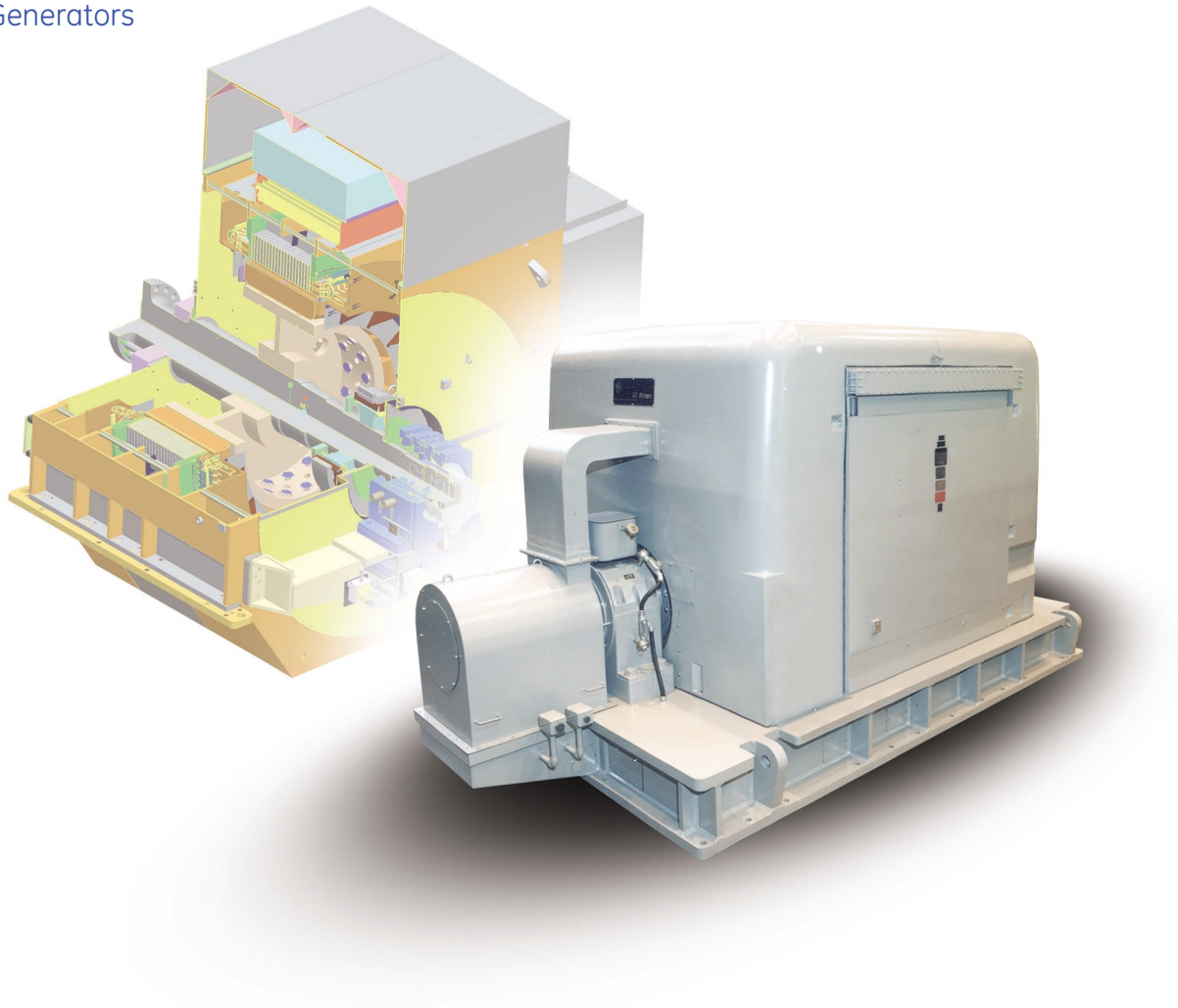
GE
Motors

Series 9000

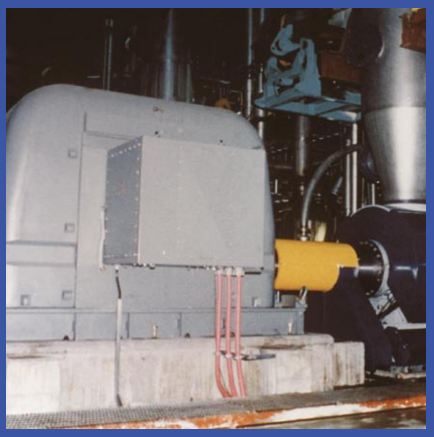
Large Synchronous Machines

Up to 15,000 Volts
Up to 100,000 HP (75,000 kW)
4 Pole and Above
Motors and Generators



imagination at work

Experience is Critical



We've manufactured motors for over 100 years.

GE Motors has the capability to design and manufacture electrical rotating machines up to 100,000 HP, and have supplied over 800,000 HP of motors for variable speed applications. This century of achievement has built a rich tradition of technical excellence, quality and reliability.

Standards & Certifications

GE has the capability to design electrical rotating machines that comply with global standards and certifications, including but not limited to NEMA, IEC, API, Lloyds, ABS, ATEX and PTB. Imperial (english) or metric systems compliant components are available per customer specification.
Our manufacturing facilities are ISO 9001 certified.

Why Synchronous Motors?

- High efficiency - increased operating cost savings
- Low starting current - provides better overall starting capability, which reduces the starting equipment cost.
- Unity or leading power factor – reduced utility penalties associated with lagging power factor.
- Reduced current pulsations for non-steady-state loads, e.g., reciprocating compressors - improved electrical system reliability.

Applications

Compressors, grinding mills, metal rolling, mine hoists, refiners, propulsion, fans, pumps, generators and many others.

Industries

- Oil & Gas
- Mining
- Power & Energy
- Cement
- Metal
- Marine
- Pulp & Paper
- Water & Wastewater
- Other Process Industries

GE Advantages

Quality

- GE motors are legendary for their efficiency, reliability and long life.

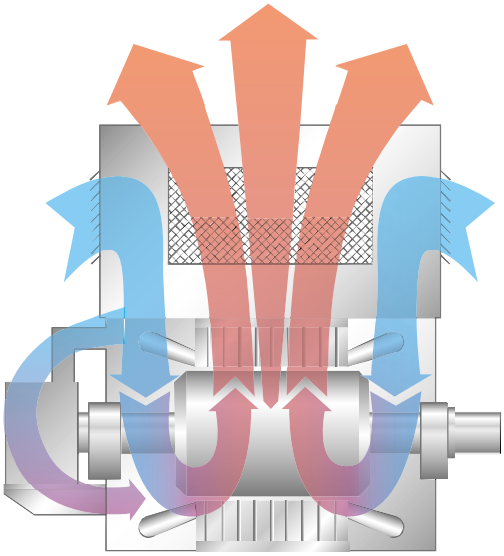
Global Presence

- GE is a global company with operations in over 100 countries and manufacturing facilities in 32 countries

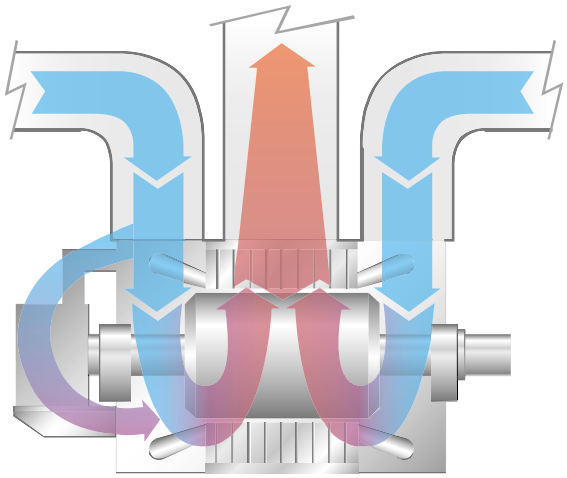
Investing in Products That Customers Need

- Our innovative 4 and 6 pole rotor design made from a single-forging provides maximum reliability.
- Our unique Quadramatic™ load sharing motor system for dramatically improved performance and less wear than traditional grinding mill systems.
- Our unique Rotector II system gathers real time readings and direct measurements to help optimize performance at all times.

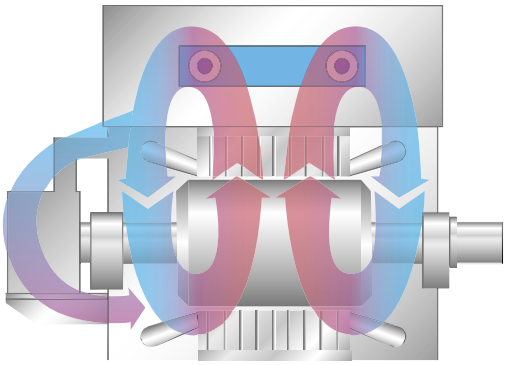
Ventilation, Enclosures & Assembly



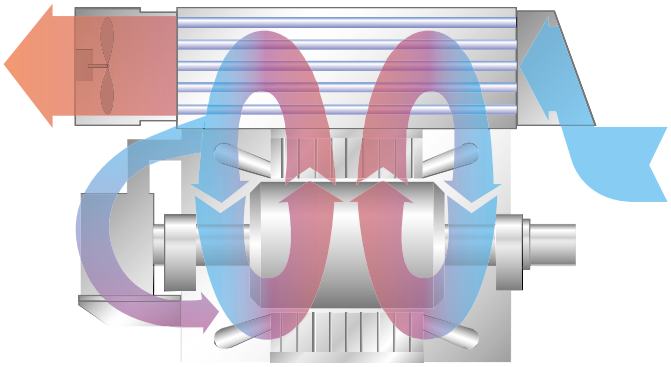
Weather Protected Enclosure
(WPI, WPII, IP24, IC-01)



Totally Enclosed, Force Ventilated Enclosure
(TEFV, IP54, IC-37)



Totally Enclosed, Water-to-Air Cooled Enclosure
(TEWAC, IP54, ICW-86)



Totally Enclosed Air-to-Air Cooled Enclosure
(TEAAC, IP54, IC-48)

Enclosure	NEMA	IP Code	IC Code
Open	Open	IP00	IC-01
Drip Proof	DP	IP12	IC-01
Drip Proof, Fully Guarded	DPFG	IP22	IC-01
Drip Proof, Guarded	DPG	IP22	IC-01
Splash Proof	SP	IP23	IC-01
Weather Protected I	WPI	IP23	IC-01
Weather Protected II	WPII	IP24	IC-01
Totally Enclosed, Water to Air Cooled	TEWAC	IP54	ICW-81
Totally Enclosed, Air to Air Cooled	TEAAC	IP54	IC-616
Totally Enclosed, Force Ventilated	TEFV	IP54	IC-37
Totally Enclosed, Inert Gas Filled	TEWIGF	IP54	ICW-81

All of the above total enclosed options are available with pressure and/or purge systems to hazardous location classifications.

Stator Construction

Stator

The fabricated steel plate stator frame consists of two or more side plates continuously welded to the wrapper plates and rectangular steel block feet to provide a rigid stator support. The strength of this frame maintains a uniform air gap under all operational stresses.

Pre-wound stator core ready for vaccuum pressure impregnation (VPI)

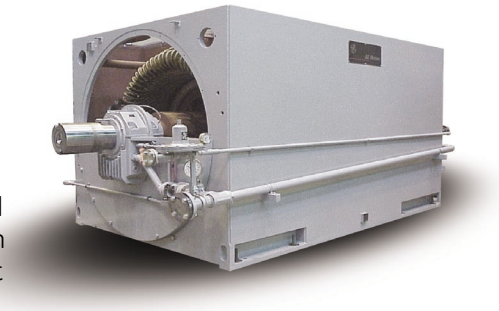
Stator laminations are precision-punched from high-quality low-loss electrical sheet steel which are coated with a thermally stable insulation film (C5 coating) to minimize eddy current losses. The laminations are assembled in accurate alignment within the stator frame to form the stator core. Ventilation ducts are formed from sturdy "I" beams spaced for strength and noise control. The core is clamped under heavy uniform pressure in the frame to prevent distortion. The resulting assembled stator structure has superior strength and rigidity, which will promote quiet performance, long life and trouble-free operation.

Complete stator assembly mounted in frame.

Bracket Frame Stator

GE Motors can manufacture bracket bearing machines up to 67,000 HP (50,000 kW) and offers pedestal bearing machines throughout our product range.

The bracket frame is similar in construction to the Pedestal machines, except that the frame extends past the end of the winding in order to mount heavy gauge fabricated steel endshields and the bearings. This type of machine has the core piled outside of the frame. The core is wound and then mounted into the frame.



Bracket bearing machine construction

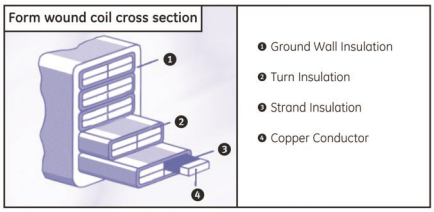
Bracing

Rigid support of the stator coil ends is critical to the ability of the machine to withstand the mechanical forces caused by starting, external short circuits and impact loading. GE's bracing systems are specifically designed for the machine application, and use materials and processes to give optimum strength to withstand the applied mechanical forces.

Insulation is Key

The advanced insulation system provided on all large motor products will reward you with many years of reliable operation, whether on fixed or adjustable speed applications.

GE's insulation systems are designed to minimize the effect of localized electrical stress and reduce the effects of partial discharge, increasing machine life and reliability. Components are carefully chosen for compatibility with the system as a whole. The insulation system is subjected to rigorous testing according to applicable IEEE, IEC, NEMA and API standards.



All but the very largest wound stators undergo global vacuum-pressure impregnation (VPI) treatment. This process employs automated capacitance monitoring to ensure that each stator winding is fully impregnated with epoxy resin. After curing, it binds the stator components into a solid and rigid structure with excellent dielectric strength, dimensional stability, and mechanical strength. It also increases the resistance of the winding to thermal shock, moisture and other contaminants.

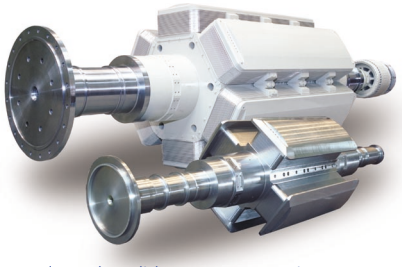
Adjustable frequency drives can place additional stresses on the machine's insulation system. GE has significant experience with these technical requirements and is able to tailor the motor and motor insulation systems to meet the most demanding applications.

Rotor Construction

High Speed

4-6 Pole Solid Rotors

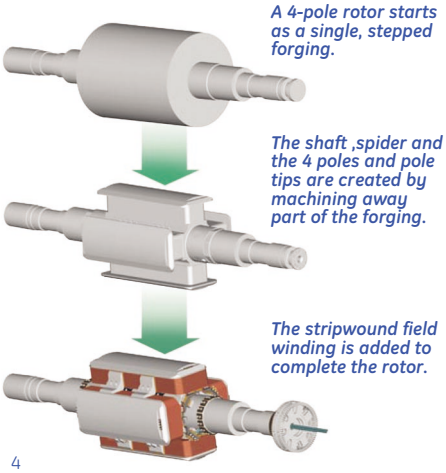
High speed rotors need maximum strength and stiffness to provide a long life. GE Motors makes its high speed rotor from a solid cylindrical forging and machines out the pole bodies and pole tips. The field windings are edge wound copper strips with dimensionally stable insulation material bonded between the turns. Every turn has mechanically locked and brazed corner joints for maximum strength and every other turn is larger for more efficient cooling.



4 and 6 pole solid rotor construction

GE Solid Rotor Design Benefits

- High thermal capacity – more frequent starts and/or high load inertia capability
- High operating efficiency leads to minimal operating costs
- Fewer components
- Reduced mechanical stress
- Improved mechanical stability from minimal vibration levels
- Proven experience from a technology innovator



A 4-pole rotor starts as a single, stepped forging.

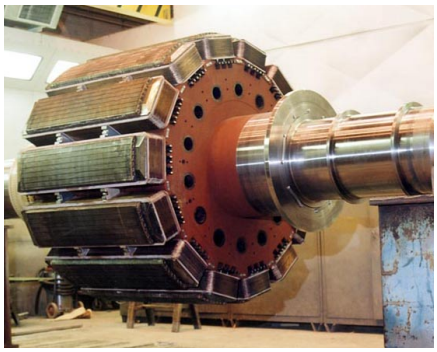
The shaft ,spider and the 4 poles and pole tips are created by machining away part of the forging.

The stripwound field winding is added to complete the rotor.

Medium Speed

8-14 Pole Rotor Construction

Medium speed machine shafts are manufactured of forged or rolled steel and machined to exact application specifications. The shaft ends are normally cylindrical, tapered or flanged.



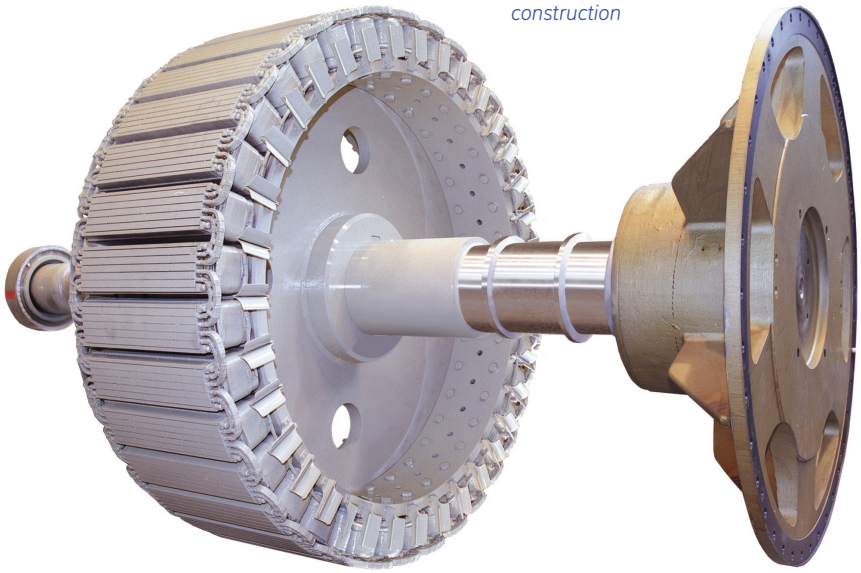
Strip wound field poles,are slid onto the spider and locked into place with steel keys.

Low Speed

Greater than 14 poles

Low speed machine designs are another strength for GE Motors. Our rotor designs typically include a forged steel shaft along with a fabricated steel hub, web and rim to support the field windings. The rim diameter and thickness is selected to suit the inertia requirements as well as meet the electrical requirements of the design. Field windings are optimized to suit the application utilizing rectangular copper wire or copper strip – all provided with our well-proven Class F insulation system. The amortisseur winding design, a key to reliability, is also optimized to suit the specific application.

Slow speed bolted pole Quadramatic™ rotor construction

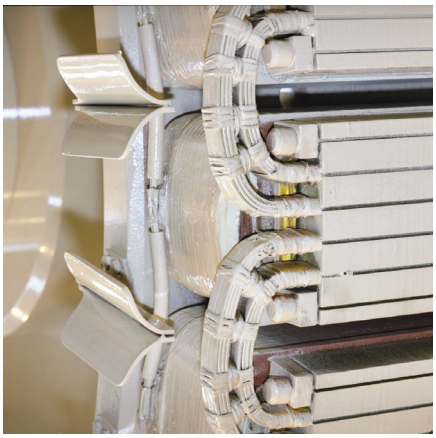


Customer Solutions

Quadramatic

Load Sharing Drive

For grinding mill applications, GE has developed a drive using two, high efficiency, synchronous motor driven pinions on one bull gear. A Quadramatic™ load sharing drive uses a special winding in addition to the amortisseur winding to dynamically alter the rotor flux. These continuous adjustments maintain the load sharing between the two pinions reducing wear and improving performance.



Close up of a Quadrature Axis winding on a bi-directional rotor

Excitation

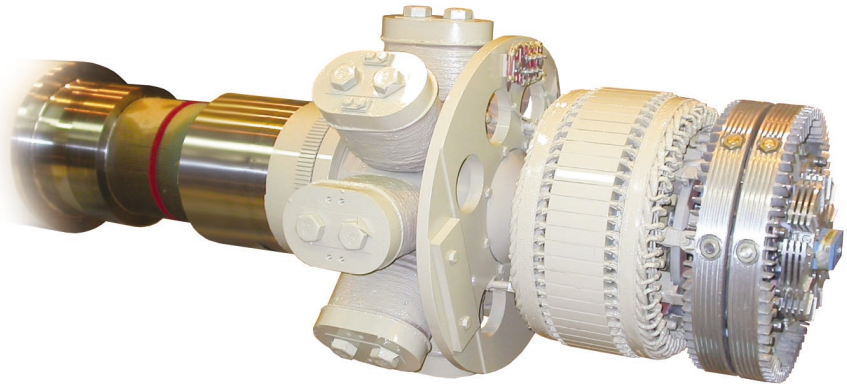
Brushless Excitation System

This arrangement is generally used across all segments of industry as it requires minimal maintenance and is well suited for hazardous or contaminated environments. The solid state components utilized are liberally rated and chosen specifically to endure the high mechanical and electrical stresses experienced on the most challenging applications.

Collector Ring Excitation

This arrangement consists of carbon steel or stainless steel slip rings mounted on, and insulated from, the rotor shaft. The rings have a grooved surface to ensure effective cooling and proper current sharing among the brushes. Depending upon current loading, additional cooling can be provided by means of annular cooling fins. This arrangement is commonly used on high performance variable speed motor applications where a particularly fast response may be required.

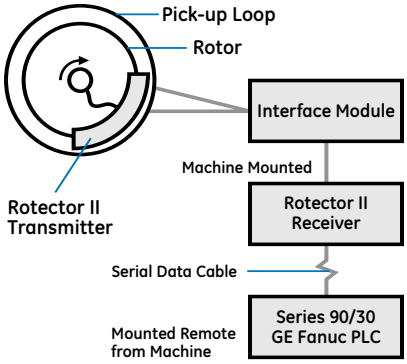
Brushless exciter contruction complete with starting resistor.



Rotector II

Faster Startups. Reduced Downtime.

Rotector II is designed to continuously monitor and protect large machines from potentially catastrophic failures. By monitoring the field winding temperature, key component temperature and field winding insulation resistance, downtime can be minimized and maintenance can be scheduled at the first sign of potential problems. By employing the latest digital telemetry, Rotector II offers a significant advancement over older analog techniques. The result is high data integrity and accuracy even in the most difficult environments experienced by large machines.



Rotector II provides improved rotor protection in the following ways:

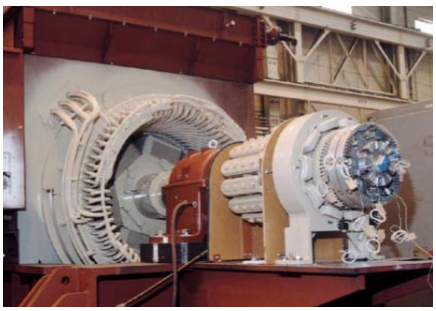
- Real time field current and voltage readings.
- Direct temperature measurement of key rotor components.
- "First fault" rotor ground fault detection during operation or while stationary.
- Diode failure detection.

All these features minimize commissioning time, increase reliability, reduce maintenance costs and allow optimized performance at all times.

Bearings, Enhancements, Testing

Bearings

- Cylindrical, two lobe or four lobe sleeve bearings
- Tilting pad bearings
- Axial thrust bearings - horizontal and vertical

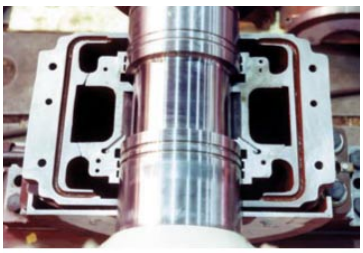


Solid 6 pole machine, with pedestal bearings, brushless exciter and rotating discharge starting resistors after final testing.

Both pedestal and bracket bearing machines are available based on application requirements.

Lubrication

- Oil ring and/or flood lubrication
- High pressure lift option available
- Run down tanks



Pedestal Sleeve bearing

Enhancements

- Partial Discharge Sensor Kits
- Air RTD (Resistance Temperature Detectors)
- Space Heaters 50/60 Hz, up to 550 volts
- Large oversized fabricated steel main terminal box - frame mounted or freestanding arrangements are both available.
- Surge arrestors and/or Surge Capacitors
- Current and Potential Transformers
- Vibration monitoring equipment
- Couplings
- Every machine is equipped with Resistance Temperature Detectors (RTD) to monitor stator winding temperature.

Custom conduit box complete with lightning arresters, surge capacitors and current transformers.

Testing

GE Motors has a world class test facility at Peterborough. Extensive experience in the performance of rotating machinery with all forms of fixed and variable-speed drives has been accumulated. Each machine is tested at the factory before installation in the field, thus reducing set-up time. GE Motors can also perform systems tests with a drive and using back to back testing.

- In Process testing
- Complete Electrical Tests
- Mechanical Testing including "runout"
- Back to Back Testing
- Efficiency Measurements
- Complete system test with drives and transformers

Every machine is tested in-house in a state-of-the-art facility to fulfill requested standards including stringent API requirements.

Customer Service

The right solution for your application.

- High Efficiency Designs
- Pro-Engineer™ Systems Modeling
- On-site Research and Development
- Quadramatic Load Sharing
- Solid Integral Pole Tip High Speed Rotor Design
- 50 MVA of test capabilities

The right people for your solution.

- **Power Solutions Team**
  Experienced application engineers are available to solve your toughest motor or generator system's problems.
- **Large Motors Services Team**
  Do you have equipment over 20 years old? Do you need more from existing motors? Would you like to know what condition your motors are in?
  Call us, we can help!
- **Application Engineering Team**
  New equipment & installations

GE Motors
Fort Wayne, IN 46802
Motors 800 541 7191
Parts 800 458 0451

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