



Motors

Induction & Synchronous Motors

100 - 20,000 HP
75 - 15,000 kW

*PegasusTM MHV
QuantumTM LMV
Custom 8000TM*



Experience Matters



We've manufactured motors for over 125 years.

In 1879, GE founder, Thomas Edison constructed the first electric motor for a 110 to 120 Volt line at Menlo Park, NJ. This device still exists and is operative! It is located in the Edison Historical Collection in New Jersey.

Since 1987, GE has produced over 15,000 medium/high voltage machines. We've been a certified ISO 9001:2000 Quality System since 1992. Six Sigma processes have been hardwired into our manufacturing processes since 1995. And now we presently offer a full range of large motors and generators up to 100,000HP (75,000KW).

Applications

These motors are designed and manufactured to operate efficiently in environments and industries where reliability, ruggedness, and easy maintenance are critical. Examples include pumps, compressors, fans, refineries, mixers, conveyors, mills plus many others.

Industries

- Power & Energy
- Oil & Gas
- Chemical & Petrochemical
- Mining
- Pulp & Paper
- Mining & Metals
- Cement
- Water and Wastewater
- Auto
- Marine

Standards & Codes

GE Motors can hold to these standards and certifications: NEMA, IEC, CSA, API 541 & 547, ATEX, GOST, ABS, NEC DIV 2, Ex-e and Ex-n for Zone 2, Ex-p for Zone 1 or 2.



Squirrel Cage Induction Motors

Simplicity, Low Cost, Adaptability

- Horizontal and Vertical
- Solid and Hollow Shaft
- 100 - 20,000 hp, Up to 16,000 Volts

The squirrel cage induction motor is the one most widely used for driving pumps, fans and compressors. Its advantages include an inherent simplicity in both motor construction and control, lower initial cost particularly in the smaller ratings, and adaptability to the worst of environments. Squirrel cage motors are available with either standard or premium efficiency. Special designs and features are available for variable frequency supply applications.



Wound-Rotor Induction Motors

Soft Start, Adjustable Speed

- Horizontal
- 100 - 15,000 hp, Up to 16,000 Volts

The wound-rotor induction motor, although more expensive than the squirrel cage motor, has some distinct application advantages. Historically it has been used for hard-to-start, high inertia fans, or where power system requirements demand a soft start. With a liquid rheostat, or a static secondary speed control, the wound-rotor is an important alternative drive where limited range adjustable speed is required.



Synchronous Motors

High Efficiency, Power Factor Control

- Horizontal and Vertical
- 300 - 7500 hp, Up to 16,000 Volts

Because of its higher efficiency and special ability to provide a system power factor improvement, the synchronous motor is often the choice for large drivers. Its large air gap relative to that in an induction motor allows the use of larger stator slots. This is an important advantage for high voltage, high power applications. Additionally the designer has greater flexibility in combining starting torques and other characteristics to match widely varying system requirements.

Enclosures Designed for Performance



Dripproof (DPG)

This standard enclosure is suitable for most indoor industrial conditions. Cooling air enters through the end-shields at both ends, passes over the coil end-turns, the rotor and stator, then exits through openings in the sides of the frame.

Louvered openings provide protection greater than required by NEMA standards. Air flow is designed carefully to eliminate hot spots and minimize noise. For larger ratings, or for special quieter operating designs, cooling air intake and discharge openings are located in an easily removed "top hat" enclosure. Cooling air enters through both ends of the top hat, passes through the machine as in the standard dripproof motor, and exits through openings in the side of the top hat. Louvered openings provide protection greater than NEMA drip-proof standards.

This type enclosure will be used when filters and/or low noise levels are specified.



Totally Enclosed Water-to-Air Cooled (TEWAC) - IP54 or IP55

The TEWAC enclosure isolates all critical motor components from its surroundings. Consequently, it can be used indoors or out in clean or dirty environments. It is provided with a water-cooled heat exchanger mounted in the top portion of the motor for cooling the recirculated ventilating air. Motor heat is conducted away by circulating water and not by discharged hot air. Thus it is suitable for confined areas. It is also the quietest of all available enclosures.



Weather Protected Type I (WPI)

A weather protected Type I machine is an open machine with its ventilating passages constructed to minimize the entrance of rain, snow, and air-borne particles to the electric parts.

Its ventilation openings are also constructed to prevent the passage of a cylindrical rod 0.75"/19 mm in diameter.

Features included with this enclosure:

- Custom Polyseal® sealed stator winding insulation
- Bearing protection
- Special attention to leads and lead exits from the motor frame into the conduit box
- Weatherproof conduit box
- Anti-corrosion treatment on both external and internal metal parts
- Corrosion resistant guard screens
- Space Heaters



Weather Protected Type II (WP2)

This enclosure is designed for use outdoors in adverse conditions. Air intake is in the removable top hat portion to minimize entrance of ground level dirt, rain or snow, or heavy gas concentrations.

This enclosure can be modified to include filters for extremely dirt conditions. Air passage includes several abrupt 90 degree changes in direction plus an intake area of reduced velocity to allow solid particles or moisture to drop out before the ventilating air contacts active parts of the motor. Inlet and exhaust openings permit a direct blow through of high velocity winds and airborne particles. Thus, all but super-fine dust and foreign material is virtually eliminated.



Totally Enclosed Fan Cooled (TEFC) - IP54 or IP55

A Totally Enclosed Fan Cooled (TEFC) motor can be applied in applications, which are indoor or outdoor, and is generally used when a corrosive or hazardous atmosphere is present.

The enclosure is designed to keep the external atmosphere of the motor separated from the internal component of the motor. The frame is ribbed and the end-shields are constructed out of cast iron, which provides rigidity and adds to the cooling capacity. The cooling fan (typically located opposite of the drive end) is attached to the motor shaft and is protected by a fan cover. The fan cover has a grill, which allows the passage of ambient air drawing in by the rotation of the fan. The air is then directed over the length of the ribbed frame of the motor.

Totally Enclosed Air-to-Air Cooled (TEAAC) - IP54 or IP55

TEAAC enclosure also provides isolation of critical motor components from the surroundings. In contrast to the TEWAC however, the TEAAC enclosure discharges the waste heat in the immediate area of the motor. The construction of this enclosure utilizes a top mounted air-to-air heat exchanger. External air is drawn in by a shaft mounted fan enclosed in a housing on the end opposite the drive. This air is forced through the cooling tubes at high velocity to promote efficient cooling and cleaning of the tubes. Cooling is accomplished by circulating the internal air over the heat exchanger tubes where the heat is dissipated and the cool air is returned to the active parts of the machine.

Superior Construction

Stator Frame And Magnetic Core

- **Strong**
- **Accessible**
- **Long and Trouble Free Life**

Designed to provide optimum physical protection and good accessibility for inspection. The heavy duty stator frame and end-shields are made of fabricated steel or cast-iron ribbed-construction to maintain alignment. Stator laminations are precision punched from high quality, low loss electrical sheet steel and coated with a thermally stable insulating film. Most ratings are of rectangular frame construction, utilizing packaged cores. The magnetic core consists of laminations highly compressed for mechanical strength and completely wound before the core package is inserted into the frame. This construction permits free access to the coil end-turns during manufacture and simplifies insertion of the winding and bracing systems. This visual accessibility also helps to ensure increased quality in manufacturing.



Insulation System

- **High Dielectric Strength**
- **Stable**
- **Contaminant Resistant**

This insulation system helps to ensure long life and reliability and meets the stringent mechanical and thermal requirements of today's applications. One material alone does not have all the properties needed. Therefore an epoxy solventless resin vacuum-pressure-impregnation (VPI) process is used to unite superior insulation materials into a complete insulation system creating a reduced voids structure and assuring long life and reliability. The insulation begins with the strand insulation materials selected for the individual machine design on the basis of expected surge levels, operating temperature and system compatibility. The turn insulation materials range from several types of enamel insulation, or double polyglass insulation to micaceous tape covering each turn or conductor group.



Insulation System Quality Assurance

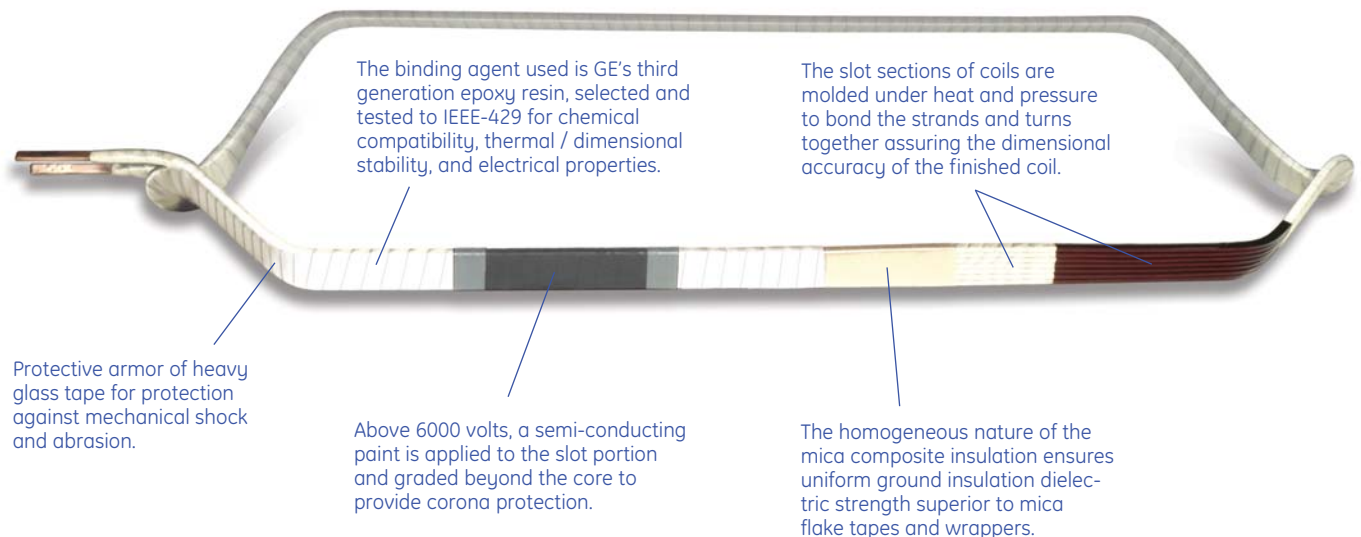
Many tests are made during the manufacture of the windings to assure that each machine meets the high standards set for quality materials and manufacturing processes. High potential tests are conducted at various stages of manufacturing. Following insertion of the coils into the stator slots, each coil is subjected to an impulse test of the turn insulation. Finally, prior to shipment, the standard IEC high-potential test of twice rated voltage plus 1000 volts is applied to the completed stator. When required, a sealed winding conformance test is provided as an option.



Coil Insulation

Special care is taken at the coil lead termination during taping to assure the filling of all voids at this critical point.

Once assembled, the coils are inserted into the stator slots and the end connections are brazed and taped. GE's Coil Lock bracing system supports the coils and makes the entire structure more rigid.



Rotors

Squirrel Cage Rotor

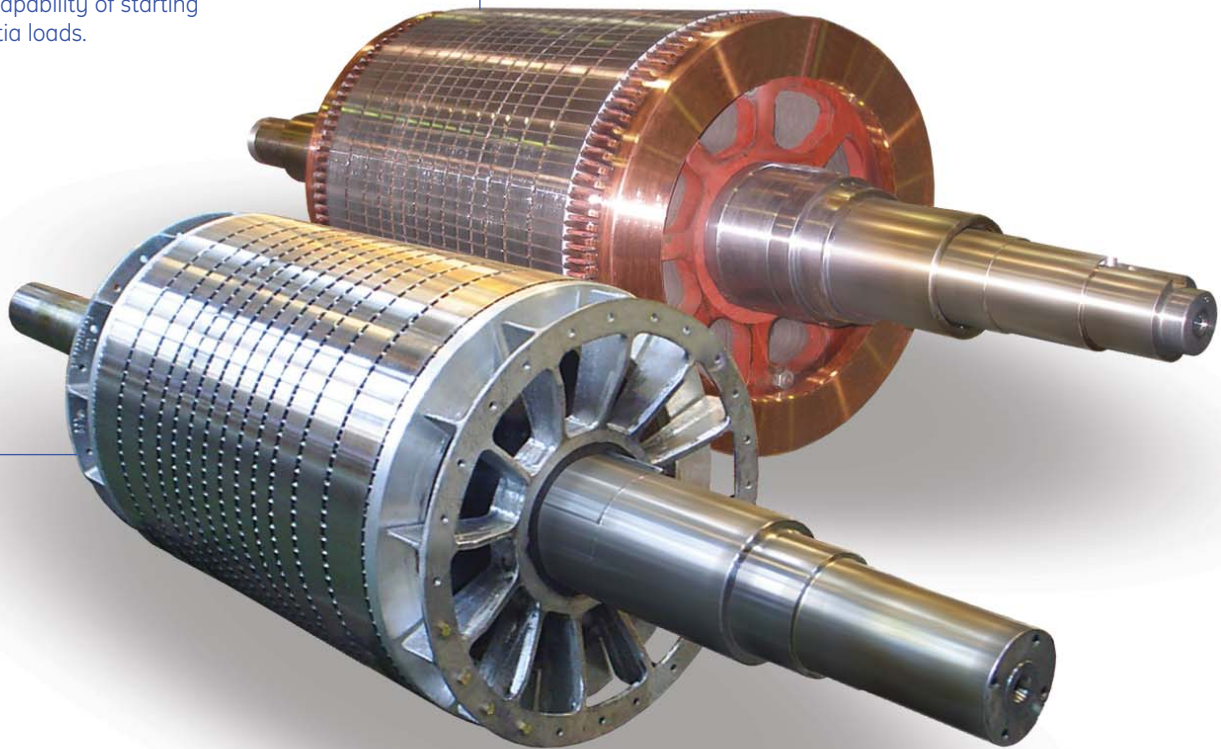
- **Lower Rotor Inertia**
- **Greater Stall Time**
- **Strong Bar to End-Ring Joints**
- **Reduced Windage Noise**
- **Optimum Torque vs. Slip Design**

The squirrel cage induction motor is basically a rugged yet simple arrangement of shaft, magnetic circuit and electric winding. The magnetic circuit consists of discs punched from electrical grade thin sheet steel assembled to form a laminated magnetic

core mounted on the shaft. The laminations are coated with a thermally stable insulating film to reduce magnetic losses and yet maintain dimensional stability in the face of the severe thermal and mechanical stresses of starting as well as normal operation. The rotor winding consists of a number of uninsulated metal bars in the outer surface of the magnetic core parallel to the shaft and short circuited by metal rings at both ends. Fabricated aluminum or copper rotor construction is available for Custom 8000® and Pegasus™ MHV motors.

Copper Squirrel Cage Construction

- Copper bar rotor construction is available upon request or to meet API 541 4th Edition Specification.
- Greater capability of starting high inertia loads.



Aluminum Squirrel Cage Construction

- Fabricated aluminum rotor windings are repairable. GE Motors AI-Tight® construction is available now on fabricated aluminum rotors. This new process technique assures rotor integrity and reliable performance.
- Bar tension maintains punching tightness.
- A larger number of rotor bar shapes for optimum torque vs. slip designs.
- Cage migration eliminated with end-rings tight against the punchings.
- Lower rotor inertia. Lower weight bars and end-rings reduce the centrifugal force, retaining rings are not required on the end-ring for standard designs.
- Closed rotor slots, reduced windage noise.

Synchronous Rotor

- *Starting Winding Versatility*
- *Brushless Excitation for Minimum Maintenance and Maximum Reliability*

Synchronous rotors are designed primarily for applications requiring highly efficient motors. Each pole assembly is made from high strength steel laminations with a DC field winding encircling the pole body. The field winding consists of a rectangular section of insulated copper wire wound directly on an insulated pole body and bonded by a high temperature, high strength insulating epoxy resin which, when cured, results in a coil impervious to dirt, moisture and other contaminants. Synchronous motors are provided with an Amortisseur, or starting winding, consisting of copper alloy bars located in the pole face, parallel to the shaft, and brazed at the ends to copper alloy rings. The Amortisseur winding is tailored for the application to provide the required starting performance. Several types of synchronous rotor construction are used depending on the size and speed. All 4 pole motors have a laminated rotor of which the poles are an integral part.

Slower speed machines utilize individually removable laminated poles dovetailed or bolted to the spider. Motors with dovetailed poles generally have a laminated spider shrunk on and keyed to the shaft. A shaft mounted brushless excitation system is most generally used. Brushless excitation requires less maintenance with no brushes to change and is ideally suited for hazardous or contaminated environments.

The system includes:

- An easily controlled stationary exciter field,
- An exciter rotating element in which multiphase AC power is generated,
- A rotor-mounted rectifier system consisting of silicon diodes, thyristors and static switching devices.

A full line of slip ring synchronous motors is also available.

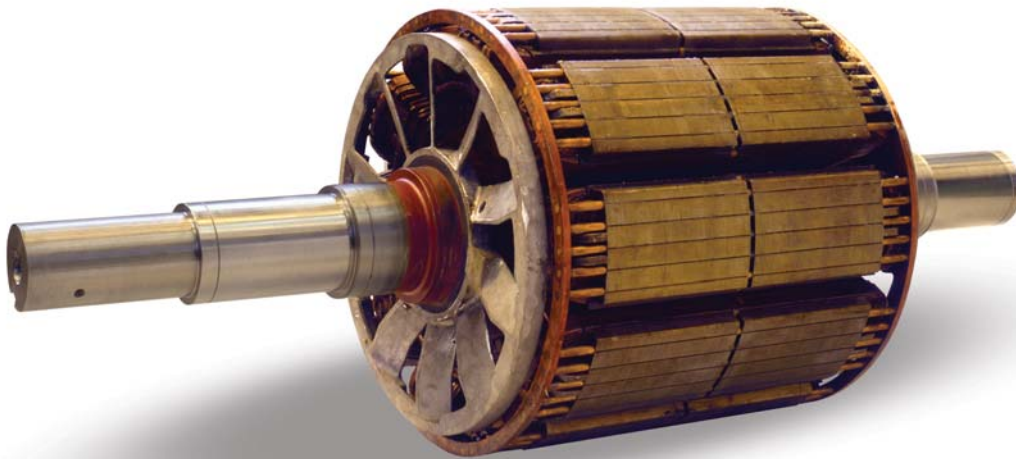
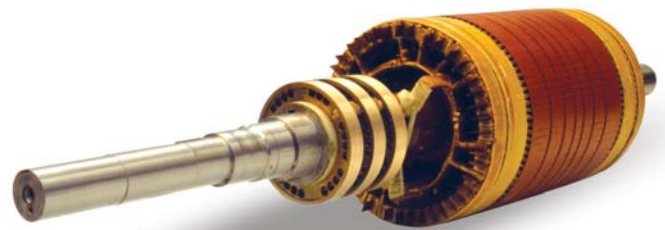
Wound Rotor

- *Versatile*
- *Adjustable Speed*
- *Soft Starts*

Some applications require an induction motor with a provision for changing the impedance of the rotor winding for adjustable speed operation or soft start. The wound rotor winding is phase wound with the same number of poles as the stator so that it may be connected through its slip-rings to a variable external impedance such as the liquid rheostat or other speed control system.

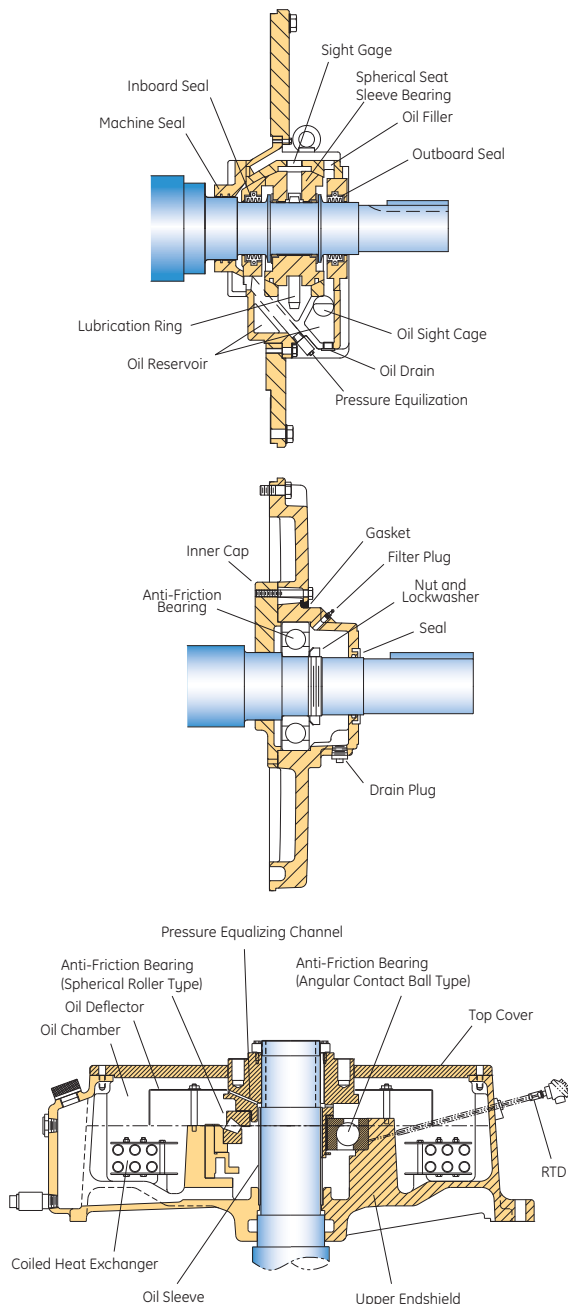
The magnetic construction of the wound rotor is similar to the squirrel cage motor. However, the rotor winding is fully insulated to ground for all expected continuous and transient operating voltage levels and connected to have the same number of poles as the stator winding. Since they are subject to severe mechanical forces, the rotor winding end-turns are constrained with glass banding bonded with a high temperature, high strength, thermosetting resin.

The rotor winding is connected to the stationary control elements by collector rings mounted on the shaft. The collector rings are positioned externally to the rest of the motor, when possible, to prevent the brush dust from contaminating the rotor and stator windings.



Balancing

After assembly, all rotors are dynamically balanced to the API 541 balancing grade to achieve quiet running and long bearing life. API 541 balancing grade is less than one-third of the ISO 2.5 balancing grade usually adopted by the industry. Step balancing techniques according to API 541 are applied to all 4-pole spider shaft designs and all 2-pole machines. All 2-pole flexible rotor designs have a central rotor balancing plane according to API 541. The balancing machines are capable of balancing even the largest rotors prior to assembly. The completed motor is run at no-load rated voltage and frequency for a final check to make certain vibration is within the required limits. This sophisticated vibration monitoring system meets API Standard requirements.



Sleeve Bearings

Self-aligning spherical-seat bearings are used on machines requiring the capability and performance of sleeve bearings. They employ construction features and sealing systems designed to keep the oil in and the dirt out. With seal additions the motor can conform to the IP-55 (dust & water jet) standard. The babbitt-lined bearing shell is supported by a rugged housing and employs an oil ring that carries the oil from the reservoir up to the bearing. The opposite drive end bearing is insulated to minimize damaging shaft currents. Sight holes and split construction allow easy inspection and replacement without uncoupling the driven load.

Anti-Friction Bearings

Ball or roller type bearings on horizontal machines are selected based on customer requirements. They are regreasable and operate smoothly providing long life with low running bearing noise. They are also assembled with grease in a sealed housing to avoid contamination. The lubrication system includes a well sized relief plug to allow the purging of excess or old grease during relubrication. External, labyrinth seals can be added to horizontal machines to provide IP-56 (Dust exclusion) protection capability.

Vertical Thrust Bearings

Thrust bearings such as angular contact ball (anti-friction), spherical roller (anti-friction) and sleeve tilting pad (hydrodynamic plate bearing) are designed to meet the requirements of load capacity, lifetime and maintenance. Compliance with the API 541 design life and procedure is also available. Regardless their type, thrust bearings are always lubricated by an oil bath. Depending on the speed, lubricating oil, bearing size and type and environmental conditions, bearings are self cooled or water cooled by a coiled heat exchanger placed inside the housing. The picture shows a cut view exemplifying a spherical roller and contact angular type bearings construction.

Stator

| Type | Description | Installation | Qty / Motor | Function |
|------------------|---|----------------------------|--------------------|---|
| RTD | Resistance temperature detector. The following options are available: Copper; 10 ohms @ 25°C Platinum: 100 ohms @ 0°C Nickel: 120 ohms @ 0°C | Inside Stator Coil Slot | 6 Two per phase | May be connected to a monitor, alarm, or shut-off device. |
| Thermostat | Bi-metallic sensor type Klixon® (normally open or normally closed) | Surface of end-turns | 1-3 | Supplies a signal when a preset, non-adjustable temperature is reached, for alarm or shut-off. |
| Thermistor (PTC) | Positive temperature coefficient thermistor connected to a solid state relay | Inside Stator Coil Slot | 6 Two per phase | Together with the solid state relay, supplies a signal when a preset, non-adjustable temperature is reached, for alarm or shut-off. |

Bearings

| Type | Description | Installation | Qty / Motor | Function |
|--------------|---|--------------------|----------------------|---|
| RTD | Resistance temperature detector. The following options are available: Copper; 10 ohms @ 25°C Platinum: 100 ohms @ 0°C Nickel: 120 ohms @ 0°C | In bearing housing | 2 One per bearing | May be connected to a monitor, alarm, or shut-off device. |
| Thermometer | Bi-metallic or capillary tube type | In bearing housing | 2 One per bearing | Supplies local or remote indication of temperature. |
| Thermocouple | Element generating a voltage proportional to temperature | In bearing housing | 2 One per bearing | May be connected to a monitor, alarm, or shut-off device. |

Vibration Equipment

Seismic-type such as Robertshaw™ measures overall vibration. 1-6 units are located on the frame.

Proximity-type such as Bentley Nevada™ measures the shaft vibration. 2-5 units are located on the bearing housing.

Acceleration-type such as Metrix™ measures bearing housing vibration. 1-6 units are located on the bearing housing.

Other Accessories

Whenever required, the following accessories may be supplied:

- Surge protection (capacitors and lightning arresters)
- Current transformers
- Pressure switch
- Space Heater
- Tachometers
- Overspeed switches
- Slide rails
- Sole-plates

GE Motors

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imagination at work

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