HYOSUNG

Power Transformers

Global Top Energy, Machinery & Plant Solution Provider

About HYOSUNG




Hyosung Power & Industrial Systems PG is a division under Hyosung which consists of seven performance groups (PGs). In addition to establishing itself as a world-class manufacturer of electrical equipments, green technology and industrial machineries, Hyosung is also the largest producer of tire cords and spandex in the global market and the second largest supplier of ATMs in the USA.

Power Transformers

CONTENTS

01 Our Business

Brief introduction of Hyosung Power & Industrial Systems

Hyosung Power & Industrial Systems Performance Group

Hyosung Power & Industrial Systems Performance Group, a comprehensive energy solution provider, boasts world-leading technology in the global power industry and has secured a competitive capability in par with that of top competitors in transformers, switchgears, motors, decelerators, industrial pumps, and wind energy business.

With globalization as one of our top priorities, we have achieved a 16.9% increase in sales over the past three years thanks to the enhancement in Hyosung's quality, technology, and brand recognition among overseas clients, which includes North America, Europe, the Middle East, and Asia. We expect such robust performance, marked by an increasing number of orders from the overseas market, to continue in the future.

At the heart of our capability to grow as a comprehensive energy solution provider is our global organization structure. Hyosung Power & Industrial Systems Performance Group is divided into four business areas or performance units, depending on the types of flagship products: Power Systems PU, Industrial Machinery PU, Hyosung Good Springs PU, and the Wind Energy Business Division.

Power Systems Performance Unit

Hyosung's Power Systems Performance Unit provides a full spectrum of power generation, transmission, and distribution services, from design and engineering to the maintenance of equipment and has been building up on cutting-edge information technology resources and developing substation automation systems, such as power monitor and control systems, and early detection and prevention systems.

Such vast product assortment and technical know-how is based on our product development history. In 1992, Hyosung was the first in Korea, and the sixth in the world, to develop a 765kV ultra-high voltage (UHV) transformer, and, in 1999, was the first in the world to manufacture the 800kV gas insulated switchgear (GIS), which has put Hyosung on an equal technological ground as its top global competitors.

Having such world-class technology, we established Baoding Hyosung Tianwei Transformer Co., Ltd., a joint venture with the Baoding Tianwei Organization, to hold the largest share of the market in Baoding City, China. This venture was established in 2003, and by the end of 2004, we established a production plant producing 11,000 transformers per year. In 2006 we acquired one of the top five companies in quality terms as certified by the Chinese government, Nantong Hyosung Transformer Co., Ltd. in Jiangsu.
The Power systems Performance Unit is continuously striving to secure competitiveness in every aspect of quality, technology, sales, services, and management, in order to satisfy customer needs globally and become a top-tire company in the world by providing customers with the best quality products and services in the power systems sector.

02 Vision

A dream of becoming tomorrow's leader

Global Top Energy, Machinery & Plant Solution Provider

Hyosung Power and Industrial Systems' vision is value maximization by becoming the global top energy, machinery & plant solution provider. We believe that "change" must occur starting with our own internal system, people, and the way we have conducted business in the past. Hyosung has six strategies- "Globalization", "Strengthen Global Competitiveness", "Discover New Growth Markets", "Global Talent Recruitment", "Free Communication", "Culture of Execution" - to implement "change" in order to achieve sustainable growth and become a leader in the global market.

03 Sustainability

Our sustainability principles are the backbone of the way we design and manufacture products

Hyosung Way

Hyosung Way is our core values and principles instilled in all of our employees across the globe.
Enhance and enrich the quality of life for humanity with its leading technology and managment capability

GLOBAL EXCELLENCE

- Maximize the competitiveness with cealseless self-improvement effort to win in any situation
- Blaze new trails in markets around the world with a global outlook

INNOVATION

- Eliminate all inefficiencies that do not and value
- Challenge new possibilities with a positive mindser

Core Values & Principles

ACCOUNTABILITY

- Act like owners and take charge in actions
- Never give up until acheving the goal

INTEGRITY

- Uphold transparency and fairness bassed on facrs and principles
- Respect and cooperate with each to make a great workplace

Quality Assurance

Hyosung strives for excellence. We believe excellence can only be achieved through absolute quality and value for customers. In order to create quality product, we believe that all of the actions of every single employee must be focused in the highest level of quality. In order to achieve such levels, we have implemented a quality assurance policy and programs that make our philosophy into a reality

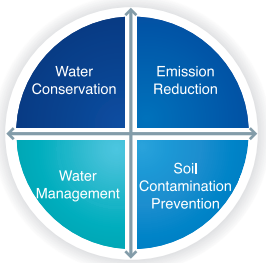
Our Quality Assurance Policy was founded based on the management policy of the president and meets the demands of ISO 9001. As a globally active company, we are committed to comprehensive and quality management through three quality strategies: quality management system, customer-focused management system, and concentration on core competencies.

The comprehensive quality management system ensures that we completely comply with all compliances and applicable legislation, codes, and standards in addition to implementing efficient operation of our management resources to eliminate unnecessary waste.

Our customer-focused management system clarifies and simplifies our first priority which is customer satisfaction. All of our work is aimed to exceed customer needs and provide exceptional value through quality standards, flexibility, and innovation.

Finally, we concentrate on our core competencies for strict quality control and continual improvement which provides quality products and cost-saving to our clients via advancement in technical capacity and technological innovation.

We implement our policy via a Quality Management Team manages research laboratories, including the Measurement Standard Laboratory, the Chemical Analysis Laboratory and the Material Analysis Laboratory to maintain a strict control over quality.



Environment Protection Policy

Hyosung understand the impact of Hyosung's activities in the environment and work to protect the environment from pollution, manage the environmental impact of Hyosung's products and technologies, and prevent future pollution and harmful effects in the environment by investing in environmentally-friendly products and solutions.

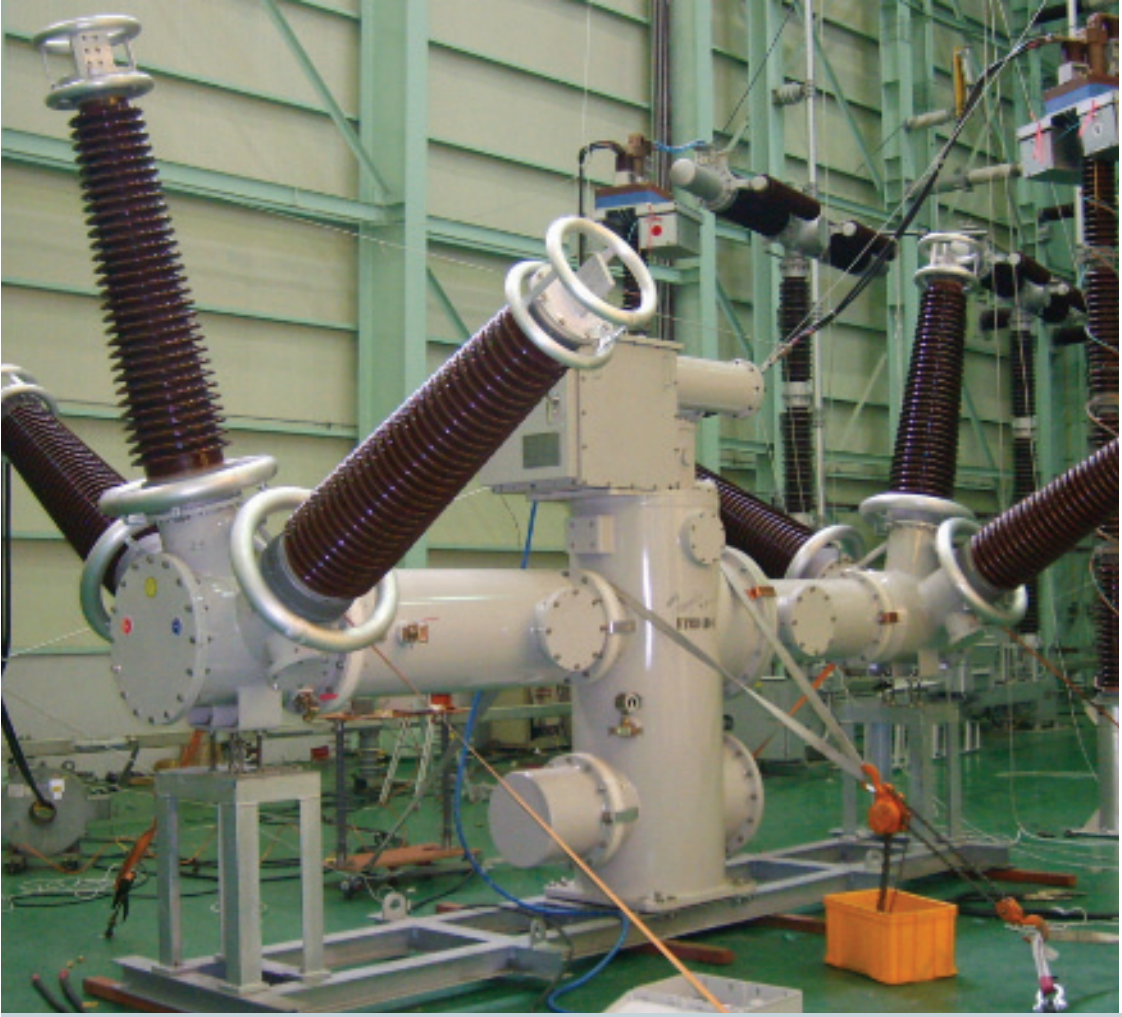
Based on this eco-philosophy of shared responsibility, Hyosung has implemented a comprehensive environmental protection program that aims to minimize our impact on the environment and conserve resources. Our environmental policy fulfils all requirements of the ISO 14001.

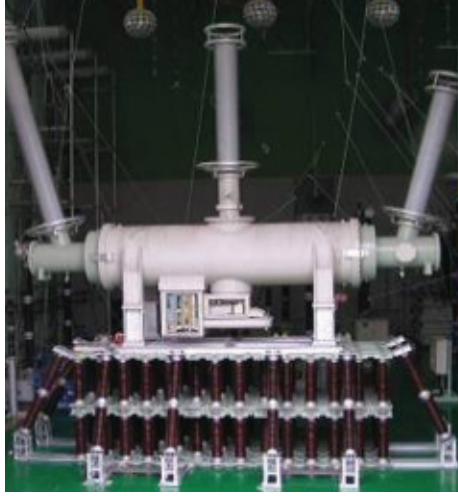
Ethics

Hyosung is committed to the transparent and trustworthy ethical management practices. To maintain the highest standards of integrity, Hyosung has implemented various ethical policies and codes that all employees and business partners must comply with.

Social Responsibility

Hyosung's sustainability mission would not be complete without giving back to the community. Hyosung initiate various types of social programs all throughout the year and contribute to making our world a delightful place to live for all.





04 R&D

Inspiring innovation, creation and expertise

Hyosung R&D Center identifies innovation, creation, and expertise as core value, and concentrates on world class R&D activities in the 21th century with a philosophy aspiring after customer satisfaction, quality priority, and performance orientation. Hyosung pursues to be the world's best company in the field of heavy electrical machinery, industrial & electrical electronics engineering, and energy system. Ever since establishment in 1978, R&D Center had led the development of domestic technology. Along with the Anyang and Changwon labs, the group has endeavored to produce core technology and world-class products in the areas of heavy electrical machinery, energy system, electrical electronics engineering, and industrial automation system.

Research Areas

Hyosung R&D Center engages in the activities in the field of energy system, solution & service, applied electrical and electronic technology, basic core technology, technology of improved reliability, core components, and new materials.

Energy System
- New and renewable energy system (wind turbine, solar power, fuel cell, co-generation, and more)
- Distributed power system (engineering, solution, and more)
- Energy storage system

Solution & Service
- Power facility diagnosis algorithm and system
- Power facility lifecycle evaluation system
- Service solution for remote diagnosis for prevention

Applied Electrical & Electronic Technology
- Power conversion system
- Flexible AC transmission system and high voltage direct current
- Power quality solution

Basic Core Technology
- Fortified technology in structural dynamics, electromagnetics, heat transfer analysis, etc.
- Skills for system simulation, analysis and evaluation
- Business support technology

Technology with Improved Reliability
- Test data analysis and testing facility
- Analysis of lifecycle and cause of error
- Reliability assessment (environment-friendliness, durability, long-term degradation, and more)

Core Components and New Materials
- Organic and inorganic insulation materials
- Silicon forming technology
- Intelligent sensor (facility diagnosis, CT, PT, VT, LA, and more)

Product Development History

Year	Milestones
2010	800kV 63kA GCB
2009	100MVA STATCOM 420/550kV 63kA GIS
2008	IED for preventive diagnosis of transformer (IEC61850) 170kV GIS bay controller (IEC61850) 25kV C-GIS bay controller (IEC61850) 3kW, 50kW, 250kW grid-connected solar inverter 1kW class PEMFC residential power generation system 25.8kV 25kA dry air insulated switchgear 245kV 40kA motor direct drive mechanism GIS 1100kV 50kA CB
2007	154kV gas insulated transformer 2MW wind turbine system
2006	10MVA STATCOM Partial discharge monitoring system for GIS
2005	750kW wind turbine system PCS for 100kW molten carbonate fuel cell system 36kV 31.5kA GIS
2004	245kV 50kA GIS 25.8kV 25kA GIS (New IEC standard) 24kV 40kA 3000A GIS 245kV 50kA GIS
2003	362kV 50kA GIS 154kV 80MVA unified power flow controller (FACTS) pilot plant 420kV 50kA 1Pole GIS
2002	Substation automation system
2001	154kV 40MVA transformer for FACTS 170kV 50kA condenserless type GIS 170kV 50kA Condensorless 3Phase common tank GIS 550kV 50kA GIS
2000	Digital protection relay
1999	800kV 50kA GIS Monitoring & diagnosis system for 765kV substation equipment 200kW gas turbine co-generation system Package type CNG refueling system Class 1E safety-related high voltage electric motor for nuclear power plant 362kV 63kA 8000A GIS
1998	the world's first 800kV 50kA 8000A 2Pole GIS 362kV 63kA 4000A GIS
1997	300kV 40kA 1600/3150A GIS
1995	Gas turbine co-generator Traction motor for urban mass transit
1993	145kV 25kA 3Phase common tank GIS
1992	765kV transformer 72.5kV 20kA 800/2000A GIS 170kV 31.5kA 3Phase common tank GIS
1989	145kV 40kA GCB
1987	170kV 31.5kA 1200A GIS
1986	Amorphous Transformer
1984	3ph 154kV 386MVA phase-separated transformer
1983	362kV 40kA 2Pole GIS
1982	1ph 345kV 1,187MVA transformer for nuclear power plant
1980	170kV 31.5kA GIS
1979	362kV GCB
1978	170kV GCB

Power Transformers

General

As the first domestic manufacturer of 765kV power transformers, Hyosung has earned a reputation of having the highest quality for over 40 years. We offer various types of power transformers with ratings up to 765kV. Our transformers have off-load or on-load tap changers to adapt to various network conditions and satisfy both national and international standards.
We make sure that the overall quality of design, manufacturing and testing of our power transformers meet the specific specifications of each country and we offer customized services to ensure customer satisfaction.

Production scope

- 110kV~765kV Core type transformers (capacity up to 3ph 2000MVA)
- 110kV~765kV Shell type transformers (capacity up to 3ph 2250MVA)
- 110kV~400kV Shunt reactors
- Special purpose transformers

• Shunt reactors • Scott transformers • Gas-insulated transformers • Furnace transformers • Mobile transformers

Technology

Hyosung is the leading supplier of the power transformer industry. Starting with the development of the 154kV high-voltage transformer in 1969, Hyosung introduced the 345kV and the 765kV transformers subsequently for the first time in the country, and the sixth in the world. Hyosung's power transformers are designed to withstand all environmental hazards.
In the rated power range up to 2250MVA and operating voltage up to 765kV, these transformers have off-load or on-load tap changers to adapt them to various network conditions. Hyosung manufactures transformers under IEC, JEC, ANSI, BS and all required national standards. Hyosung offers individual solutions for satisfying requirements related to types of operation, low noise and low losses, connection technology, type of cooling, transportation, installation and so on.

Various Types
Various types of transformers are available according to the specific requirements including single phase and three phase transformers, auto and multi-winding transformers, reactors and transformers for special applications such as furnace transformer, rectifier transformer and more.

Fit Design
If there are any constraints related to transportation or site conditions, we can offer fit design transformer to ensure smooth shipping and installation. We also possess experience in transportation by airplanes.

Safety
To ensure safe operation of our transformers, potential hazards are identified and eliminated at all stages. Safety during installation is ensured by extending on-site support to customers by our experienced and efficient supervisor.

Flexible Manufacturing System
Our production flow management system is fully computerized and automatically controlled to prioritize and finalize the manufacturing schedules based on delivery dates. This system yields the most optimized use of resources and also enables us to accommodate the unexpected and/or urgent orders by customers with shorter time delivery requirements.

Simple Handling and Maintenance
Compact design of our transformers ensure easy and smooth handling of transformers whereas Efficient design and manufacturing process and use of reliable components and accessories from reputed manufacturers ensure the trouble free operation rendering low maintenance cost of the equipment.

Customized Solutions
Tailor-made customized transformers can also be supplied based on the specific requirements.

Smart Grid Enabled
Design, manufacture, installation, and maintenance &repair of electric power facilities (transformer, GIS, and switchboard) are based on technology and knowhow accumulated over the past 35 years. By linking Hyosung's new preventive diagnostic system, users can diagnose the status of the equipment and schedule inspections through data received in real-time, including partial discharge and insulation oil deterioration, OLTC monitoring, insulation oil temperature, operation status of cooling fans, pumps, motor operation, and oil filter pressure.

World Class Technology and Capacity to Meet Global Challenges

• Type / Rating

- Core Form : Up to 3ph 765kV 2000MVA
- Shell Form : Up to 3ph 765kV 2250MVA


Core-Form


Shell-Form


Transformer Production Hall

Total Quality Assurance

At Hyosung, our goal is not only to meet the needs of our customers today but also to provide them better life in the future.

Hyosung's total quality commitment to our customers is demonstrated by providing the highest quality product at the most competitive prices with on time delivery. Hyosung achieves these high quality levels through our integrated quality assurance program. Hyosung's products are used extensively both at home and abroad. This level of experience allows Hyosung's quality assurance and reliability to exceed those of our competitors. We share our customer's goals with high quality products. From design to assembly, testing and installation, our customer's requirements are our minimum standards. All tests are based on International standards and our customer's requirements. Through additional testing, Hyosung seeks to exceed established testing criteria, thereby producing more reliable products. Our special process operators and technicians are highly trained. Continued professional growth and advanced training are encouraged through internal training groups and outside courses.
All Hyosung's products have ISO 9001, ISO 14001 and OHSAS 18001 certifications. Hyosung endeavors to maintain the highest quality.


ISO 9001


ISO 14001


OHSAS 18001

Scope

In line with major international standards for quality assurance, the quality assurance program of our plants includes the following elements.

- Contract review
- Inspection/test control
- Design control
- Measuring and test equipment
- Procurement document control
- Storage, handling and shipping
- Material purchasing
- Nonconforming item
- Identification
- Quality assurance records
- Special process

Design Concept

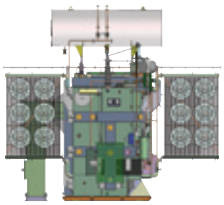
Hyosung's transformers are designed and manufactured through verification from the design stage using design program, electromagnetic field analysis program, and structural analysis program.

Dielectric Strength

Hyosung transformers offer superior dielectric strength to withstand impulse voltage. Our advanced technology design principles ensure low capacitance between winding and the ground for proper coordination of insulating material mitigating any potential creepage issues.

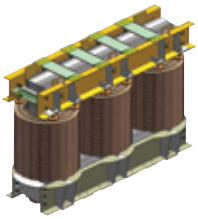
Thermal Capability

The coils that form the electric circuit inside the transformer as well as the core material which creates the magnetic circuit must dissipate heat effectively. This heat must be released through the insulating oil which in turn radiates to the air through the cooler or radiator system. This cooling effect is vital as it is directly linked to insulation life and the total capacity of the transformer. Hyosung's transformers emphasize improving cooling performance as well as regulating the temperature of the hottest spots by using an advanced cooling system.



Mechanical Strength

Hyosung transformers exhibit excellent mechanical strength because the design is able to distribute mechanical force evenly in event of a short circuit condition. Consideration is also given to engineering for overseas and rail transportation requirements required for delivery to the customer's site.



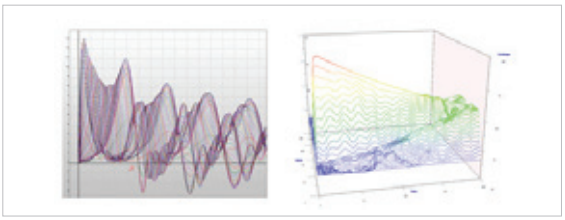
Design Concept

Design and Analysis

Hyosung transformers distinctly stand out from the competition with world-class engineering and unparalleled quality. Our engineering teams use highly efficient, reliable and accurate software programs based on state-of-art techniques for preparing most optimized design to deliver the low cost and high quality products. 2-D electric field analysis for optimization of insulation structure, 3-D magnetic field analysis for determination of partial overheating and tank shield optimization and stress analysis for determination of seismic withstand and short circuit capability are few to name. Our 3-D CAD engineering system allows us to review the final product before assembly preventing errors and minimizing defects at manufacturing stage. Our dedicated R&D cell continue to research and develop innovative, efficient and cost effective designs and working towards standardization of the design parameters to reduce the lead cycle time.

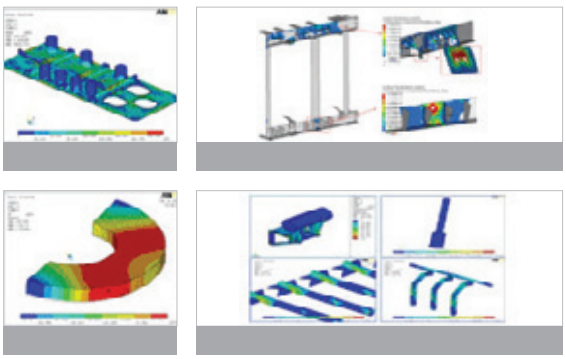
Transient Analysis

The program uses advanced technique for calculation of the various parameters like stresses on each turns, coils and windings. The windings are divided into several segments and the actual test conditions are simulated by proper input. The program gives the values of resistance, inductance and capacitance which are further used to calculate the electrostatic stresses along the winding and determine adequacy of the insulation structure and requirement of intershielding and/or interleaving.



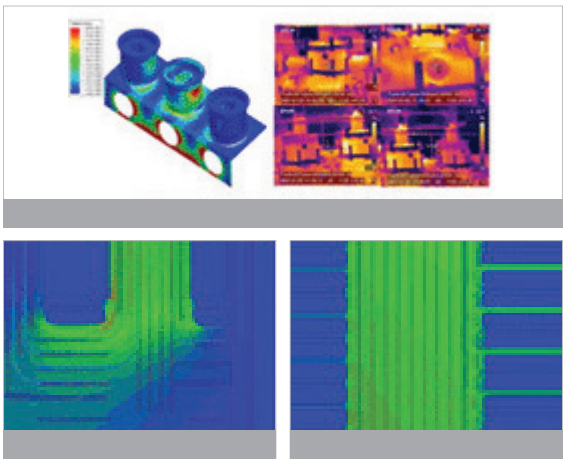
Structural Analysis

Structural analysis is performed to ensure safe operation of the transformer and a robust construction to withstand static and dynamic forces.



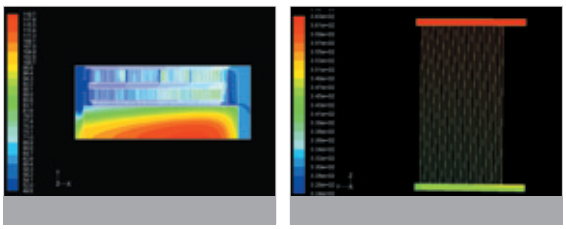
Magnetic Field Analysis

Electromagnetic calculations are performed to describe the stray field in a transformer and to calculate transformer parameters such as impedance, losses and short-circuit forces can be made in the initial design stage.



Thermal Analysis

Computational Fluid Dynamics (CFD) is used to understand the thermal behavior of the transformer. CFD analysis enables the designer to accurately calculate the fluid velocity, oil and winding temperature in all parts of the transformer.



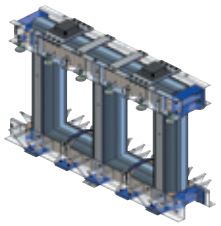
Data Management

Hyosung maintains database of its engineering schematics. By using our PDM (product data management) system, the design lead cycle time can be reduced by fetching data from existing high quality design units for reference at design stage. Our commitment to provide the transformers with best quality at most competitive price inspires us to strive for innovative research and development which in turn brings perfection to our products making us a reputed name in transformer industry.

Construction

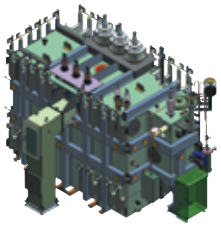
Core

The core is layered step-by-step to maximize space ratio. The same detailed process is utilized whether the transformer being manufactured is core form or shell form design.



Tank

The transformer tank enclosure is robustly manufactured with the necessary strength to protect all internal structures, to contain and preserve insulating oil and to withstand internal pressure during faults. Each tank is manufactured according to customer specification with manholes or hand-holes in locations to allow for simplified installation, maintenance inspection as well as repair.



Winding

The quality of the winding material and how it is processed during manufacturing contribute greatly to the overall quality of our transformers. Hyosung's transformers apply state-of-the-art manufacturing methods for both core form and shell form using advanced materials including rectangular wire or CTC (Continuously Transposed Cable).
In addition, the winding process is completed in a dust-proof clean room with both temperature and humidity controls which meets NAS 100,000 grade.

Core Form


Continuous Winding


Hisercap Winding


Cylindrical Winding


Helitran Winding

Shell Form


Pancake Winding

Products and Details

Core Form Transformers

Core form transformer refers to the structure of locating low-pressure/high-pressure winding surrounding core to concentric circle.

Characteristic

- Compact structure
- Easy assembly
- Linear potential distribution
- Circular form with short circuit strength
- Easy inspection and repair

Item	Phase	Rated Voltage	Capacity
❶ 765kV Transformer	1 ph	765/345/23kV	667MVA
❷ 345kV Transformer	3 ph	345/118/22.5kV	550MVA
❸ 230kV Transformer	3 ph	230/115/13.2kV	224MVA

Shell Form Transformers

Shell form transformer refers to the structure of layering core around winding to support winding from the circumference.

Characteristic

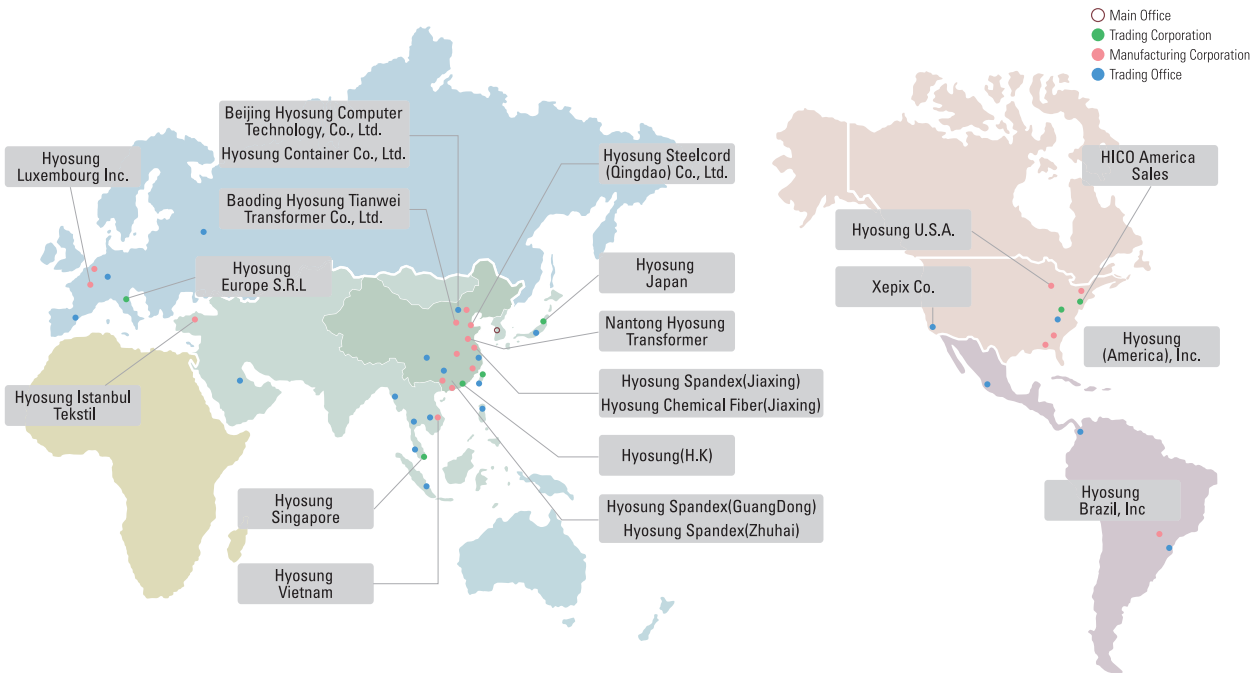
- Consistent potential distribution
- Short circuit strength allowing for high dielectric strength
- Outstanding cooling efficiency
- Easy manufacturing of special transformers
- Lay-down shipping
  (furnace transformerstraction transformers)

Item	Phase	Rated Voltage	Capacity
❶ 765kV Transformer	1 ph	765/20.9kV	395.7MVA
❷ 500kV Transformer	1 ph	525/230/34.5kV	433MVA
❸ 345kV Transformer	3 ph	345/118/34.5kV	672MVA

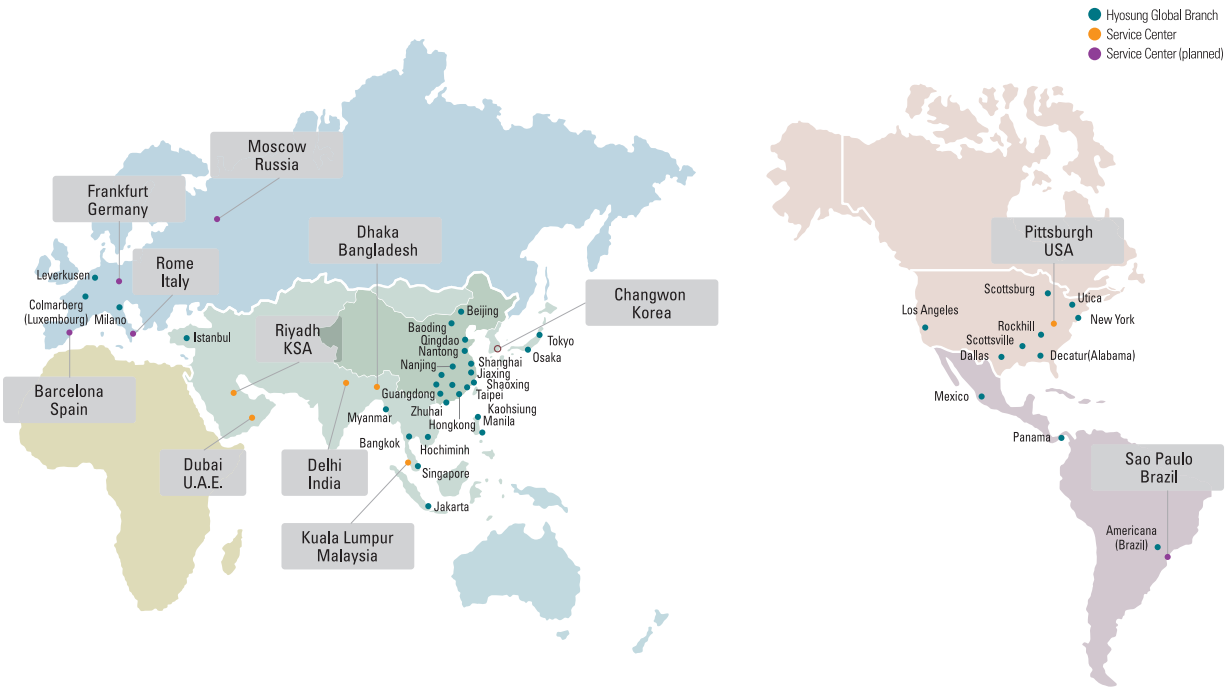
Global Network

Ready to serve our global customer anytime, anywhere

Global Network | Aggressive Expansion of Global Customer Support Structure



Service Network | Hyosung's Worldwide Service Network for Timely Service



HYOSUNG

ISO 9001
ISO 14001
OHSAS 18001
BUREAU VERITAS
Certification

2011. 01

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