

# Power and traction transformers

## Advanced technology for maximum reliability

# ABB – a global leader



ABB is a global leader in Power and Automation technologies that enable utility and industry customers to improve performance while lowering environmental impact. The ABB Group of companies operates in around 100 countries.

In India, ABB serves customers with the complete range of power and automation technologies. The company has a vast installed base, extensive manufacturing facilities and a countrywide marketing and service presence.

The Power Technologies division offers electric, gas and water utilities as well as industrial and commercial customers a wide range of products, systems and services for power generation, transmission and distribution. ABB turnkey solution capabilities in the sector range from bulk power transmission, substations and complete electrification to utility automation and distribution systems.

The product offering covers a wide spectrum of technologies across the entire voltage range including indoor and outdoor circuit breakers, air and gas insulated switchgear, instrument

transformers, disconnectors, capacitor banks, reactive power compensators, power and distribution transformers and a range of power distribution products like compact secondary substations (CSS) and ring main units (RMU).

## Advantage ABB

- 120 years of technology and innovation
- Unparalleled domain competence
- Vast global experience
- Total solution provider
- Large installed base
- Environment-friendly technologies

## Commitment to quality and sustainability

ABB manufacturing facilities conform to the highest quality and environmental standards. The facilities are ISO 9001 and ISO 14001 compliant and certified by leading international authorities.

# Experience and expertise makes the difference



Testing facilities for transformer from 220kV to 765kV

With over 100 years of experience in manufacturing world-class transformers, ABB has led the way setting new benchmarks in transformer technology. ABB's advanced technology, design, processes and materials that go into every transformer ensure trouble-free operation, high efficiency and reliability.

Extensive R&D in the field of transformer technology, power transmission and distribution has enabled ABB to develop various concepts in design as well as engineering of transformers.

ABB Transformers are designed based on the patented and proven TrafoStar™ concept, ensuring minimal losses, low noise and overall reduction in life-cycle costs. ABB also undertakes repairs, refurbishment and life-enhancement of transformers that help optimal utilisation and lower operating costs.

ABB is the largest manufacturer of transformers in the world with over 49 factories in 30 countries.

ABB offers a wide range of Power transformers, Traction transformers and HVDC transformers.

ABB also manufactures a wide range of Distribution transformers.

Like any of its numerous facilities across the world, ABB's state-of-the-art transformers manufacturing and testing facility in Vadodara, Gujarat, India is equipped with the latest and best-in-class processes and systems for design, manufacturing and testing.

The Vadodara facility employs the best-in-class manufacturing practices drawn from experience and expertise developed over the years across ABB's global operations.

Well-trained engineers with global experience and expertise ensure that every transformer that rolls out is a symbol of the highest quality and reliability.

# Unparalleled range

ABB offers the widest range of transformers which are synonymous with technological innovation, superior quality and reliability.



Power Transformers - 66 kV to 765 kV, 10 MVA and above



Shunt Reactors - 50-125 MVar 400kV class



HVDC Converter Transformers

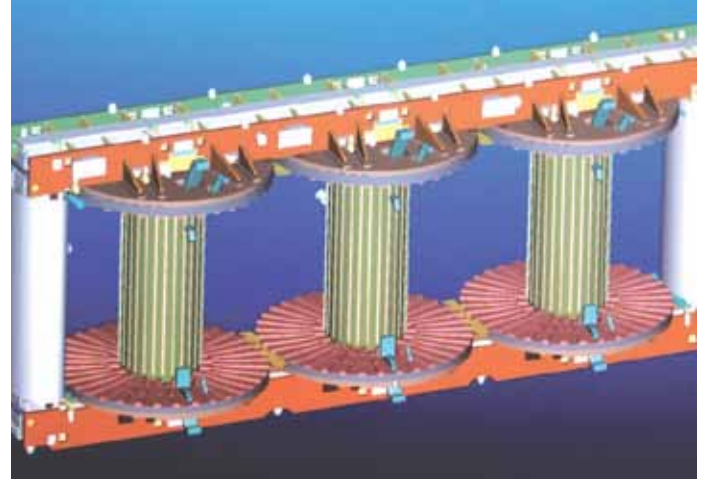
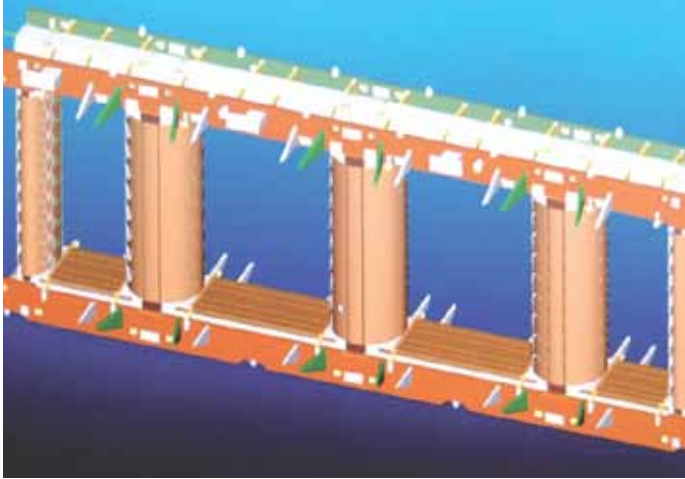


Traction Transformers - LOT 6500/7500



Traction Transformers - EMU

# TrafoStar™ – for efficient and dependable transformers



“TrafoStar™” is the common ABB concept used for the design and manufacture of Power Transformers across all its manufacturing facilities. It is based on the best practices and know-how acquired over several decades coupled with global manufacturing experience.

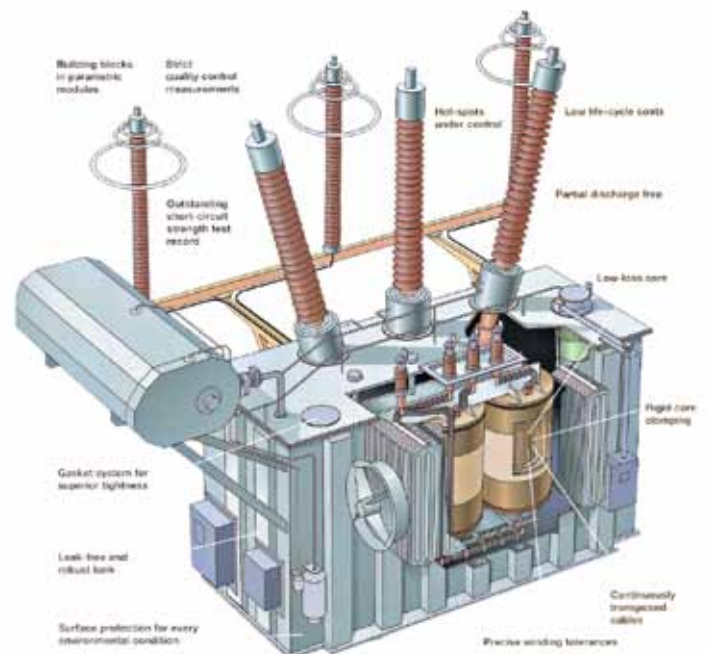
The concept incorporates common electrical and mechanical design standards, global processes and quality norms with a 6-Sigma system. Every Trafostar™ transformer is built from standardised, service proven components and modules ensuring flexible, dependable and tailor-made transformer designs. The high reliability of these transformers ensures maximum availability, lower maintenance costs and reduced life-cycle costs.

Powerful and sophisticated software tools are used to develop the mechanical and electrical design of all transformers. These tools help in ensuring optimum electrical design and determining eddy current losses and short circuit forces accurately. A 3-dimensional modelling software (Pro-Engineer) used in developing the mechanical design enables designers to view the virtual prototype of a transformer (including tanking of the corecoil assembly) on the computer screen before production commences.

TrafoStar™ design used for core type transformers has a circular shaped core limb, surrounded by concentrically arranged, cylinder shaped windings. This facilitates the most efficient use of active material and reduced production time.

The core is made of cylindrical windings that can withstand short circuits even under extreme fault conditions.

High voltage windings are built as interleaved discs, while the low voltage windings are of helical design. The tapped portion of the winding is normally arranged as a separate physical winding shell. This design allows a balanced ampere turn distribution, avoiding excessive short circuit forces and additional losses.



# State-of-the-art processes



## Windings

Windings are designed to withstand high short circuit capability, uniform surge voltage distribution and effective heat dissipation which are critical to transformer reliability. The disc type design of the high voltage windings ensures better short circuit withstand capability, uniform surge voltage distribution and effective heat dissipation. These windings can be used with different designs for both small and large transformers up to the highest voltage levels. Using the latest developments in winding technology, ABB uses “voltage stabilised” disc windings for the high voltage side. The individual winding turns in each group of discs are interleaved thereby increasing the winding series capacitance to get uniform voltage distribution.

The low voltage windings are made of helical type windings with turns composed of several strands in parallel. Spacers between the strands make it easy to accommodate large oil ducts for insulation and cooling.

The specially designed vertical winding machines make it possible to produce windings to meet the exact design specifications. Adjustable winding mandrels guarantee compliance with the specified winding geometry for coils of a transformer.

The windings of the on-load tap changers are designed in such a way that the tapped segment of each winding is evenly distributed over the entire length of the core limb. This design ensures proper ampere distribution facilitating electromagnetic balance regardless of the selected tapping position.



# World-class material and components



5 Limb Core of 315 MVA, 400 kV Auto Transformer



Core lifting on core table

## Core

Cold-rolled grain oriented silicon steel laminations are used to ensure low no-load losses and suppression of vibrations resulting in lower noise levels. Using stepped sheet widths helps in achieving an almost circular cross section of the core.

Advanced step-lap core construction technique achieve precise core stacking with step lap joints at the corners. This technique also helps in stacking at precise angles thereby preventing the formation of air gaps in the core joints, which otherwise could lead to increased losses and noise generation.

Core form structure is used without any through bolts in the limb or yoke portion. The core limb is wound with conducting resin impregnated glass tape to give rigidity to core and to get a minimum uniform circular section for inner winding. To avoid internal mechanical stresses, the core is set upright in the stacking device itself.

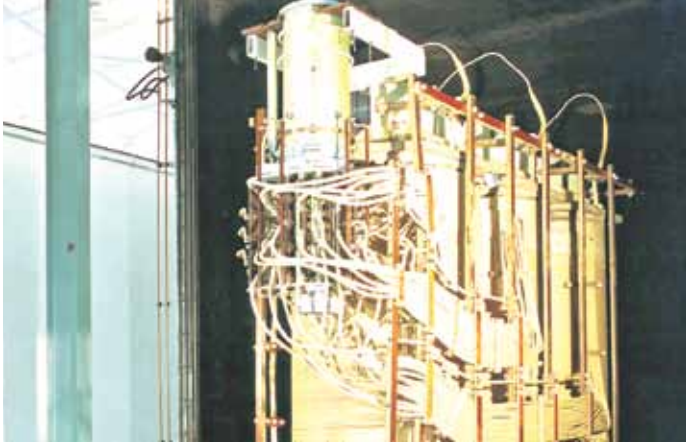
## Active part (Core coil assembly)

In the main assembly bay the windings are assembled with the core on movable and fixed work stations. Special care is given to electrical connections of cleats, leads and tap changer. All the necessary joints are made secured by applying high frequency brazing or specially patented crimping technology carried out by trained personnel.



Active part view (LV side) of 100 MVA, 220 kV Transformer

# Best-in-class systems



Active part drying in a VPD



Tanking with precision

## Insulation and drying system

An oil barrier system is used as the main insulation medium and moulded angle rings for end insulation. Major oil gaps between the windings and earthed parts are divided into thin oil layers by means of press board barrier cylinders enabling uniform drying and PD (Partial Discharge) free insulation even at high electric stresses. Pre-compressed press board spacers and moulded end-barriers used in the active part provide a rigid insulation structure with low PD levels.

Moisture content in insulating materials of winding assembly is removed by application of heat and vacuum in a separate drying oven (Winding Autoclave) before windings are individually pressed in a hydraulic press. As the active part can absorb moisture during the assembly process a final drying process is carried out in a completely automated vapour phase drying (VPD) plant. This ensures thorough and uniform drying resulting in a clean and dry core coil assembly (active part) which ensures long transformer life.

A clean, dust-free environment ensures the highest standards in quality. By using an automated oil-filling and processing system and by virtue of leak proof joints in the transformers there is no oil spillage.

## Tanking

After inserting the active part into the tank, processed insulating oil is added. The oil passes through a special flushing process in a filter system during which any remaining impurities are removed. An advanced nitrile rubber gasket system used in the grooves ensures the joints are secure, making the transformer leak proof. Processing and handling of oil is done by means of an automated oil handling system, which eliminates any chance of oils intermixing.



Final assembly

## Bushings

ABB's factory for oil-filled transformer bushings up to 245kV is equipped with the latest vacuum evacuation and oil filling plant. The state-of-the-art testing facility comprises a 'Faraday Cage' - which is a completely metal enclosed hall to ensure no external electromagnetic interferences while the equipment is tested. The facility is equipped to test bushings up to 440kV.



# Testing and quality control



## Testing

The Vadodra transformer facility is equipped with state-of-the-art testing facility to test transformers up to 765 kV.

This modern testing facility includes an impulse generator, precision power analyser for transformer loss measurement, PD analyser and temperature data logger to carry out routine and type tests accurately. A special motor-generator set-up is used to test transformers at the exact operating frequency to obtain accurate results.

Modern data collecting systems and high-end testing instruments allow easy access to accurate results obtained from test measurements. ABB transformers are subjected to all the necessary routine tests in accordance with BIS or IEC, ensuring they withstand conditions beyond normal operating conditions. The extremes to which the transformers are tested are a measure of the highest standards in quality and reliability built into every transformer.

In addition to all routine tests, special and type tests that can be carried out in-house include:

- Temperature rise test
- Lightning & switching impulse test
- Induced over-voltage test with PD measurements
- Measurement of zero sequence impedance
- Noise levels

## Quality Assurance, Health and Safety

An up-to-date quality assurance system is well in place that covers all aspects involved in the production and testing of all transformers.

Quality checks are carried out on all material and processes at various manufacturing stages to ensure highest quality standards. Following a global quality manual ensures that the quality assurance system used is on par with similar systems deployed in other ABB factories across the world. The facility is ISO:9001 certified for its quality systems.



# World-class facilities and operations



## In-house handling

The entire facility floor is epoxy coated with no rails. ABB uses air castors which work on the hovercraft principle for moving windings, sub-assemblies and complete transformers ensuring smooth and jerk-free movement.

## Transportation

Moving an object, the size and weight of a large power transformer is no easy task and requires precise coordination and execution. ABB has state-of-the-art infrastructure and reliable logistics partners that ensure that the end product is packed and transported safely to its destination. ABB installs impact recorders for higher ratings of transformers.

## Installation, service and support

ABB's well-trained and dedicated service engineers ensure that transformers are erected and commissioned as per ABB's global standard procedure. Extra care is taken to supervise the unloading, erection on foundation pads, assembly of components, refilling the transformer with oil and performing the necessary on-site pre-commissioning tests to assure proper, trouble-free service.

ABB has a wide network of marketing offices and service centres located across the country, ensuring quick response to customer needs.





90 MVA, 110/34.5 kV Power Transformer



87.5 MVA, 138/34.5 kV Transformer



100 MVA 220/66 kV Power Transformer



400/74.5/74.5kV HVDC back-to-back Converter Transformers



154 MVA, 11/420 kV Generator Transformer



315 MVA, 400kV Auto Transformer

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