not exceeded.

TYPES OF SIGNAL TRANSMISSION

- Sensors
  - Thermocouple
  - Strain gauge (static and dynamic)
  - Pressure transducer
  - RTD
  - Digital signal
  - Virtually any electrical signal or sensor type
- Power
  - AC or DC
  - High voltage
  - High current (combining multiple contacts)

Slip ring contacts are universal. They can be used for any type of sensor or power configuration. The slip ring can transmit signals either from or to the test article.

COOLANTS/FLUIDS

Aerodyn slip rings typically require recirculating cooling fluid to lubricate the contacts and remove frictional heat. The coolant also flushes wear debris out of the slip ring. Some low speed applications have been done with sealed coolant cavities, but these are custom applications. Return coolant is also sometimes used to control cavity temperatures and bearing housing temperatures.

There are several coolants available, depending on rotational velocity. Aerodyn recommends synthetic heat transfer fluids for low speed operations (below 15,000 rpm) and solvent-based coolants for higher speed applications. Current coolants include Syltherm XLT, Syltherm 800, AK-225, and Vertrel XL. The recommended coolant depends on several factors of the application. Coolant recommendations are determined on a case-by-case basis.

Generally, Syltherm XLT and Syltherm 800 are used for lower speed operations. These fluids offer higher temperature operations because they have an elevated boiling point. They are also a single fluid and not a mixture of fluid with oil. However, Syltherm XLT has a low flash point, and both are flammable. Both fluids can be heated to 140° F to reduce their viscosity and increase their speed capability.

AK-225 and Vertrel XL are solvent-based coolants and are used for all-speed applications. These coolants have relatively low boiling points and require a two- to five-percent mixture of turbine oil for lubricity.

Generally, air is not an acceptable solution for coolant on a gold brush on gold ring configuration due to the heat build up in friction. Air is used as a cooling fluid mostly with applications that utilize silver graphite contacts.

If coolant flow is interrupted to an operating slip ring, it would only take a few seconds to destroy the contacts in a slip ring due to excessive heat build up. Therefore, Aerodyn Engineering builds many redundant systems into their cooling carts; these include battery backups, high reliability gear pumps, relays, filters, etc.

For technical data sheets and material safety data sheets (MSDS), please refer to the technical index located in the back of this catalog.

ENVIRONMENT

Slip rings can operate in very harsh environments when proper precautions are taken. Slip rings have been installed in turbine exhausts,, under high temperature and high pressure conditions, with great success. When temperature environments are greater than 200° F, the slip ring needs to be protected from these conditions. These may take the form of ventilated/ cooled enclosures.

Pressures from vacuum through high pressures can be accommodated. In general, if ambient pressures are outside the range of 12-18 PSIA, special considerations for bearing lubrication and coolant supply pressures must be taken.

Aerodyn Engineering specializes in the integration of our slip ring assemblies into many complex test environments. Our decades of experience have allowed us to cover a broad array of custom installations. This experience allows us to work effectively with customers on new applications.

VIBRATION

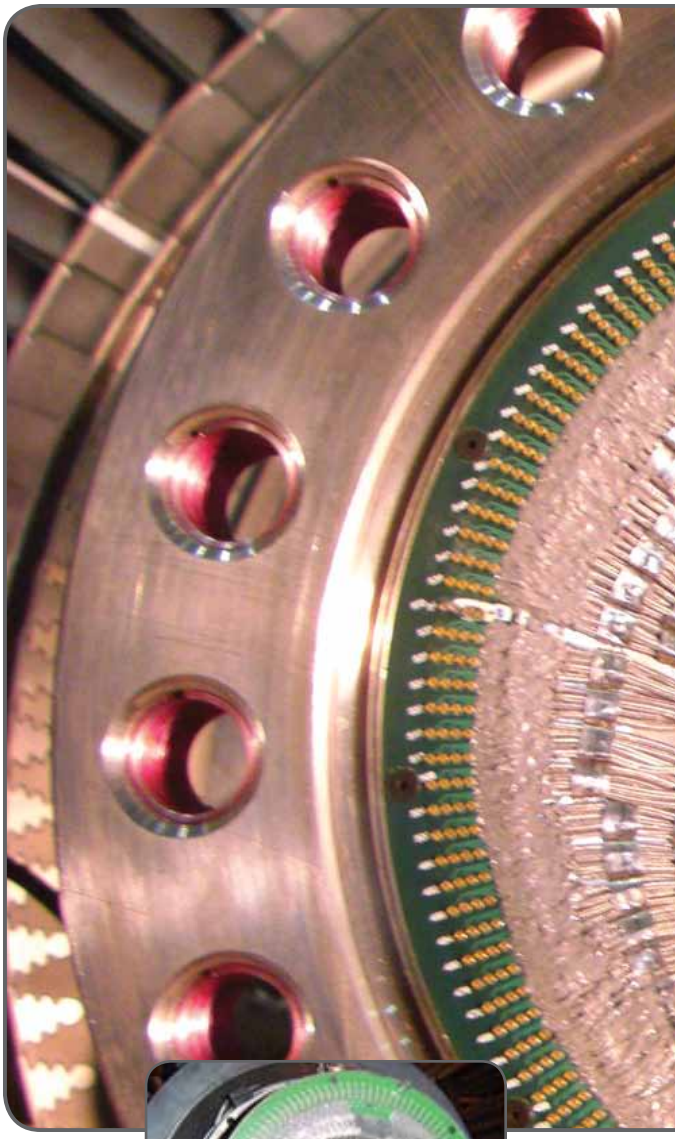
Aerodyn slip rings are typically very tolerant of vibration without signal degradation. They have operated in harsh environments such as gear boxes, diesel engines, and blade-off tests.

The slip ring is only one part of an overall system. A system vibration analysis to identify structural modes and responses should be performed on each installation. Aerodyn can perform this work or supply necessary input data for customer analysis.

Aerodyn specializes in replicating as much of the engine installation as possible during final testing to identify any issues prior to actual installation. Modal testing can also be performed on installations.

The quill shaft effectively isolates the slip ring from the engine rotor precession and vibration.

Provisions for mounting accelerometers are typically made on all of our slip rings. Operating limits are typically set at 3 in/sec peak.

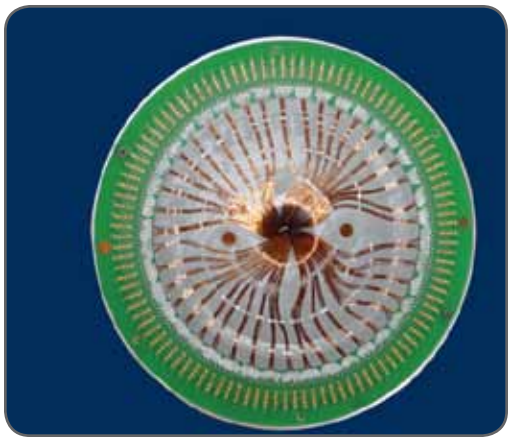


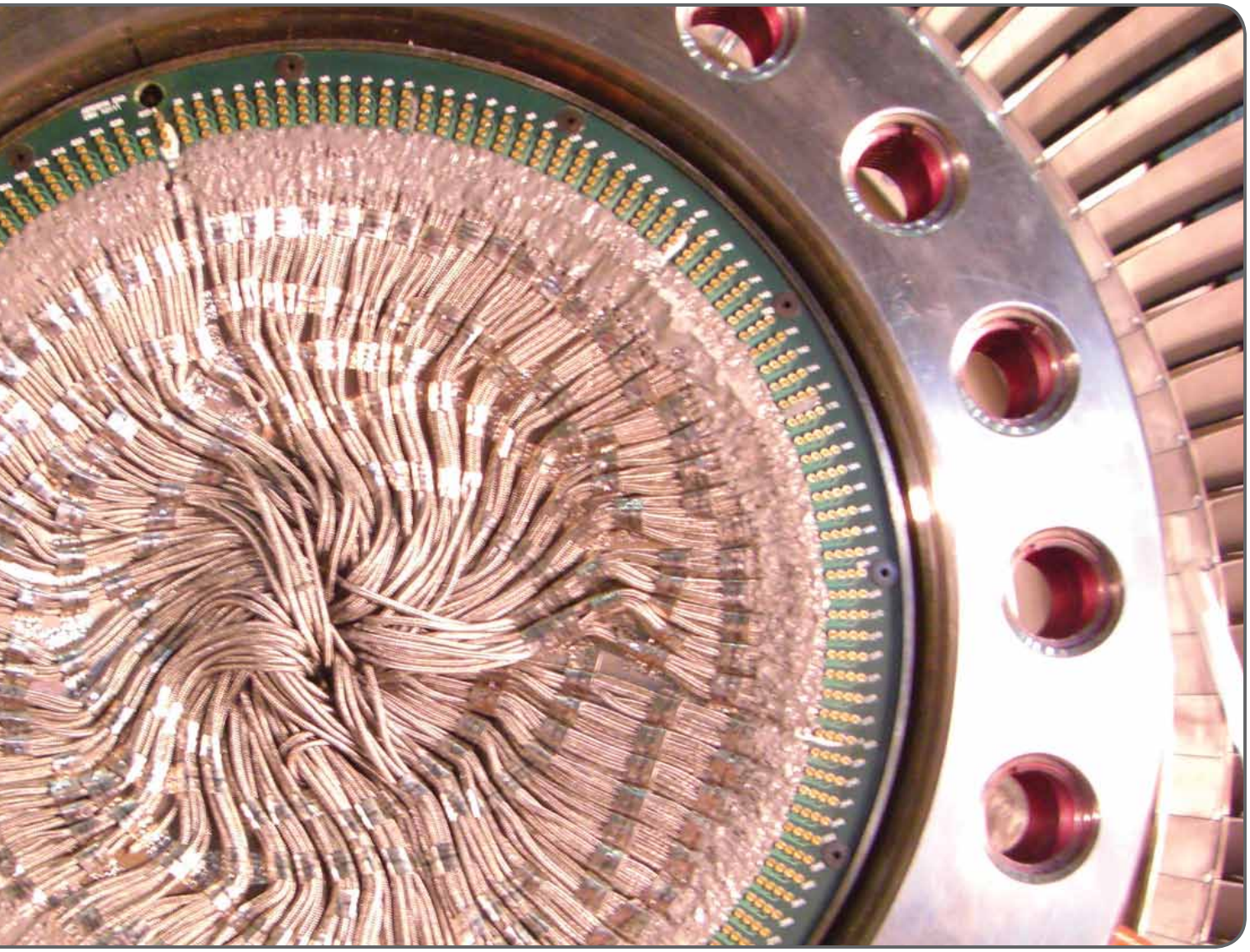
ALIGNMENT

Alignment is critical to the success of the installation. Shaft alignment typically must be within .003 inches total indicated run out (TIR). Perpendicularity of the slip ring mounting interface to the rotating spin axis must be .001 inches or less. Verification of the alignment and perpendicularity must be done at installation of the slip ring. Special tooling may be required to perform this check.

Aerodyn can offer design and manufacturing support to control the interface limits and fits to achieve the necessary alignment.

When using an IBA or nose cone configuration, the quill shaft can tolerate operation through engine critical excursion or other high precession events.





TERMINATION

Multiple types of sensor leads can be terminated to the slip ring. Examples are flexible leads such as Kapton Teflon insulated wire, high temp leads such as fiberglass insulated wire, and mineral insulated cable. Wire materials such as copper, silver-plated copper, or other solderable material can be soldered directly to the PCB. Thermocouple wires of any type can be welded to special rivets installed in the PCB or tinned with silver and soldered directly to the PCB.

Wire bundle size is limited to quill shaft ID. The smaller the slip ring, the smaller the wire size must be. The number of leads will be restricted to quill shaft ID and slip ring size.

When transferring thermocouples from the IBA to the slip ring, the RTDs can compensate for the temperature reference at that junction.

Aerodyn Engineering has skilled technicians who can be available to land the slip ring on your test article. Termination is typically done at the customer's site. We also provide training for slip ring termination. We pride ourselves in supporting all aspects of the engine test to ensure proper testing and data is received.

After wires are terminated, Aerodyn recommends securing leads with Aeroshim and coating the leads with epoxy to secure all leads in place.

SENSOR CONSIDERATIONS

Slip Rings can transmit virtually any type of sensors. No signal transformation or change occurs to the signal inside the slip ring. However, some considerations need to be given to various sensors for accurate signal transmission.

THERMOCOUPLES

Thermocouples are commonly used on rotating hardware due to their simplicity and robustness. Any type of thermocouple can be transmitted through a slip ring. However, the user must be aware that the thermocouple alloy material does not continue in the slip ring and that the rotating reference junction is created where the thermocouple alloys are terminated to the slip ring input PCB. Because thermocouples only measure the difference between the hot junction and rotating reference junction, the temperature at the reference junction must also be measured. This is commonly done using a rotating RTD or thermistor located on the input PCB. Aerodyn PCBs are designed to accommodate these sensors. These sensors must be considered in the selection of the overall channel count for the application. Inside the slip ring, Aerodyn uses the same alloy for ring and brush contacts so that no thermoelectric potential is created at this location. Thermocouple signals are then read as millivolts at the output of the slip ring, and correction for rotating reference temperature must be performed. Consult Aerodyn for assistance with this algorithm.

STRAIN GAGES

Various configurations of strain gages are used on rotating hardware. These include quarter, half, and full bridges; static and dynamic applications; and constant current or constant voltage excitation. All these can be transmitted through the slip ring. These configurations require either two-, three-, or four-wire channel configurations in the slip ring.

Quarter bridge dynamic sensors are very commonly used for airfoil vibratory measurements. These are two-wire sensors usually with constant current excitation. Common excitation levels are 10mA to 25mA. Aerodyn slip rings can transfer up to 250 mA per contact.

Frequency bandwidth is not limited with slip rings up to megahertz ranges.

RTDS

Common RTDs used are 1000 ohm or 100 ohm thin film, platinum element sensors. These can be configured in two-, three-, or four-wire configurations. Aerodyn slip rings have relatively low series resistance, typically .5 ohm or less per contact, enabling two-wire use of RTDs. If higher accuracy is needed, Aerodyn would recommend a four-wire configuration.

For rotating reference temperature measurement, Aerodyn typically uses 1000 ohm RTDs placed at the same radius as the wire terminations. These are then monitored through the slip ring in a four-wire configuration.

BRIDGE-TYPE SENSORS

Pressure transducers and strain gage-based sensors (such as shaft torque, bending moment, and tension) are common full bridged transducers transmitted by slip rings. These are typically four-wire configurations and no special considerations are needed.

OTHER

Accelerometers, proximity sensors, and many other electrical-based transducers have been successfully transmitted through slip rings. Consult Aerodyn for any special considerations for these types of sensors.

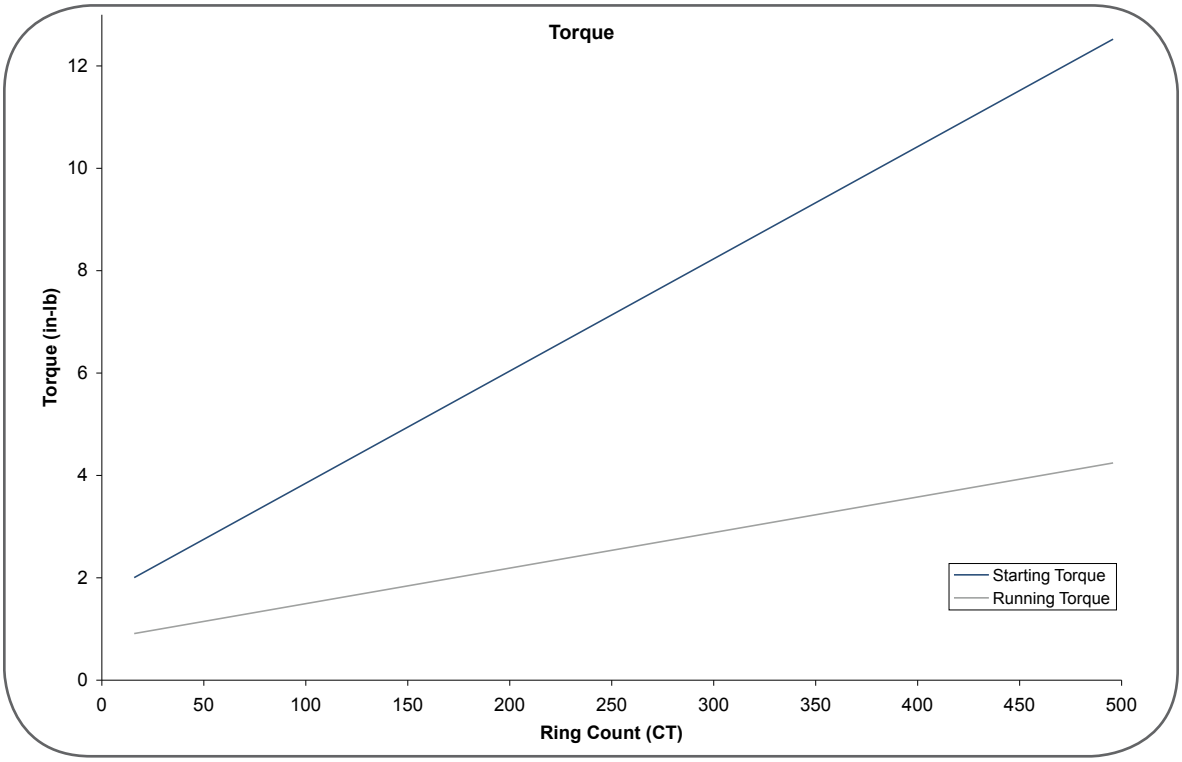
NOISE

Aerodyn Engineering's slip rings transfer very clean and quiet signals from rotating sensors to stationary data systems. Our gold alloy contacts provide very quiet signals, long life, and high contact density. Dynamic noise of typical Aerodyn slip rings is less than 1 m at any discreet frequency. Each slip ring is spun up to operating speed and each channel is tested for a clean signal in our test facility.

Frequency bandwidth of slip rings is typically not limited until MHz range. Cross talk, channel to channel, is typically -55 dB or greater.

DRIVING TORQUE

- Start up torque
- Running torque
  - Startup torque is moment required to initiate rotation.
  - Running torque is the moment required to maintain rotation.



INPUT WIRE

Aerodyn slip rings can accommodate many types of input leads from sensors. However, Aerodyn does not recommend the use of thermocouple wire for rotating strain gage due to intrinsic noise generation. Please consult Aerodyn to discuss specific wires, applications, and termination techniques.

OUTPUT WIRE

Aerodyn uses several types of Mil-Spec connectors for output connectors. Aerodyn recommends the use of twisted pair, individually shielded wire for output wire harnesses.

Aerodyn Engineering stocks various wire and cable harnesses for this purpose. We can also fabricate an output harness to a customer's specification.

ELECTRO-MAGNETIC INTERFERENCE (EMI)

Slip rings consist of wires rotating slightly off centerline; therefore, they can be susceptible to magnetic fields. If a magnetic field is present, it can induce small currents in the rotating wiring. This may show up in the data as 1/rev sinusoidal noise. All adapting hardware and engine hardware should be non-magnetic or degaussed prior to assembly.

The use of twisted pair, shielded lead wires should be used for input and output wire harnesses to reduce the effects of electro-magnetic fields.

MAINTENANCE/OVERHAUL

Aerodyn stocks spare components for all slip rings in services and can offer rapid repair and overhaul service for our products. Basic overhaul would include disassembly, inspection, cleaning, retension of brushes, reassembly, and spin test of the slip ring. If required, bearings, brushes, and seals are replaced. Typically, a rotor will last through several brush sets before requiring replacement. Rotors can also be regrooved to reestablish new contact wear surface.

Typical life expectancy of the slip ring, before brush replacement, is 100 million revolutions.

Aerodyn Engineering can repair and overhaul many older designs of slip rings. We have experience with virtually all high speed slip rings used in the last 40 years and can provide rebuild and overhaul support for these units.

CUSTOM DESIGNS

Aerodyn Engineering can apply our experience to create custom designs to meet challenging applications.

- Automotive transmission slip rings
- Flight test slip rings
- Silver graphite slip rings for blade-off testing and power applications
- Thru-bore slip rings for APU/gear box application
- Steam turbine
- Power generation/gas turbine
- Diesel engines
- Turbo-chargers
- Rate-table

Our designs are the result of decades of experience as slip ring users and designers. The units are very easily adapted to the test article and are very robust.

Aerodyn Engineering welcomes the opportunity to design and fabricate the installation adapting hardware for the slip rings. This assures the customer that this hardware will be right and proven before the actual test. We typically assemble and spin test the hardware with the slip ring to assure that fit and stack-up are correct. Installation designs can include cooling cans for hot end installations, sealing arrangements for lead wires exiting the engine shaft, and complicated outer housing rotating installations.

Aerodyn Engineering can also provide complete support for the slip ring installations. Our technicians can terminate the rotating leads, mount the slip rings, and provide test support as required to assure successful testing and data quality.

RENTALS

Aerodyn Engineering also has a rental fleet of slip rings and cooling systems, which customers can use. Cost is based on slip ring size, duration of lease period, and number of hours used.

Configuration can be modified to suit the application. This includes bearing lubrication and external configuration.

COOLING SYSTEMS

Aerodyn Engineering designs and manufactures its own line of cooling carts. Our cooling carts will supply filtered coolant to the slip ring while in operation. Aerodyn Engineering's cooling units are extremely reliable and are designed and manufactured with the highest quality components and craftsmanship available in the industry today. Magnetically coupled pumps are employed within our system to deliver the cooling fluid, with full user instruments showing flow rate and system pressures. Aerodyn Engineering cooling systems are equipped with battery backup to assure continued operation in the event of a site power failure.

Specifications	
Pump	Magnetically coupled gear pump
Flow Rate	0 - 1 GPM
Tank	Stainless steel, five-gallon capacity
Heat Rejection	2,500 BTU/hr, air/fluid heat exchanger
Filtration	5 micron sintered stainless steel filter
Voltage	110/220 VAC, 50/60 HZ
Power	Less than 700 watts
Battery Backup	Provides 30 minutes operation after AC power failure
Controls	On/off (can be remote controlled) Pump on/off (can be remote controlled) Flow rate
Displays	Pump pressure Slip ring supply pressure Flow rate (digital with analog output)
Alarms	Low flow Low tank AC power failure

The cart is also fitted with multiple gauges to monitor pressures (pump and supply pressure) as well as flow rate with a digital readout. These systems also include electronics to alert the operator when the system is in a situation where the cooling cart falls below certain parameters (low flow, low tank, and AC power failure). The cooling cart can be controlled remotely, so the operator is be able to monitor the vitals and even manage the cart from a control room. In the case of on-site power loss, the battery backup will provide an additional 30 minutes of continuous running to protect the slip ring from heat damage by drawing from the built in five-gallon tank.

Custom features are also available and offer coolant preheating, refrigeration, and network control/monitoring.

ORDERING AND SPARE PARTS

The selection of the appropriate slip ring is a process that will match all of your design requirements together to find the right combination. These design constraints include:

- Speed
- Environmental temperature and pressure
- Intended purpose
- Maximum number of channels that need to be monitored at any given time or test situation
- Mounting geometry
- Type of signal needed

These criteria must all be identified at the start of the selection and design process.

We have provided key considerations to allow for easy ordering of your slip ring.

Slip Ring Size

16 count to 744 count

Bearing Configuration

a. Grease pack bearings

b. Oil air mist

Attachment Configuration

a. IBA

b. Nosecone

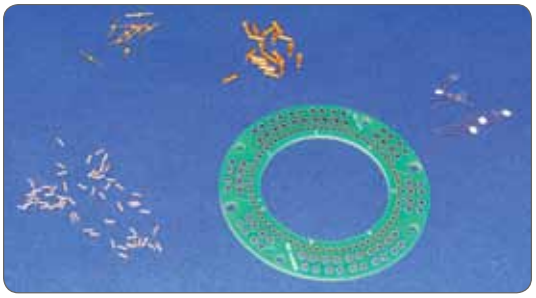
c. Tethered

PCB Configuration

a. Solder contacts

b. Weldable rivets

c. RTDs



TECHNICAL INDEX

AK-225

AK-225 is an environmentally sensible hydrochlorofluorocarbon (HCFC) designed to replace chlorofluorocarbon (CFC), perfluorocarbon (PFC), and other HCFCs with high ODP values in a variety of applications. Its selective solvency, physical properties, and ability to form azeotropes make AK-225 ideal for general and precision cleaning, as a carrier for silicone and halogenated lubricants, and as a coolant.

Physical Properties of AK-225

Molecular Weight	202.94
Boiling Point (°C)	54
Freezing Point (°C)	-131
Critical Temperature (°C)	208
Critical Pressure (kg/cm^2)	30.2
Critical Density (kg/m^3)	558
Density (g/cm^3)	
Liquid (25°C)	1.55
Vapor (60°C, 1atm)	7.78
Viscosity (cP, 25°C)	0.59
Surface Tension (dyne/cm, 25°C)	16.2
Vapor Pressure (kg/cm^2, 25°C)	0.385
Latent Heat of Vaporization (cal/g, b.p.)	34.6
Relative Evaporation Rate (Ether=100)	90
Specific Heat (cal/g•°C)	
Liquid (25°C)	0.25
Vapor (60°C, 1atm)	0.173
Ratio of Specific Heat (CpCv, 60°C, 1atm)	1.076
Refractive Index (23°C)	1.326
Dielectric Constant (1MHZ, 25°C)	4.14
Solubility of Water (wt%, 25°C)	0.031
Solubility in Water (wt%, 25°C)	0.033
Flash Point (C°)	None
KB Value	31
Solubility Parameter	6.9
Ozone Depletion Potential (CFC-11 = 1.0)	0.03
Global Warming Potential (CO_2 = 1.0, 100yr TTH)	370

VERTREL® XF Physical and Chemical Properties

Boiling Point: 55°C (131°F)
Vapor Pressure: 226 mm Hg @ 25°C (77°F)
Solubility in Water: 140 ppm
pH: Neutral
Form: Liquid
Color: Clear, colorless
Density: 1.58 g/cm^3 @ 25°C (77°F)
13.2 lb/gal

® DuPont Fluoroproducts

TECHNICAL INDEX

SYLTHERM XLT†

SYLTHERM XLT† heat transfer fluid is a specially formulated, high performance silicone polymer designed for use as a low temperature, liquid phase heat transfer medium. It offers outstanding low temperature heat transfer and pumpability, plus excellent thermal stability. SYLTHERM XLT fluid has essentially no odor, is low in acute oral toxicity, and is not listed as reportable under SARA Title III, Section 313††.

Recommended use temperature range: -100°C (150°F) to 260°C (500°F)

Suitable applications: Single fluid process healing and cooling systems in the pharmaceutical and fine chemical industries.

†Trademark of Dow Corning Corporation
††You may need to comply with similar or additional regulations in other countries.

Typical Properties of SYLTHERM XLT Fluid[1]

Composition: Dimethyl Polysiloxane

Color: Crystal Clear Liquid

Property	SI Units	English Units
Viscosity @ 25°C (77°F)	1.4 mPa-s	1.4 cp
Flash Point[2], Closed Cup	47°C	116°F
Flash Point[3], Open Cup	54°C	130°F
Autoignition Temp., ASTM D-2155	350°C	662°F
Acid Number, Typical	-11°C	0.01
Freeze Point		-168°F
Density @25°C (77°F)	852 kg/m^3	7.1 lb/gal
Specific Gravity @ 25°C (77°F)		0.85
Heat of Combustion	32,800 kJ/kg	14,100 Btu/lb
Average Molecular Weight		317
Estimated Critical Temperature	327°C	620°F
Estimated Critical Pressure	12.16 bar	12 atm
Estimated Critical Volume	3.9 l/kg	0.063 ft^3/lb

[1] Not to be construed as specifications.
[2] ASTM D92
[3] ASTM D93

SYLTHERM† 800

SYLTHERM† 800 heat transfer fluid is a highly stable, long-lasting silicone fluid designed for high temperature liquid phase operation. It exhibits low potential for fouling and can often remain in service for 10 years or more. SYLTHERM 800 has essentially no odor, is low in acute oral toxicity, and is not listed as reportable under SARA Title III, Section 313††.

Recommended use temperature range: -40°C (-40°F) to 400°C (750°F)

†Trademark of Dow Corning Corporation
††You may need to comply with similar or additional regulations in other countries.

Typical Properties of SYLTHERM 800 Fluid[1]

Composition: Dimethyl Polysiloxane

Color:	As Supplied Clear Yellow		After Extended Use Darkened	
Property	SI Units	English Units	SI Units	English Units
Viscosity @ 25°C (77°F)	9.1 mPa-s	9.1 cps	≥6.0 mPa-s	≥6.0 cp
Flash Point[2], Closed Cup, Typical	160°C	320°F	≥85°C	≥95°F
Flash Point[3], Open Cup, Typical	177°C	350°F	≥57°C	≥135°F
Fire Point[2]	193°C	380°F	≥68°C	≥155°F
Autoignition Point, ASTM D 2155	385°C	725°F	385°C	725°F
Acid Number, Typical	0.03		0.03	
Freeze Point	-60°C	-76°F	≥40°C	≥40°F
Density @25°C (77°F)	936 kg/m^3	7.8 lb/gal	936 kg/m^3	7.8 lb/gal
Specific Gravity @ 25°C (77°F)	0.93		0.93	
Heat of Combustion	28,659 kJ/kg	12,300 Btu/lb	28,659 kJ/kg	12,300 Btu/lb
Estimated Critical Temperature	367°C	692°F	367°C	692°F
Estimated Critical Pressure	10.9 bar	10.8 atm	10.9 bar	10.8 atm
Estimated Critical Volume	3.22 l/kg	0.0515 ft^3/lb	3.22 l/kg	0.0515 ft^3/lb

[1] Not to be construed as specifications.
[2] ASTM D92
[3] ASTM D93

SLIP RINGS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
16 Contact SR			
Slip Ring	103420	16 Ct. Slip Ring (Dwg # 7221)	Each
IBA	103443	16 Ct. IBA (Dwg # 7222)	Each
Nosecone	105595	16 Ct. Nosecone	Each
36 Contact SR			
Slip Ring	100241	36 Ct. Slip Ring (Dwg # 7016)	Each
IBA	100481	36 Ct. IBA (Dwg # 7021)	Each
Nosecone		36 Ct. Nosecone	Each
72 Contact SR			
Slip Ring	106107	72 Ct. Slip Ring Oil Mist (Dwg # 70015)	Each
Slip Ring	106096	72 Ct. Slip Ring (Dwg # 70015)	Each
IBA	106108	72 Ct. IBA Oil Mist (Dwg # 70016)	Each
IBA	106097	72 Ct. IBA Grease (Dwg # 70016)	Each
Nosecone		72 Ct. Nosecone	Each
100 Contact SR			
Slip Ring	102262	100 Ct. Slip Ring (Dwg # 7041)	Each
IBA	100055	100 Ct. IBA (Dwg # 7000)	Each
Nosecone	105508	100 Ct. Nosecone	Each
150 Contact SR			
Slip Ring	101375	150 Ct. Slip Ring (Dwg # 7135)	Each
IBA	101731	150 Ct. IBA (Dwg # 7136)	Each
Nosecone	101585	150 Ct. Nosecone	Each
212 Contact SR			
Slip Ring	7037	212 Ct. Slip Ring (Dwg # 7037)	Each
IBA	7038	212 Ct. IBA (Dwg # 7038)	Each
Nosecone	105877	212 Ct. Nosecone	Each
300 Contact SR			
Slip Ring	7063	300 Ct. Slip Ring	Each
IBA	7064	300 Ct. IBA	Each
424 Contact SR			
Slip Ring	100237	424 Ct. Slip Ring (Dwg # 7081)	Each
IBA	104813	424 Ct. IBA (Dwg # 7082)	Each
Nosecone		424 Ct. Nosecone	Each
SR/CC Services			
Inspect/Clean/Spin	103665	Inspection, Cleaning, and Spin Test of 28 Ct. SR	Each
Inspect/Clean/Spin	103665	Inspection, Cleaning, and Spin Test of 212 Ct. and below	Each
Inspect/Clean/Spin	103665	Inspection, Cleaning, and Spin Test of 212 Ct. to 424 Ct.	Each
Inspect/Clean/Spin	103665	Inspection, Cleaning, and Spin Test of 424 Ct.	Each
Inspect/Clean/Spin	103665	Inspection, Cleaning, and Spin Test of 496 Ct.	Each
SR Rentals			
36 SR		Slip Ring Rental – 36 Ct. and below	Month/Hr
72 Ct. SR and below		Slip Ring Rental – 72 Ct.	Month/Hr
100 Ct. SR and above		Slip Ring Rental – 100 Ct.	Month/Hr
212 Ct. SR and above		Slip Ring Rental – 212 Ct.	Month/Hr
AEI 16 Ct. SR Spares			
Bearhug, 16 Ct.	103407	Locknut, Bearhug, BH-00	1
Bearing, 16 Ct.	103403	Bearing, 100HJB	1
Bearing, 16 Ct.	104965	Bearing, 100SST	1
Bearing, 16 Ct.	103404	Bearing, 200HJB	1
Bearing, 16 Ct.	104971	Bearing, 200SST	1
Bearing, 16 Ct.	103405	Bearing, SR2H	1
Brush Assy, 16 Ct.	103384	Assy, 16 Ct., SR, Brush Block	2

SLIP RINGS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
AEI 16 Ct. SR Spares, Cont.			
Connector, 16 Ct.	103447	16/484/424 Ct., SR, Output Connector	1
Fastener Kit, 16 Ct.	106929	Assy, 16 Ct., SR & IBA, Screw Kit	1
Gold Pins, 16 Ct.	100017	Double Ended Pins	16
Drive Insert, 16 Ct.	103446	16 Ct., SR, Customer Drive Insert, .250 Hex	1
Hex Drive, 16 Ct.	103456	16 Ct., SR, Hex Driver	1
Lip Seal, 16 Ct.	103402	Lip Seal, 16 Ct. Aerodyn SR	1
O-Ring Kit, 16 Ct.	106930	O-Ring Kit, 16 Ct., SR	1
PCB, 16 Ct.	103353	Assy, 16 Ct., PCB, Circuit Board	1
Quill Shaft, 16 Ct.	105548	Quill Shaft, 1/4 x 1/4 x 0.750 long, 17-4, 16 Ct.	1
Rotor Assy, 16 Ct.	103377	Assy, 16 Ct., SR, Rotor	1
Spring, 16 Ct.	100019	Wave Spring, W0367-006, Tail Brg.	2
Spring, 16 Ct.	103409	Wave Spring, W1004-011	3
AEI 36 Ct. SR Spares			
Bearhug, 36 Ct.	100096	Locknut, Bearhug, BH-02	1
Bearing, 36 Ct.	100447	Bearing, 102HJB	1
Bearing, 36 Ct.	100801	Bearing, 102SST	1
Bearing, 36 Ct.	100092	Bearing, 202HJB	1
Bearing, 36 Ct.	100969	Bearing, 202SST	1
Bearing, 36 Ct.	100446	Bearing, SR3H	1
Brush Assy, 36 Ct.	101296	Assy, 36 Ct., SR, Brush Block	2
Connector, 36 Ct.	101301	Connector, Output, 28/36/72 Ct., SR, 18" Leadwire	1
Connector, 36 Ct.	100114	Connector, Output, 28/36/72 Ct., SR	1
Fastener Kit, 36 Ct.	102897	Assy, 36 Ct., SR, Screw Kit	1
Gold Pins, 36 Ct.	100017	Double Ended Pins	36
Hex Drive, 36 Ct.	100357	36 Ct., IBA, Hex Drive	1
Hex Insert, 36 Ct.	100967	36 Ct., SR, Customer Drive Insert, .375 Hex	1
Lip Seal, 36 Ct.	100464	Lip Seal, 28/36/72/100/150/212 Ct. Aerodyn SR	1
O-Ring Kit, 36 Ct.	105752	O-Ring Kit, 36 Ct., SR	1
PCB, 36 Ct.	101121	Assy, 36 Ct., PCB, Sockets	1
PCB, 36 Ct.	101123	Assy, 36 Ct., PCB, Sockets and Rivets	1
PCB, 36 Ct.	101124	Assy, 36 Ct., PCB, Sockets, RTD, and Rivets	1
PCB, 36 Ct.	101122	Assy, 36 Ct., PCB, Sockets and RTD	1
Quill Shaft, 36 Ct.	100437	Quill Shaft, 3/8 x 3/8 x 2.000 long, 17-4, 36 Ct.	1
Quill Shaft, 36 Ct.	105219	Quill Shaft, 3/8 x 3/8 x 2.750 long, 17-4, 36 Ct.	1
Quill Shaft, 36 Ct.	101328	Quill Shaft, 3/8 x 3/8 x 3.644 long, 17-4, 36 Ct.	1
Rotor Assy, 36 Ct.	100346	Assy, 36 SR, Rotor	1
Spring, 36 Ct.	100759	Wave Spring, W0492-007	1
Spring, 36 Ct.	100095	Wave Spring, W1235-014	2
Spring, 36 Ct.	100020	Wave Spring, W1351-015, Mid Brg.	2
AEI 72 Ct. SR Spares			
Bearhug, 72 Ct.	100096	Locknut, Bearing, BH-02	1
Nut, 72 Ct.	100368	Locknut, Bearing, 72 IBA	1
Bearing, 72 Ct.	104966	Bearing, 101HJB	1
Bearing, 72 Ct.	100447	Bearing, 102HJB	1
Bearing, 72 Ct.	100801	Bearing, 102SST	1
Bearing, 72 Ct.	100092	Bearing, 202HJB	1
Bearing, 72 Ct.	100969	Bearing, 202SST	1
Bearing, 72 Ct.	100802	Bearing, 202SST	1
Bearing, 72 Ct.	100446	Bearing, SR3H	1
Brush Assy, 72 Ct.	100081	Assy, 72 Ct., SR, Brush Block	2
Connector, 72 Ct.	101301	Connector, Output, 28/36/72 Ct., SR, 18" Leadwire	1

SLIP RINGS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
AEI 72 Ct. SR Spares, Cont.			
Connector, 72 Ct.	100114	Connector, Output, 28/36/72 Ct., SR	2
Fastener Kit, 72 Ct.	100964	Assy, 72 Ct., IBA to Engine, Screw Kit	1
Fastener Kit, 72 Ct.	100966	Assy, 72 Ct., SR to IBA, Screw Kit	1
Fastener Kit, 72 Ct.	100888	Assy, 72 Ct., SR, Screw Kit	1
Gold Pins, 72 Ct.	100017	Double Ended Pins	1
Drive Insert, 72 Ct.	100030	72/100 Ct., SR, Customer Drive Insert, .500 Hex	1
Hex Insert, 72 Ct.	100967	36 Ct., SR, Customer Drive Insert, .375 Hex	1
Hex Drive, 72 Ct.	100369	72 Ct., IBA, Adapter, Hex Drive	1
Hex Drive, 72 Ct.	100366	72 Ct., IBA, Hex Drive	2
Lip Seal, 72 Ct.	100464	Lip Seal, 28/36/72/100/150/212 Ct. Aerodyn SR	1
O-Ring Kit, 72 Ct.	100889	O-Ring Kit, 72 Ct., SR	1
PCB, 72 Ct.	106102	72 Ct., Cover, PCB, Rotor, Inside Termination	1
PCB, 72 Ct.	106098	Assy, 72 Ct., PCB, Inside Termination	1
PCB, 72 Ct.	100982	Assy, 72 Ct., PCB, Solder, No RTD	1
PCB, 72 Ct.	100981	Assy, 72 Ct., PCB, Solder, RTD	1
PCB, 72 Ct.	100984	Assy, 72 Ct., PCB, Rivets, No RTD	1
PCB, 72 Ct.	100983	Assy, 72 Ct., PCB, Rivets, RTD	1
Quill Shaft, 72 Ct.	100766	Quill Shaft, 1/2 x 1/2 x 1.000 or 2.968 long, Torlon, 72 Ct.	1
Quill Shaft, 72 Ct.	104527	Quill Shaft, 3/8 x 1/2 x 2.4 long, 17-4, 144/72 Ct.	1
Quill Shaft, 72 Ct.	104417	Quill Shaft, 5/16 x 1/2 x 2.065 long, 440SS, 72 Ct.	1
Retaining Ring, 72 Ct.	100004	Retaining Ring, WH-87	1
Rotor Assy, 72 Ct.	106099	Assy, 72 Ct., SR Rotor, Inside Termination	1
Spring, 72 Ct.	100759	Wave Spring, W0492-007	1
Spring, 72 Ct.	100019	Wave Spring, W0367-006, Tail Brg.	1
Spring, 72 Ct.	100095	Wave Spring, W1235-014	1
Spring, 72 Ct.	100020	Wave Spring, W1351-015, Mid Brg.	2
AEI 100 Ct. SR Spares			
Bearhug, 100 Ct.	100482	Locknut, Bearhug, BH-03	1
Bearhug, 100 Ct.	100001	Locknut, Bearhug, BH-04	1
Bearing, 100 Ct.	101453	Bearing, 103HJB	1
Bearing, 100 Ct.	100458	Bearing, 103SST	1
Bearing, 100 Ct.	100459	Bearing, 203HJB	1
Bearing, 100 Ct.	100460	Bearing, 203SST	1
Bearing, 100 Ct.	100453	Bearing, 204HJB	1
Bearing, 100 Ct.	102113	Bearing, 204SST	1
Bearing, 100 Ct.	100446	Bearing, SR3H	1
Brush Assy, 100 Ct.	102284	Assy, 100 Ct., SR, Brush Block, Standard	2
Connector, 100 Ct.	100011	100 Pin Connector, Mate to S/R	1
Connector, 100 Ct.	101280	Backshell, Connector AEI 100 Slip Ring	1
Connector, 100 Ct.	100653	Connector, 100 Mating SR	1
Fastener Kit, 100 Ct.	102898	Assy, 100 Ct., SR, Screw Kit	1
Fastener Kit, 100 Ct.	101317	Assy, 100 Ct., SR to IBA, Screw Kit	1
Gold Pins, 100 Ct.	100017	Double Ended Pins	100
Drive Insert, 100 Ct.	100030	72/100 Ct., SR, Customer Drive Insert, .500 Hex	1
Hex Insert, 100 Ct.	100053	100 Ct., IBA, Insert, .500 Hex	1
Lip Seal, 100 Ct.	100464	Lip Seal, 28/36/72/100/150/212 Ct. Aerodyn SR	1
O-Ring Kit, 100 Ct.	106998	O-Ring Kit, 100 Ct., SR	1
PCB, 100 Ct.	101312	Assy, 100 Ct., PCB, 1000 Ohm RTD, No Rivets	1
PCB, 100 Ct.	100554	Assy, 100 Ct., PCB, Rivets, No RTD	1
PCB, 100 Ct.	100555	Assy, 100 Ct., PCB, Rivets, RTD	1
PCB, 100 Ct.	100056	Assy, 100 Ct., PCB, Solder, No RTD	1
PCB, 100 Ct.	100553	Assy, 100 Ct., PCB, Solder, RTD	1

SLIP RINGS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
AEI 100 Ct. SR Spares, Cont.			
Quill Shaft, 100 Ct.	100032	Quill Shaft, 1/2 x 1/2 x 1.000 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	105921	Quill Shaft, 1/2 x 1/2 x 1.300 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	101433	Quill Shaft, 1/2 x 1/2 x 1.890 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	105512	Quill Shaft, 1/2 x 1/2 x 1.936 long, 440SS, 100 Ct.	1
Quill Shaft, 100 Ct.	104622	Quill Shaft, 1/2 x 1/2 x 2.000 long, Torlon, 100 Ct.	1
Quill Shaft, 100 Ct.	106554	Quill Shaft, 1/2 x 1/2 x 2.000 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	105889	Quill Shaft, 1/2 x 1/2 x 2.027 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	101883	Quill Shaft, 1/2 x 1/2 x 2.084 long, Torlon, 100 Ct.	1
Quill Shaft, 100 Ct.	102840	Quill Shaft, 1/2 x 1/2 x 2.336 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	102316	Quill Shaft, 1/2 x 1/2 x 3.082 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	106555	Quill Shaft, 1/2 x 1/2 x 3.107 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	105856	Quill Shaft, 1/2 x 1/2 x 1.000 long, Torlon, 100 Ct.	1
Quill Shaft, 100 Ct.	104527	Quill Shaft, 3/8 x 1/2 x 2.4 long, 17-4, 144/72 Ct.	1
Quill Shaft, 100 Ct.	105523	Quill Shaft, 3/8 x 1/2 x 2.950 long, 17-4, 100 Ct.	1
Quill Shaft, 100 Ct.	104417	Quill Shaft, 5/16 x 1/2 x 2.065 long, 440SS, 72 Ct.	1
Retaining Ring, 100 Ct.	100562	Retaining Ring, WH-65, 100 Ct., IBA	1
Rotor Assy, 100 Ct.	102263	Assy, 100 Ct., SR, Rotor	1
Spring, 100 Ct.	100759	Wave Spring, W0492-007	1
Spring, 100 Ct.	100762	Wave Spring Washer, W1351-015	1
Spring, 100 Ct.	100563	Wave Spring Washer, W1819-020	2
AEI 150 Ct. SR Spares			
Bearhug, 150 Ct.	100482	Locknut, Bearhug, BH-03	1
Bearhug, 150 Ct.	100806	Locknut, Bearhug, BH-05	1
Bearing, 150 Ct.	101453	Bearing, 103HJB	1
Bearing, 150 Ct.	100458	Bearing, 103SST	1
Bearing, 150 Ct.	100448	Bearing, 105HJB	1
Bearing, 150 Ct.	100450	Bearing, 105SST	1
Bearing, 150 Ct.	100459	Bearing, 203HJB	1
Bearing, 150 Ct.	100460	Bearing, 203SST	1
Bearing, 150 Ct.	100498	Bearing, 205HJB	1
Bearing, 150 Ct.	100451	Bearing, 205SST	1
Bearing, 150 Ct.	100446	Bearing, SR3H	1
Brush Assy, 150 Ct.	101458	Assy, 150 Ct., SR, Brush Block, need 2 for quoting	2
Connector, 150 Ct.	100011	100 Pin Connector, Mate to S/R	1
Connector, 150 Ct.	101441	Backshell, 155 Pin Connector	1
Connector, 150 Ct.	101435	Connector, Cable End	1
Mating Connector, 150 Ct.	101436	Connector, Box Mount Receptacle	1
Fastener Kit, 150 Ct.	106644	Assy, 150 Ct., SR, Screw Kit	1
Gold Pins, 150 Ct.	100017	Double Ended Pins	150
Hex Insert, 150 Ct.	106297	150 Ct., SR, Customer Drive Insert, .688 Hex	1
Drive Adaptor, 150 Ct.	101654	150 Ct., IBA, Drive Adapter	1
Hex Drive, 150 Ct.	101730	150 Ct., IBA, Insert, Hex	1
Lip Seal, 150 Ct.	100464	Lip Seal, 28/36/72/100/150/212 Ct. Aerodyn SR	1
O-Ring Kit, 150 Ct.	106643	O-Ring Kit, 150 Ct., SR	Each
PCB, 150 Ct.	102154	Assy, 150 Ct., PCB, with Rivets and 100 Ohm RTD	1
PCB, 150 Ct.	106592	Assy, 150 Ct., PCB, Slip Ring Rotor	1
PCB, 150 Ct.	106299	Assy, 150 Ct., PCB, IBA Side	1
Quill Shaft, 150 Ct.	105857	Quill Shaft, 1/2 x 11/16 x 3.010 long, 17-4, 150 Ct.	1
Quill Shaft, 150 Ct.	106296	Quill Shaft, 11/16 x 11/16 x 1.500 long, 17-4, 150 Ct.	1
Quill Shaft, 150 Ct.	101733	Quill Shaft, 11/16 x 11/16 x 3.910 long, 17-4, 150 Ct.	1
Rotor Assy, 150 Ct.	101462	Assy, 150 Ct., Rotor	1

SLIP RINGS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
AEI 150 Ct. SR Spares, Cont.			
Spring, 150 Ct.	100759	Wave Spring, W0492-007	1
Spring, 150 Ct.	100762	Wave Spring Washer, W1351-015	2
Spring, 150 Ct.	100769	Wave Spring, SSB-0185	1
AEI 212 Ct. SR Spares			
Bearhug, 212 Ct.	100482	Locknut, Bearhug, BH-03	1
Bearhug, 212 Ct.	100806	Locknut, Bearhug, BH-05	1
Bearing, 212 Ct.	101453	Bearing, 103HJB	1
Bearing, 212 Ct.	100458	Bearing, 103SST	1
Bearing, 212 Ct.	100448	Bearing, 105HJB	1
Bearing, 212 Ct.	100450	Bearing, 105SST	1
Bearing, 212 Ct.	100459	Bearing, 203HJB	1
Bearing, 212 Ct.	100460	Bearing, 203SST	1
Bearing, 212 Ct.	100498	Bearing, 205HJB	1
Bearing, 212 Ct.	100451	Bearing, 205SST	1
Bearing, 212 Ct.	100446	Bearing, SR3H	1
Brush Assy, 212 Ct.	102221	Assy, 212/424 Ct., SR, Brush Block, Aft/Fwd	2
Connector, 212 Ct.	101286	Backshell, Connector	2
Connector, 212 Ct.	101275	Connector, Output, 424/212 Ct., SR	2
Fastener Kit, 212 Ct.	106645	Assy, 212 Ct., SR, Screw Kit	1
Gold Pins, 212 Ct.	100017	Double Ended Pins	1
Hex Insert, 212 Ct.	105321	212 Ct., SR, Customer Drive Insert, .750 Hex	1
Drive Insert, 212 Ct.	105318	212 Ct., IBA, Drive Insert, .75 Hex	212
Drive Adaptor, 212 Ct.	105317	212 Ct., IBA, Drive Adapter	1
Lip Seal, 212 Ct.	100464	Lip Seal, 28/36/72/100/150/212 Ct. Aerodyn SR	1
O-Ring Kit, 212 Ct.	106642	O-Ring Kit, 212 Ct., SR	1
PCB, 212 Ct.	105425	Assy, 212 Ct., PCB	1
Quill Shaft, 212 Ct.	105397	Quill Shaft, 1 x 3/4 x 5.784 long, Torlon, 212 Ct.	1
Quill Shaft, 212 Ct.	105322	Quill Shaft, 3/4 x 3/4 x 1.500 long, 17-4, 212 Ct.	1
Quill Shaft, 212 Ct.	105530	Quill Shaft, 3/4 x 3/4 x 2.494 long, 17-4, 212 Ct.	1
Quill Shaft, 212 Ct.	106687	Quill Shaft, 5/8 x 3/4 x 2.570 long, 17-4, 212 Ct.	1
Quill Shaft, 212 Ct.	105879	Quill Shaft, 7/8 x 7/8 x 4.100 long, 440SS, 212 Ct.	1
Rotor Assy, 212 Ct.	105416	Assy, 212 Ct., Rotor	1
Spring, 212 Ct.	100759	Wave Spring, W0492-007	1
Spring, 212 Ct.	100762	Wave Spring Washer, W1351-015	1
Spring, 212 Ct.	100769	Wave Spring, SSB-0185	1
AEI 300 Ct. SR Spares			
Bearhug, 300 Ct.	100482	Locknut, Bearhug, BH-03	1
Bearing, 300 Ct.	101453	Bearing, 103HJB	1
Bearing, 300 Ct.	100458	Bearing, 103SST	1
Bearing, 300 Ct.	100460	Bearing, 203SST	1
Bearing, 300 Ct.	100459	Bearing, 203HJB	1
Bearing, 300 Ct.	100449	Bearing, 39H	1
Bearing, 300 Ct.	100446	Bearing, SR3H	1
Brush Assy, 300 Ct.	101458	Assy, 150 Ct., SR, Brush Block, need 2 for quoting	2
Brush Assy, 300 Ct.	102177	Assy, 300 Ct., SR, Brush Block, Fwd	1
Bearing, 300 Ct.	106443	Bearing, C203HJH	1
Gold Pins, 300 Ct.	100017	Double Ended Pins	300
Lip Seal, 300 Ct.	102189	Lip Seal, 300/352 Ct. Aerodyn SR	1
O-Ring Kit, 300 Ct.	106890	O-Ring Kit, 300 Ct., SR	1
PCB, 300 Ct.	103247	Assy, 300 Ct., PCB, Solder Only	1

SLIP RINGS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
AEI 300 Ct. SR Spares, Cont.			
Rotor Assy, 300 Ct.	102176	Assy, 300 Ct., Rotor	1
Spring, 300 Ct.	100759	Wave Spring, W0492-007	1
Spring, 300 Ct.	100762	Wave Spring Washer, W1351-015	1
Spring, 300 Ct.	102188	Wave Spring, SSB0102	1
AEI 352 Ct. SR Spares			
Bearhug, 352 Ct.	100482	Locknut, Bearhug, BH-03	1
Bearing, 352 Ct.	101453	Bearing, 103HJB	1
Bearing, 352 Ct.	100458	Bearing, 103SST	1
Bearing, 352 Ct.	100460	Bearing, 203SST	1
Bearing, 352 Ct.	100459	Bearing, 203HJB	1
Bearing, 352 Ct.	100449	Bearing, 39H	1
Bearing, 352 Ct.	100446	Bearing, SR3H	1
Brush Assy, 352 Ct.	104260	Assy, 352 Ct., SR, Brush Block, Aft, Even	1
Brush Assy, 352 Ct.	103959	Assy, 352 Ct., SR, Brush Block, Aft, Odd	1
Brush Assy, 352 Ct.	104261	Assy, 352 Ct., SR, Brush Block, Fwd, Even	1
Brush Assy, 352 Ct.	103958	Assy, 352 Ct., SR, Brush Block, Fwd, Odd	1
Drive Insert, 352 Ct.	103985	352 Ct., Customer Drive Insert, 1.000 Hex	1
Drive Insert, 352 Ct.	103996	352 Ct., Drive Insert, 1.000 Hex	1
Fastener Kit, 352 Ct.	106885	Assy, 352 Ct., SR, Screw Kit	1
Gold Pins, 352 Ct.	100017	Double Ended Pins	352
Lip Seal, 352 Ct.	102189	Lip Seal, 300/352 Ct. Aerodyn SR	1
O-Ring Kit, 352 Ct.	106889	O-Ring Kit, 352 Ct., SR	1
PCB, 352 Ct.	104331	352 Ct., Circuit Board, Install Side	1
Quill Shaft, 352 Ct.	103994	Quill Shaft, 1 x 1 x 2.000 long, 17-4, 352 Ct.	1
Retaining Ring, 352 Ct.	104000	Retaining Ring, WH-156	1
Retaining Ring, 352 Ct.	104001	Retaining Ring, WH-175	1
Retaining Ring, 352 Ct.	104002	Retaining Ring, WH-225	1
Retaining Ring, 352 Ct.	104003	Retaining Ring, WH-725	1
Retaining Ring, 352 Ct.	104004	Retaining Ring, WSM-255	1
Rotor Assy, 352 Ct.	103926	Assy, 352 Ct., Rotor	1
Spring, 352 Ct.	100759	Wave Spring, W0492-007	1
Spring, 352 Ct.	100762	Wave Spring Washer, W1351-015	2
Spring, 352 Ct.	102188	Wave Spring, SSB0102	1
AEI 424 Ct. SR Spares			
Bearhug, 424 Ct.	100806	Locknut, Bearhug, BH-05	1
Bearing, 424 Ct.	100448	Bearing, 105HJB	1
Bearing, 424 Ct.	100450	Bearing, 105SST	1
Bearing, 424 Ct.	102501	Bearing, 109HX	1
Bearing, 424 Ct.	100498	Bearing, 205HJB	1
Bearing, 424 Ct.	100451	Bearing, 205SST	1
Bearing, 424 Ct.	100449	Bearing, 39H	1
Bearing, 424 Ct.	100446	Bearing, SR3H	1
Brush Assy, 424 Ct.	102221	Assy, 212/424 Ct., SR, Brush Block, Aft/Fwd	2
Brush Assy, 424 Ct.	102220	Assy, 424 Ct., SR, Brush Block, Fwd	2
Connector, 424 Ct.	101286	Backshell, Connector	2
Connector, 424 Ct.	100788	Connector, Harness End, 424 S/R	2
Connector, 424 Ct.	101275	Connector, Output, 424/212 Ct., SR	2
Fastener Kit, 424 Ct.	102896	Assy, 424 Ct., SR, Screw Kit	1
Gold Pins, 424 Ct.	100017	Double Ended Pins	424
Hex Insert, 424 Ct.	100395	424 Ct., IBA, Hex Insert, 1.500 Hex	1
Drive Insert, 424 Ct.	101707	424 Ct., IBA, Drive Insert, 1.250 OCT	1
Lip Seal, 424 Ct.	100463	Lip Seal, 424 Ct. Aerodyn SR	1

SLIP RINGS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
AEI 424 Ct. SR Spares, Cont.			
O-Ring Kit, 424 Ct.	106841	O-Ring Kit, 424 Ct., SR	4
PCB, 424 Ct.	104777	Assy, 424 Ct., PCB, 2 RTDs and Rivets	1
Quill Shaft, 424 Ct.	106267	Quill Shaft, 1 x 1.5 x 5.470 long, Torlon, 424 Ct.	1
Quill Shaft, 424 Ct.	104452	Quill Shaft, 1.25 x 1.25 x 4.440 long, 17-4, 424 Ct.	1
Quill Shaft, 424 Ct.	100764	Quill Shaft, 1.5 x 1.5 x 3.400 long, 17-4, 424 Ct.	1
Quill Shaft, 424 Ct.	102247	Quill Shaft, 1.5 x 2.05 x 7.063 long, 17-4, 424 Ct.	1
Quill Shaft, 424 Ct.	104451	Quill Shaft, 1.75 x 1.75 x 2.859 long, 17-4, 484/424 Ct.	1
Quill Shaft, 424 Ct.	104545	Quill Shaft, 1/2 x 1.75 x 5.345 long, Torlon, 484/424 Ct.	1
Quill Shaft, 424 Ct.	104544	Quill Shaft, 1/2 x 2.05 x 5.345 long, 17-4, 556/424 Ct.	1
Rotor Assy, 424 Ct.	101040	Assy, 424 Ct., Rotor	1
Spring, 424 Ct.	100759	Wave Spring, W0492-007	1
Spring, 424 Ct.	100767	Wave Spring, SSB-0102	1
Spring, 424 Ct.	100769	Wave Spring, SSB-0185	1
Spring, 424 Ct.	100768	Wave Spring, SSB-0295	1
QAT 28 Ct. SR Spares			
Brush Assy, QAT 28 Ct.	103927	Assy, QAT 28, SR, Brush Block	1
Gold Pins, QAT 28 Ct.	100017	Double Ended Pins	28
PCB, QAT 28 Ct.	106275	Assy, 28 Ct., PCB, Rivets, RTD	1
PCB, QAT 28 Ct.	106277	Assy, 28 Ct., PCB, Sockets and Rivets	1
PCB, QAT 28 Ct.	106276	Assy, 28 Ct., PCB, Sockets and RTD	1
PCB, QAT 28 Ct.	106278	Assy, 28 Ct., PCB, Sockets, RTD, and Rivets	1
PCB, QAT 28 Ct.	101837	Assy, 28 Ct., PCB, Sockets Only	1
Rotor Assy, QAT 28 Ct.	100440	Assy, 28 Ct., Rotor, Rotor Refurbishment	1
QAT 100 Ct. SR Spares			
Bearing, QAT 100 Ct.	100459	Bearing, 203HJB	2
Bearing, QAT 100 Ct.	100460	Bearing, 203SST	2
Bearing, QAT 100 Ct.	100446	Bearing, SR3H	1
Brush Assy, QAT 100 Ct.	100040	Assy, QAT 100 Ct., SR, Brush Block	2
Connector, QAT 100 Ct.	100653	Connector, 100 Mating SR	1
Connector, QAT 100 Ct.	100652	Sockets, Connector, QAT Mating 100 SR	104
Connector, QAT 100 Ct.	100818	Strain Relief, QAT 100 Ct., SR, Mating Connector	1
Wire Harness, QAT 100 Ct.	101322	Assy, QAT 100, SR, Output Wire	1
Gold Pins, QAT 100 Ct.	100017	Double Ended Pins	100
Gasket, QAT 100 Ct.	100774	QAT 100 Ct., SR, Gasket	1
Drive Insert, QAT 100 Ct.	100030	72/100 Ct., SR, Customer Drive Insert, .500 Hex	100
Hex Insert, QAT 100 Ct.	104314	QAT 100 Ct., IBA, Hex Insert	1
Fastener Kit, QAT 100 Ct.	101321	Assy, QAT 100 Ct., SR, Screw Kit	1
Lip Seal, QAT 100 Ct.	100464	Lip Seal, 28/36/72/100/150/212 Ct. Aerodyn SR	1
O-Ring Kit, QAT 100 Ct.	100319	O-Ring Kit, QAT 100 Ct., SR	1
Rotor Assy, QAT 100 Ct.	101048	Assy, QAT 100, Rotor	1
Spring, QAT 100 Ct.	100019	Wave Spring, W0367-006, Tail Brg.	1
QAT 300 Ct. SR Spares			
Brush Assy, QAT 300 Ct.	103579	Assy, 300 Ct., SR, Brush Block, Aft, Refurb	2
Brush Assy, QAT 300 Ct.	103584	Assy, 300 Ct., SR, Brush Block, Fwd, Rotor Refurb	2
Gold Pins, QAT 300 Ct.	100017	Double Ended Pins	300
PCB, QAT 300 Ct.	103247	Assy, 300 Ct., PCB, Solder Only	1
PCB, QAT 300 Ct.	101311	Assy, QAT 300 Ct., PCB, RTD Only	1
Rotor Assy, QAT 300 Ct.	101838	Assy, QAT 300, Rotor	1

TOOLS PARTS LIST

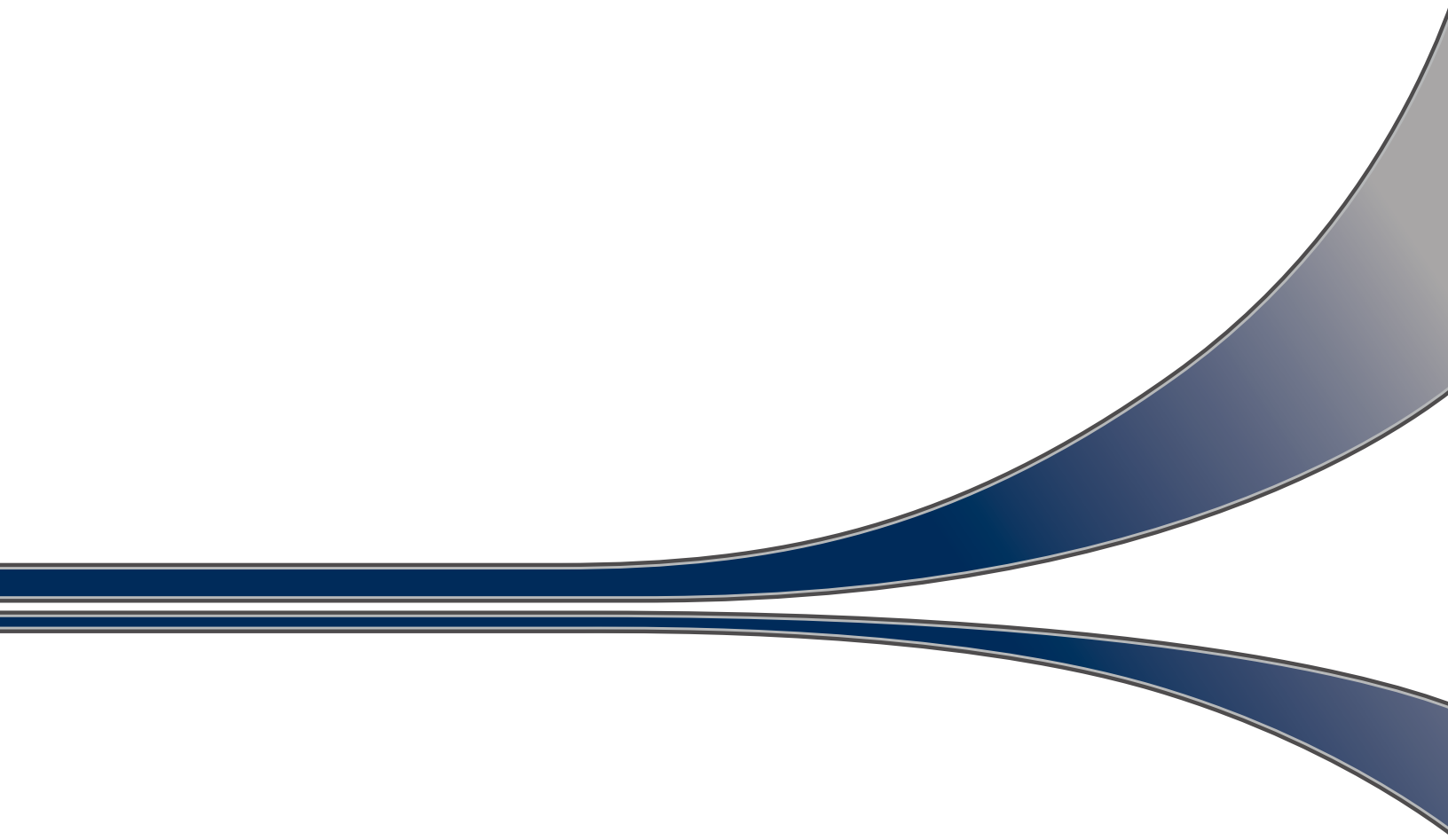
CATEGORY	AE P/N	DESCRIPTION	QUANTITY
Tools			
Crimp Tool	101277	Crimp Tool, Output Connector Socket	Each
Crimp Tool	101279	Insert / Extract	Each
Crimp Tool	101282	Crimp Tool Locator	Each
Crimp Tool	101440	Tool, Extract, 155 Pin Connector	Each
Crimp Tool	101278	Crimp Tool Locator	Each
Crimp Tool	101283	Crimp Tool Locator, Output Connector Socket	Each
Crimp Tool	101284	Insert / Extract Tool Steel, Tool, Output Connector Socket (Steel)	Each
Crimp Tool	106508	Insert / Extract Tool – Plastic	Each
Hex Key	103868	Hex L-Key, .035 , Short Arm	Each

COOLING SYSTEMS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
Coolants/Fluids			
AK-225	101657	AK-225 Coolant (above 20,000 rpm)	5 gal
Syltherm XLT	101849	Syltherm XLT (under 20,000 rpm)	5 gal
Oil for Air Mist	105168	Mobil Jet Oil II	qt

COOLING CARTS PARTS LIST

CATEGORY	AE P/N	DESCRIPTION	QUANTITY
Cooling Carts			
Cooling Cart Purchase		Cooling Cart (does not include Fluid, Hoses, etc.)	Each
Cooling Cart Rental		Cooling Cart Rental (does not include Coolant)	Month
Cooling Cart Rental		Cooling Cart Rental with Heating or Cooling	Month
Vogel Oil Air Mist System	105415	Vogel Oil Air Mist System	Month
CC Spare Parts			
Oil Air Mist System	105415	Oil Air Mist System	Each
Relay	100175	Relay, Latching, Pump Start/Stop	Each
UPS	100191	UPS	Each
Flow Meter	100204	Flow Meter	Each
Battery	106179	Battery, 12V	Each
Pressure Gauge	106180	Pressure Gauge, 1/4" NPT (including bracket)	Each
Gear Pump	101397	Pump, Gear, Magnetically Coupled with Motor	Each
Filter Housing	101398	Filter Housing, Stainless 10"	Each
Filter Cartridge	101399	Filter Cartridge, SS, Pleated	Each
O-Ring	101400	O-Ring, Filter Housing	Each
Relay	101573	Relay, 230 VAC Coil	Each
Power Supply	102155	24 VDC Power Supply	Each
Relay	102871	Relay, 24 VDC Solid State	Each
Hoses	102409	Hose, 3/8" OD 316SS Core with 304SS Overbraid, 15' long	Each
Hoses	102408	Hose, 3/8" OD 316SS Core with 304SS Overbraid, 20' long	Each



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