



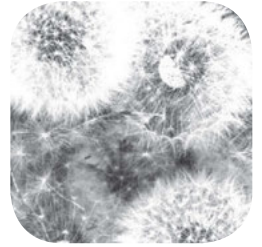
HYUNDAI IDEAL POWER TO MOVE THE WORLD





www.hyundaiideal.com

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- Customer Service & Support
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Company History

1900

- 1903** Ideal Electric Co. is created out of former Card Electric Co., occupying 2500 ft² in a converted carriage shop on East Fifth and Elm Streets, Mansfield Ohio
- 1905** First high torque squirrel cage motor for elevator service developed and produced by Ideal
- 1920** Manufacturing processes move to 29 acre site at current location on East First Street, Mansfield
- 1923** Office personnel move to new building
- Post-WWI** Ideal pioneers large, slow speed synchronous motor and generator and poly-phase capacitor induction motor
- WWII** Ideal delivers generator sets to US Navy to provide shipboard power for EC-2 Liberty class ships; as well as powering gun turrets on US cruisers and supplying power to allied ground bases throughout the world

1950

- 1950's** Ideal leads the move to brushless excitation of synchronous machines
- 1953** Ideal marks 50th anniversary with over 500 employees
- 1976** Ideal acquired by Carrier Corporation
- 1979** Carrier restructures and divests Ideal
- 1986** Management buyout by 17 employees
- 1996** International ISO 9001 certification achieved
- 1997** State-of-the-art test floor is built

2000

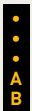
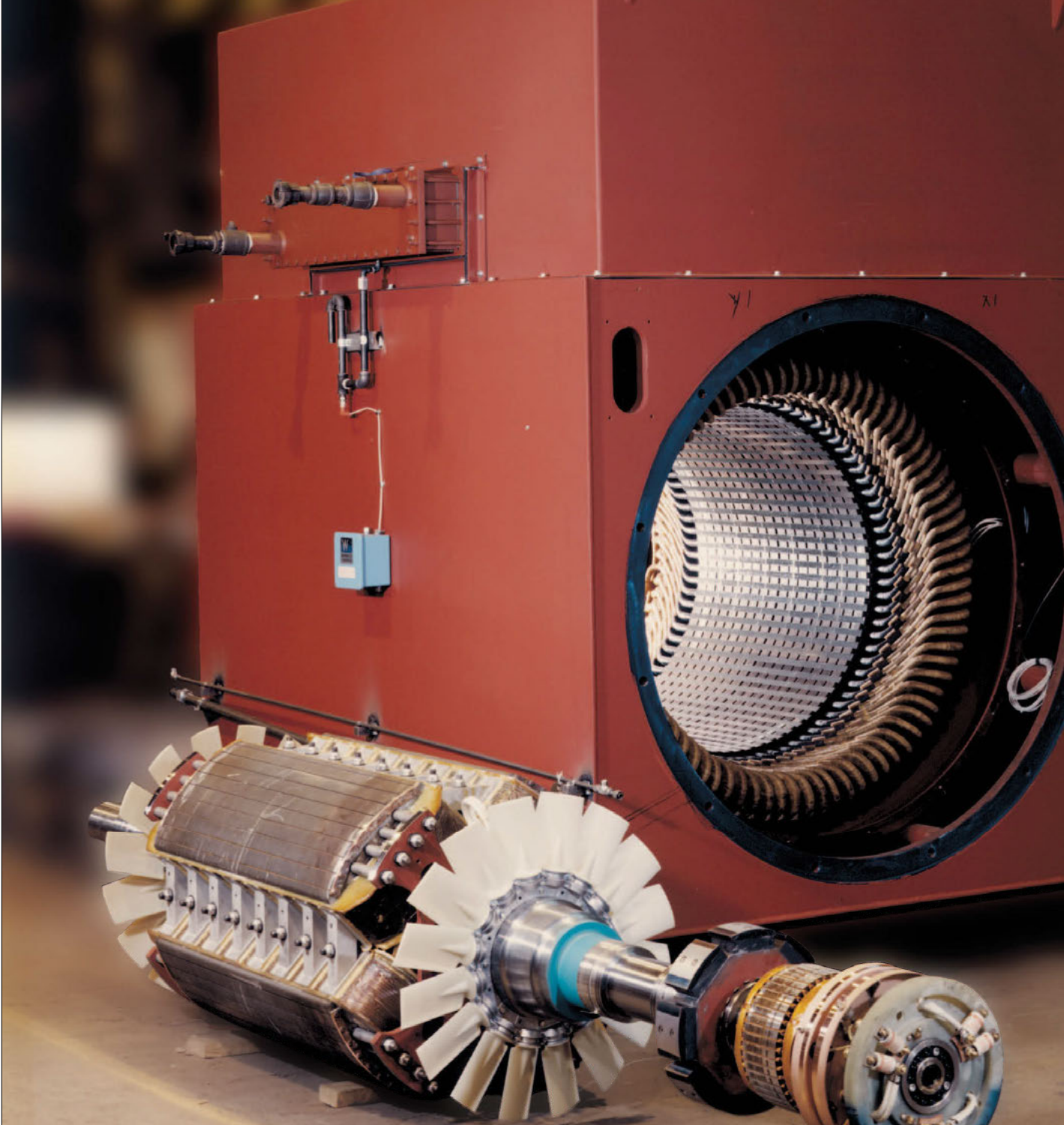
- 2001** Ideal aids Verizon in rebuilding major telephone exchanges after September 11 terror attacks
- 2003** Ideal helps supply power after the Great East Coast blackout
- 2007** Ideal's 280,000 ft² facility is purchased by Hyundai Heavy Industries, Ulsan, South Korea and renamed Hyundai Ideal Electric Co. (HIEC) Sales total \$37 million with 160 total employees.
- 2008** HIEC remodels offices. A new 25,000 ft² assembly floor is added, including two 40-ton overhead cranes and a new, 14 foot vacuum pressure impregnation tank is added to the manufacturing floor. Sales reach \$50 million with 237 total employees.
- 2011** Ground is broken for another 25,000 ft² building addition to house machining and welding operations. Sales top \$100 million. Workforce reaches a total of 300 employees.





Four-Pole Synchronous Generators

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A Four-Pole Rotor in construction
B Forged Four-Pole Rotor

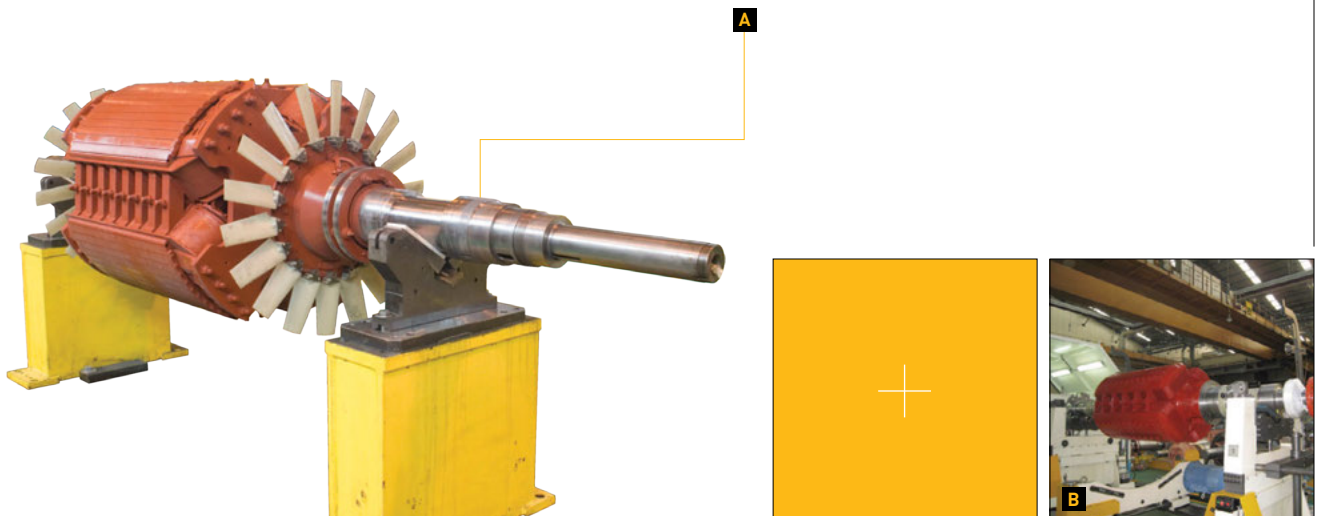
Hyundai Ideal Electric Co. has been a leading supplier of four-pole synchronous generators for over 50 years. With thousands of these generators in operation around the world, our machines have proven their reliability in virtually all types of applications and environments, including gas, steam, and geothermal.

Features / Benefits:

- Efficiency - Our generators have evolved over the years to include a variety of improvements in both manufacturing methods and design. These changes have improved generator efficiencies to above 97% in many cases, and have also improved reliability and reduced maintenance.
- Two types of rotor construction.
 - › **Integral pole stacked lamination type:** Laminations bolted and riveted together under high pressure before being shrunk-fit and keyed to the shaft. This integral salient pole design eliminates separately attached field poles or pole tips. The field coils are tension wound using insulated rectangular copper wire. Aluminum supports are spaced to secure the field coils under all operating conditions. This rotor construction is utilized on generators up to approximately 13 MW.
 - › **Solid forged salient pole construction:** The shaft and the rotor pole bodies are machined from one integral solid forging. Copper strap field coils are secured in place with bolted on forged pole tips. This rotor construction is utilized on generators from approximately 13 MW up to 40 MW.
- Rigidity - The rigidity of our frame allows for applications using frame mounted Epicyclic gearboxes if required.
- Industry Standards - we manufacture four pole synchronous generators to meet all current industry standards, including IEEE, NEMA, IEC, API and ATEX. Special designs meet CSA, DNV, ABS standards. Hazardous area requirements / certifications are also available.

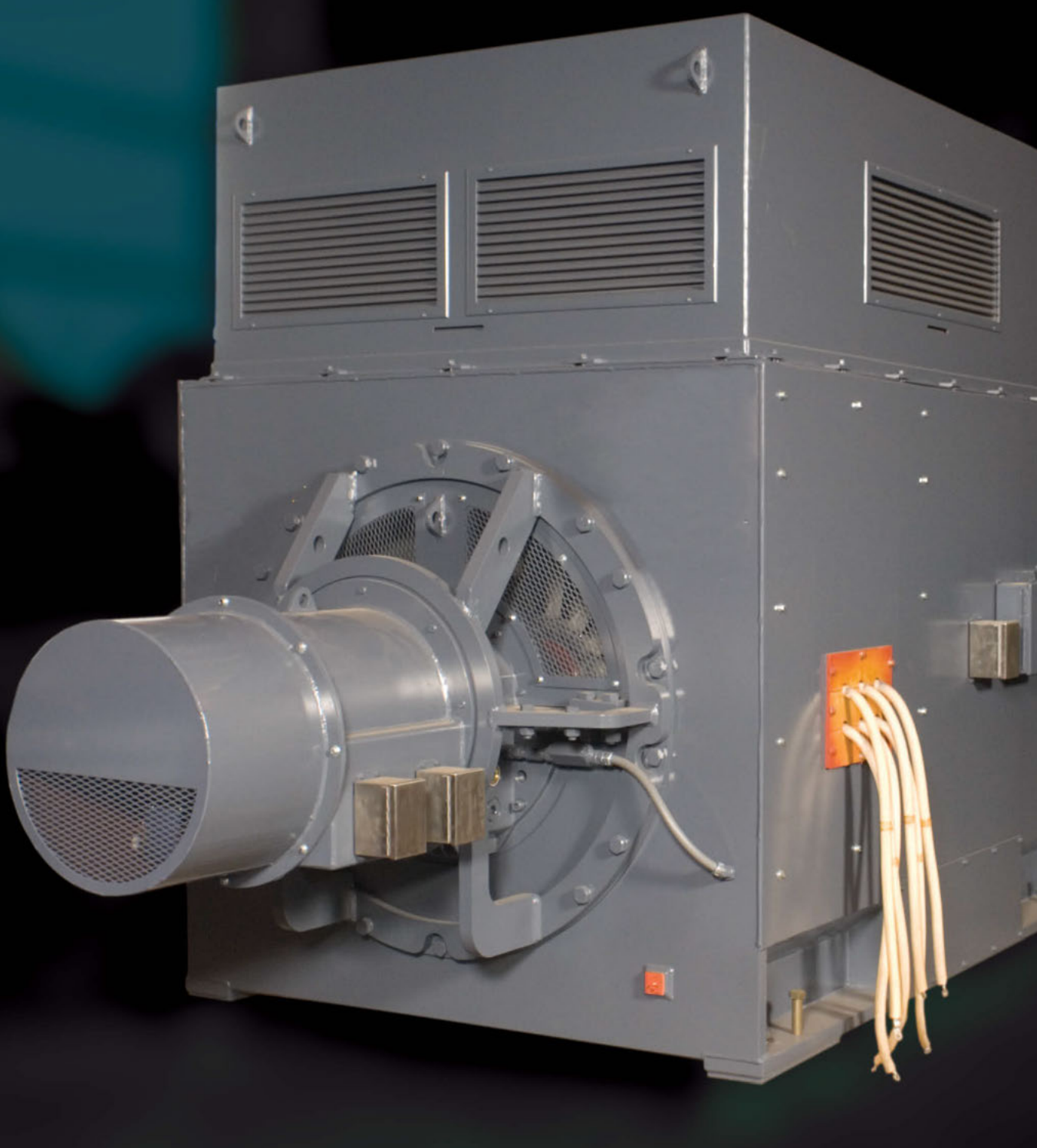
HIEC's Four-Pole Synchronous Generator Output Range:

- 1,000 to 40,000 kW
- 400 to 15,000 Volts
- 50 or 60 Hz, 1500 or 1800 RPM



Low & Medium Speed Synchronous Generators

05



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A Eight-Pole Rotor Assembly
B Computer controlled tape machine for installing half-lap insulating tape on stator coils

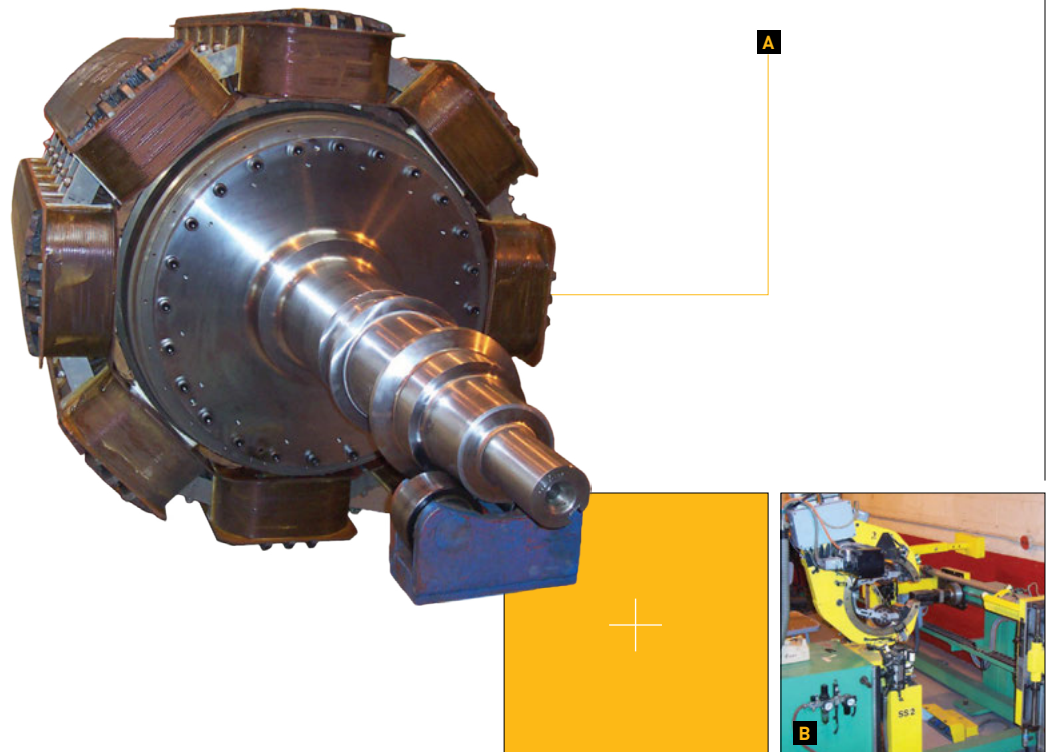
Hyundai Ideal Electric Co. has been a leading supplier of low and medium speed synchronous generators for diesel engine applications for more than eighty years. Our experience and conservative design philosophy, combined with top quality materials and workmanship, result in a rugged, reliable, high quality generator that is among the best available in the world today.

Features / Benefits:

- Reliable salient pole rotor construction.
- Wound poles are attached to the spider by one of two methods, depending upon speed. Low speed generators utilize a fabricated or cast steel spider with bolted-on poles. Medium speed machines employ a laminated spider and dovetail pole attachment.
- Split sleeve journal bearings are standard, either end-bracket or pedestal mounted. All bearings are designed for self-lubrication via oil rings, and conservative bearing load limits and peripheral speeds assure cool operation and long life.
- Open dripproof enclosure with top air discharge (suitable for most indoor applications) is the most commonly used enclosure for engine-generator set applications. Filters can be furnished on self-ventilated generators as conditions dictate, and generators can also be arranged for external forced ventilation through ducting. For severe environments, totally enclosed generators with air-to-water heat exchangers are available.

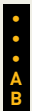
HIEC's Low & Medium Speed Synchronous Generator Output Range:

- 1,000 to 14,000 kW
- 380 to 13,800 Volts
- 50 or 60 Hz
- 500 to 1,200 RPM



Hydroelectric Generators

03



A Stator, M-Type Hydroelectric Generator
B Connecting stator winding of a Hydroelectric Generator

Hyundai Ideal Electric Co. is the US leader in small hydro electric experience, with over 250 projects and 800 MW installed.

Features / Benefits:

- Exclusive US single source company – capable of producing both generators and switchgear and allowing for sole sourcing of a coordinated electrical package.
- Each generator is custom designed allowing for optimal performance with a variety of accessories.
- We design and manufacture both synchronous and induction generators, in horizontal and vertical arrangements.
- All units are designed and built with site-specific powerhouse requirements.
- Projects are coordinated with turbine manufacturers to ensure each generator meets all requirements of the turbine speeds and loads.
- Every generator is assembled and tested in accordance with our standard test procedures, which are far more rigorous than the requirements of NEMA MG-1. A complete test, including temperature rise and efficiency in accordance with IEE procedures, is performed on all new designs or by customer request.
- Synchronous generators can be designed for excitation from a shaft mounted brushless exciter or from a static source with brushes.
- Standard insulation system includes Class F insulation vacuum pressure impregnated epoxy or polyester resins. Both systems pass an immersion and spray test, per NEMA 1-20.49. Corona protection is provided as a standard for stators above 5000 Volts.

Hyundai Ideal's Hydroelectric Generator Range:

Synchronous

- 500 – 25,000 kW
- 380 – 13,800 Volts
- 50 or 60 Hertz
- 100 – 1,200 RPM

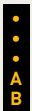
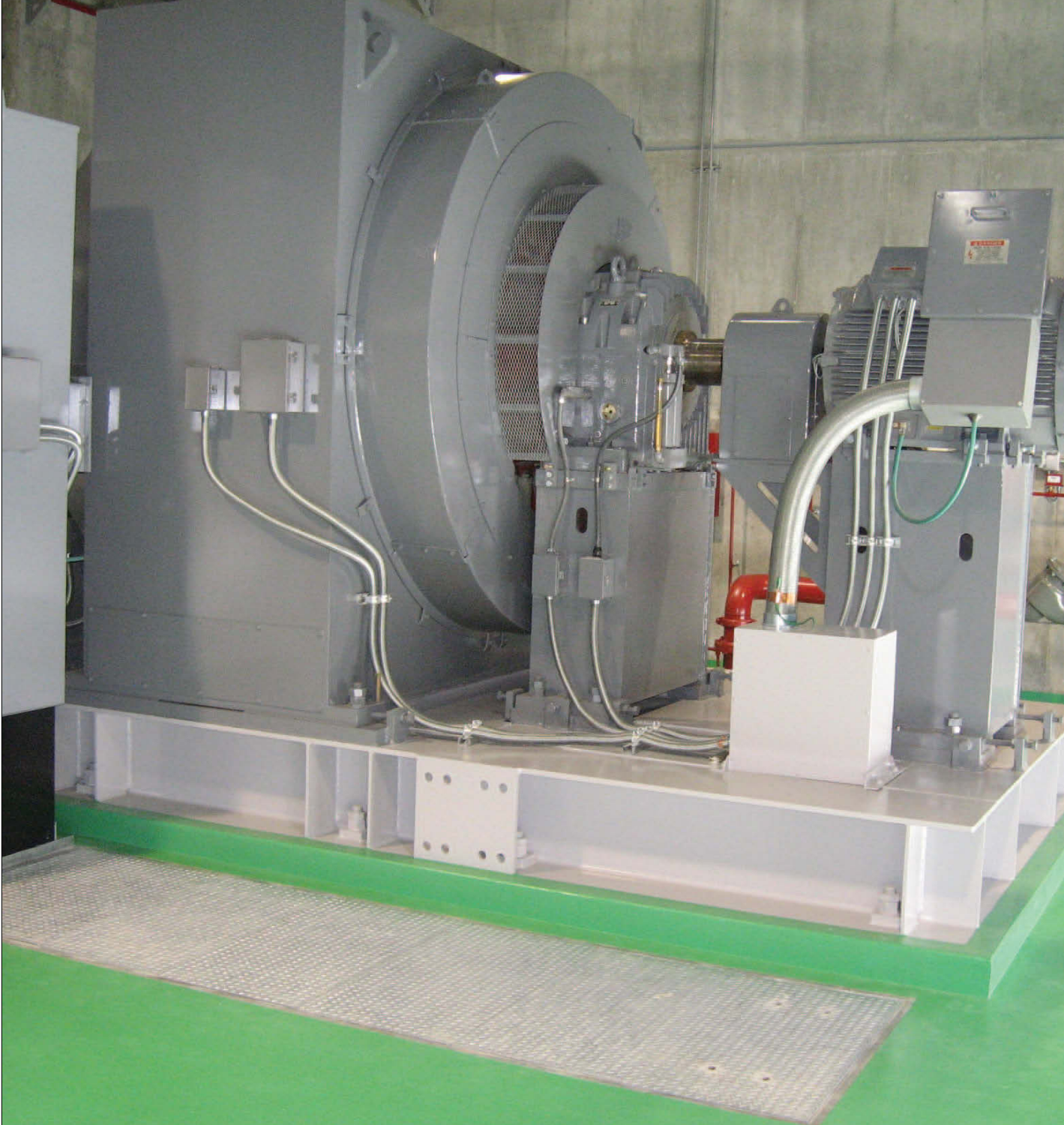
Asynchronous

- 500 – 8,000 kW
- 380 – 13,800 Volts
- 50 or 60 Hertz
- 500 – 1,800 RPM



Synchronous Condensers

02



A Synchronous Condenser switchgear line up
B 15 MVAR Synchronous Condenser

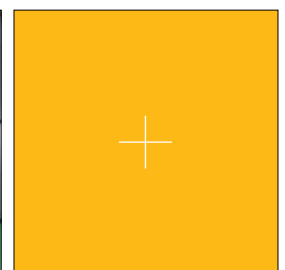
Synchronous condensers are fundamentally a synchronous motor that is not connected to any driven load. Once started and connected to the electrical system it operates at full leading power factor to put VAR's into the network to support the system voltage or maintain the system power factor at the desired level.

Features / Benefits:

- Power Factor Correction – Synchronous condensers are used as an alternative or supplement to fixed capacitors. Condensers are not affected by harmonics.
- Voltage Support – Synchronous condensers provide voltage support when starting large loads or transmission of power over long distances.
- Lower Utility Charges – Synchronous condensers improve plant power factor to reduce penalties for low power factor and lower power bills.
- Infinitely adjustable.
- Provide reactive power requirements for wind farms and solar panel installations.

Ratings

- High Speed laminated rotor- up to 8MVAR, high speed forged rotor up to 25MVAR, slow speed dovetail or bolt on poles- up to 16MVAR
- Voltage ranges of 480-13,800 volts
- 50/60HZ



Induction Motors

07



- A Above NEMA Motor in Low Voltage (TEFC)
- B NEMA Motor in Low Voltage (TEFC)
- C Weather Protected Type II or I (WPII or WPI)
- D Totally Enclosed Air-to-Air Cooled (TEAAC)

Hyundai Ideal Electric Co. has been a leading supplier of Low, Medium, and High voltage Induction motors for Power Generation, Oil & Gas, Petro-Chemical, Mining, Steel Plant, Sugar Mill, Municipal Water Applications, and Boiler Plants in Hazardous (Explosion Proof) or Non-hazardous areas. Our state-of-the-art manufacturing facilities guarantee that all motors meet various customers' requirements with regard to delivery and quality.

Features / Benefits:

- Lower Vibration in Stationary Parts (High Stiffness Enclosure)
- Heavy Duty Rotor Construction
 - › Optimized design of end ring and retainer ring with proven FEM analysis
 - › Swaged rotor bars ensuring increased rotor life by minimizing movement and vibration
- Reliable Bearing Application
 - › Low temperature rise & quiet operation by proven design application
 - › Easy maintenance for dismantling and inspection
 - › Self-aligned Oil Ring Type Sleeve Bearings
- Rigid & Vibration Free Shaft System
 - › Balancing at rated speed up to 3600 rpm by special balancing machine
 - › Computer -aided "Shaft Analysis Program" for Low Shaft Vibration
 - › Vibration below 50% of International Standard
- Quiet Operation
 - › Minimized windage loss by ventilation system with use of optimized cooling fan & fluid dynamic analysis
 - › Minimized magnetic noise emission with optimized slot combination by electromagnetic analysis
- Proven Up-To-Date Insulation System
 - › Excellent thermal and mechanical properties by Aramid insulation
 - › Mica tape combined with Epoxy Resin for Medium and High Voltage
 - › Special treatment on corona prevention over 4000V

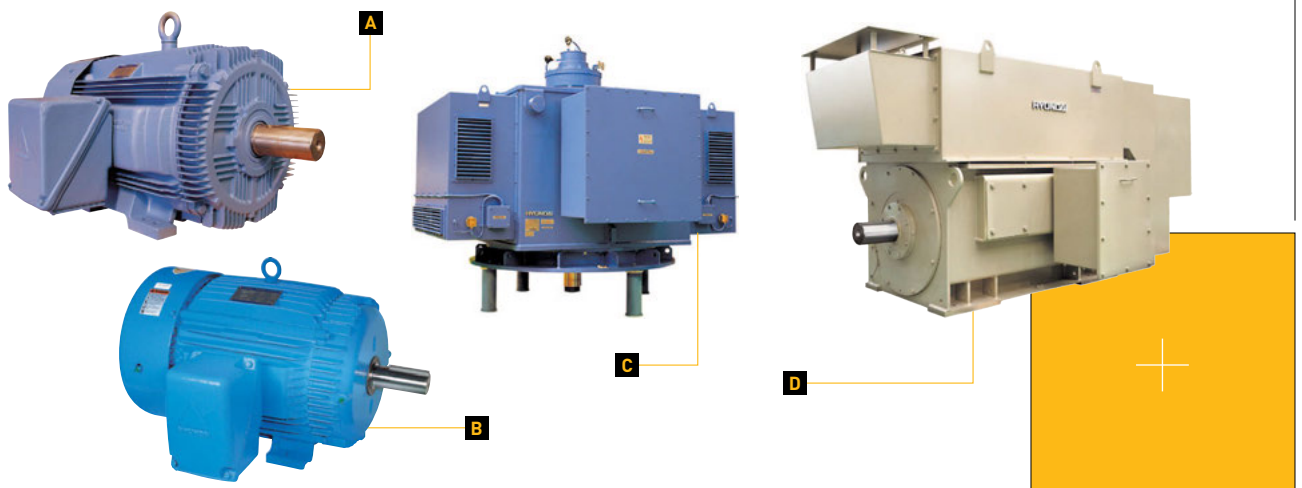
HIEC Induction Motor Ranges:

Low Voltage

- 1 to 1500 HP
- 200 to 1000 Volts
- 50 or 60 Hz
- 500 to 3600 RPM

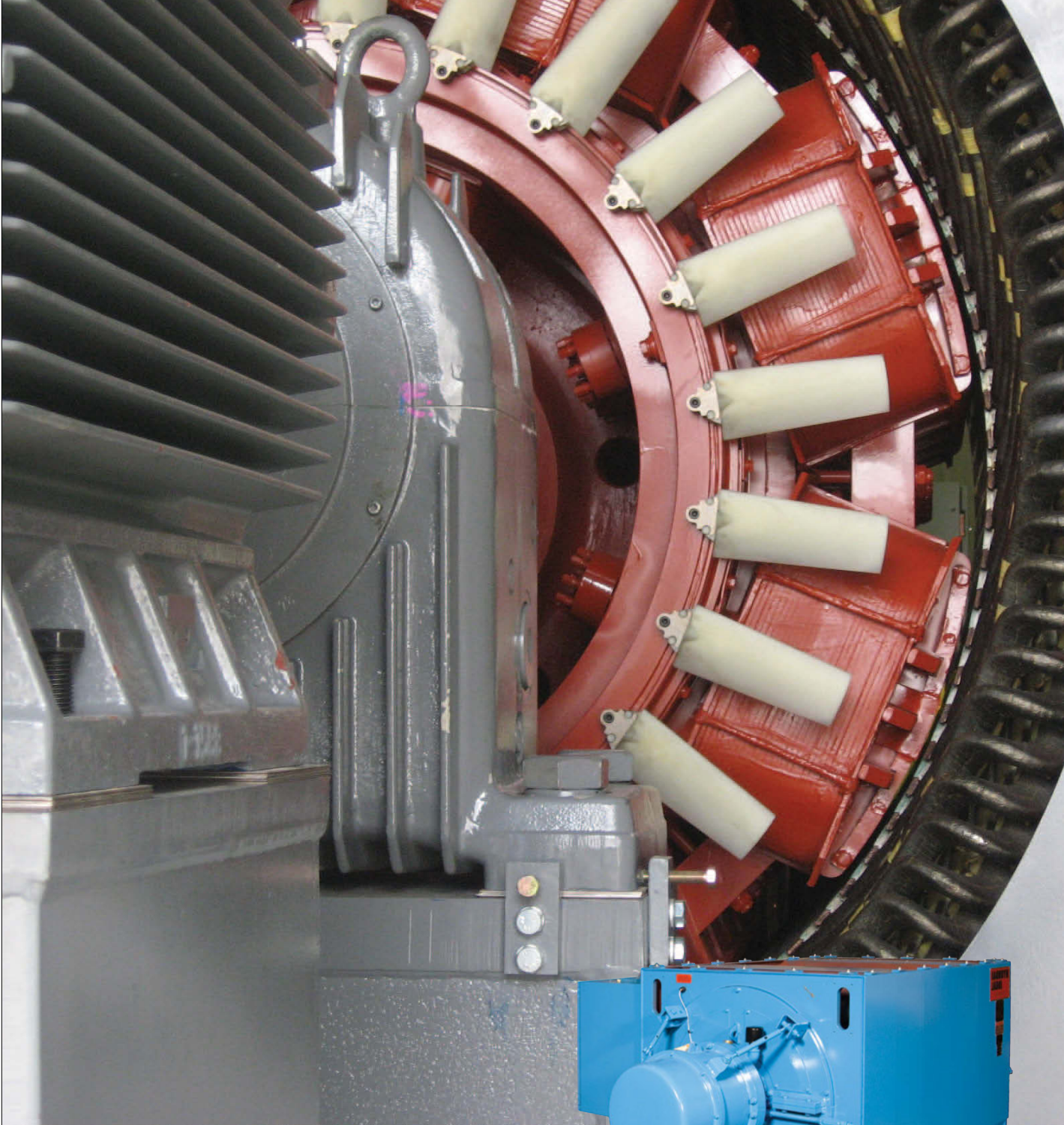
Medium & High Voltage

- 250 to 27000 HP
- 2000 to 14000 Volts
- 50 or 60 Hz
- 200 to 3600 RPM



Synchronous Motors

06



- A Brushless Synchronous Motor, 600HP
- B 400 RPM Synchronous Rotor
- C Four-Pole Rotor Assemblies
- D 4500 HP, 720 RPM, 13,800 Volt Vertical Synchronous Pump Motors

A



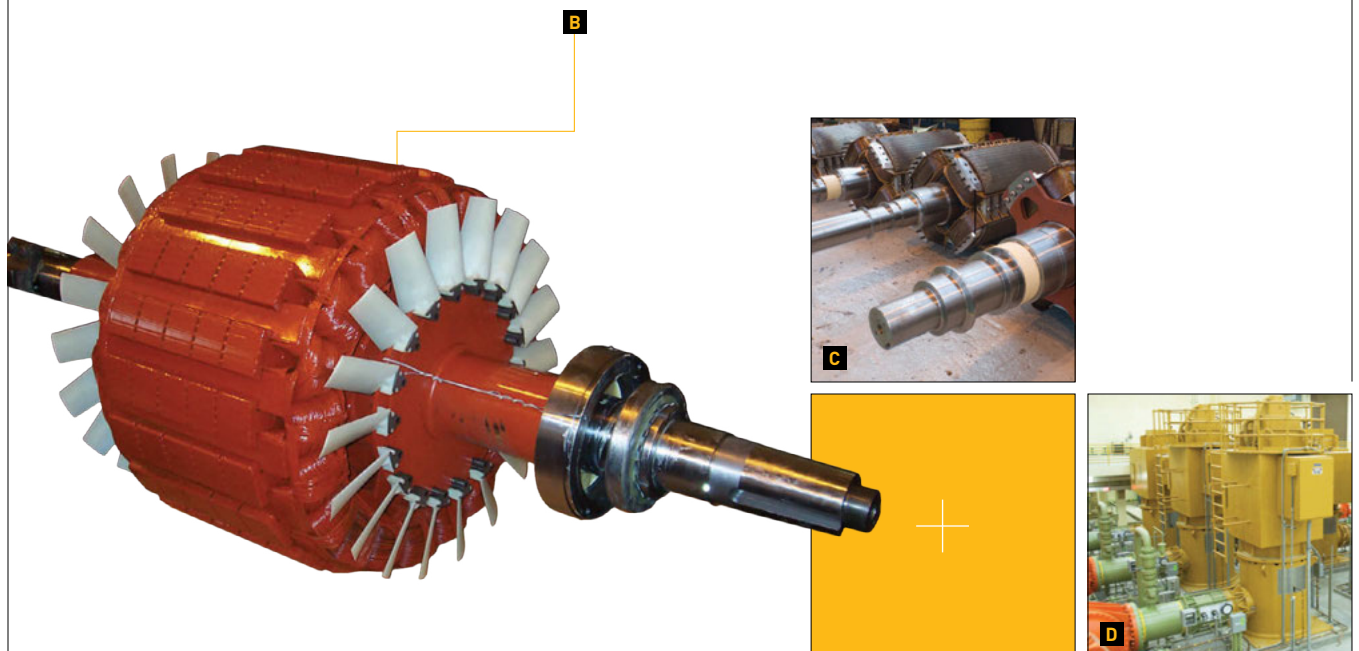
Hyundai Ideal Electric Co. has built synchronous motors for over seventy-five years. Our expertise, combined with high quality materials and manufacturing processes results in a reliable, cost-effective motor with high performance and low operating costs.

Features / Benefits:

- Higher Efficiency – Synchronous motors are typically 1% to 2% more efficient than induction motors. This results in a substantial reduction in operating costs over the life of the motor.
- Eliminate Demand Charges – Synchronous motors consume no reactive power, avoiding utility demand charges that are common with induction motors. A synchronous motor running at unity or leading power factor actually supplies reactive power back to the power system, improving the operations of a plant's electrical system and reducing operating costs.
- Rotor Construction – Quality materials and manufacturing techniques optimize stability and allow Hyundai Ideal Electric Co. motors to perform dependably under all conditions. Vibration problems are minimized with a very rigid frame construction, and by pre-balancing the rotor.

Motor Ratings:

- Hyundai Ideal Electric Co. can manufacture both vertical and horizontal synchronous motors ranging from 500 HP thru 30,000 HP with RPM 1800 and below. Supply voltages ranging from 400v thru 15,000v.



Switchgear & Controls

01



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A
B

Turbine/Generator Control Panel with Dual Excitation System
Generator Control and Protection Panel

A



Hyundai Ideal Electric Co. designs and manufactures a full-range of custom engineered switchgear and control solutions. We are unique in that we are the only US manufacturer that is capable of producing both rotating equipment and the switchgear to control it.

SWITCHGEAR & CONTROLS

HIEC is a sole source for entire electrical packages offering application and engineering support throughout the entire project lifecycle. We are experts at coordinating switchgear and controls with generators and motors.

Features / Benefits:

- Hands off automatic operation
- Bus paralleling and synchronizing
- Power factor/Var/Voltage regulation
- Generator and motor protection with fault shutdown and system lock-out
- Prime mover governing and protection
- Digital communication with SCADA and digital control systems
- Full voltage and reduced voltage motor starting.

MEDIUM VOLTAGE METAL CLAD SWITCHGEAR

We offer a full range of custom engineered metal clad switchgear for utility, industrial, institutional and municipal applications. We provide application and engineering support throughout the entire project lifecycle.

Features / Benefits:

- 4.16 kV through 13.8 kV ratings
- Designed in accordance with ANSI 37.20.2
- Type tested to ANSI 37.20.2 and 37.20.7
- Arc resistant
- 1200, 2000 and 3000 ampere continuous current ratings
- Vacuum circuit breakers designed and tested in accordance with ANSI 37.06 and 37.09



Vacuum Pressure Impregnation (VPI) System



- 14-foot diameter VPI tank
- A Repaired stator being lowered into HIEC VPI tank
- B Bakeout Oven used to cure VPI epoxy resin

08

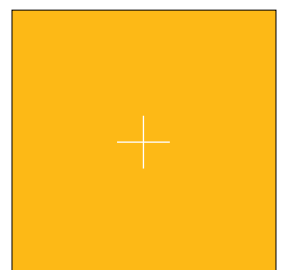
The Hyundai Ideal Electric Company (HIEC) insulation system is a proven insulation system based on a global Vacuum Pressure Impregnation (VPI) method using mica tapes combined with epoxy resin. Global VPI is a widely used insulation method in the electrical industry and epoxy resins have been found superior to polyester resins. This insulation system is employed over the full range of form wound machines produced by HIEC.

Features / Benefits:

- Class F (155°C) Temperature Rating
- Voltages up to 15 kV
- Mica Insulation combined with Epoxy Resin VPI
- Excellent Chemical, Oil, and Moisture Resistance
- High Dielectric Strength with Low Dielectric Losses
- High Mechanical Strength
- High Thermal Conductivity for Improved Heat Transfer
- Withstands Starting and Short Circuit Stresses, Voltage Surges, and Thermal Cycling

Quality Assurance

- Checks on stator coils to assure dimensional uniformity and proper fit of coils in stator slots
- High potential tests of coils during coil installation and prior to VPI
- Turn to turn insulation tests of coils prior to VPI
- Periodic tests of epoxy resin system
- Periodic tests of power factor tip-up per IEEE Standard 286 to monitor insulation system performance
- Final high potential test of completed winding after VPI at twice rated voltage plus 1000 volts



Customer Service & Support



- A PLC Based 300-013 Brushless Synchronizer
- B HIEC Digital Programmable Eddy Current Clutch Controller
- C In plant medium and high voltage rewinds
- D Unit returned damaged
- E Unit after repair



Our mission is to provide our customers the best cost effective support available to meet or exceed their needs. Hyundai Ideal Electric Co. experience... responding with solutions for over 100 years.

We have earned a reputation for quality by supporting our customers with specialized technical product support and our ability to respond promptly to customer demands. Excellent service is assured by people who understand your equipment and process needs. Our experienced staff of service engineers can spot potential performance problems and recommend corrective action. HIEC can recommend ways to improve your equipment efficiency and reduce operation costs with improvements such as overhauls and upgrades.

Hyundai Ideal Electric Co. is an original equipment manufacturer with quality that's been established worldwide. A complete range of customer-focused service has proven Hyundai Ideal Electric Co. the ideal partner for any application.

Hyundai Ideal Electric Co. provides a full range of support services for its customers.

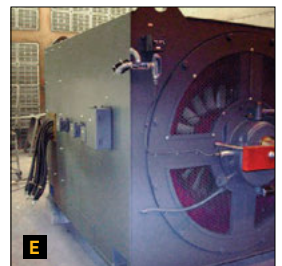
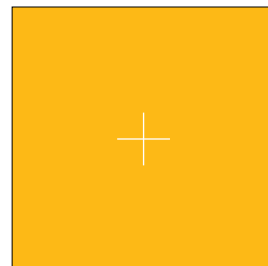
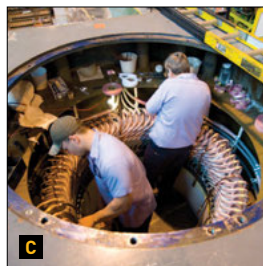
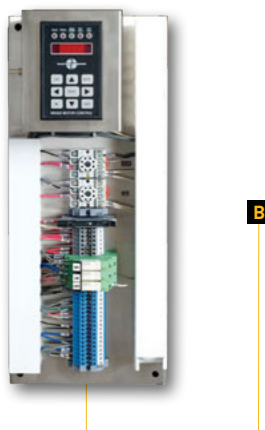
- **Parts and Spares:** HIEC maintains a stock of standard spares in its Ohio facility and using its equipment history data base can order and assure the parts being provided are the correct part for the customer's system based on serial number and manufacturing and repair history. Parts orders or questions can be placed on the HIEC website, customer service email or by calling our toll free number.
- **Field Service Support:** HIEC provides Domestic and International emergency call out service, start up, inspection, testing and analysis. Service can be scheduled using the HIEC service request document.
- **Factory Repairs and Refurbishing:** HIEC using its factory and engineering resources at the Ohio facility can provide repairs or total rebuild of customer's motors and generators transported to the facility.

Communications:

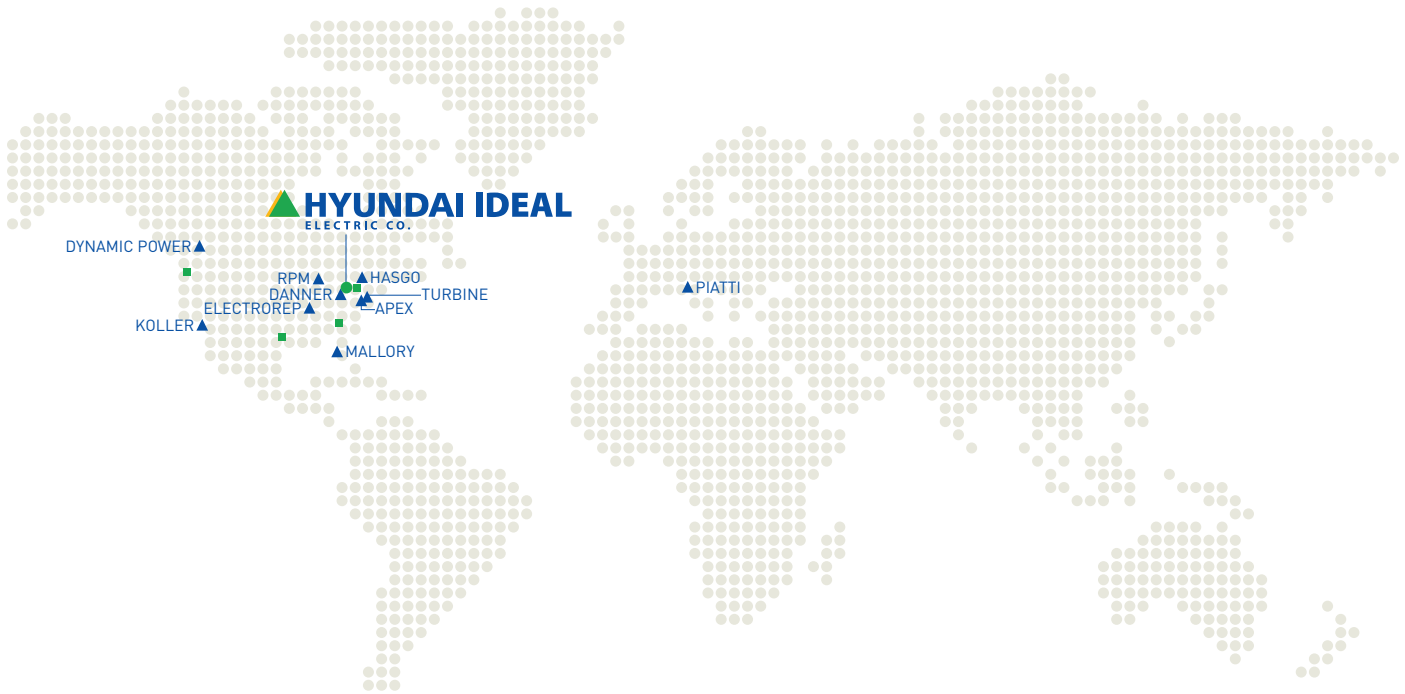
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