ABB Industrial Transformers

The largest technology base – worldwide

ABB Industrial Transformers: Unified power for your success

Series Reactors for AC Arc Furnaces

Most AC arc furnaces will require a series reactor in the primary. For long-arc steel furnace operation additional reactance is normally required to stabilize the arc and optimize the operation. A series reactor for this purpose is built into the furnace transformer tank itself or supplied separately.

Rectifier Transformers

For various electrolysis applications like aluminium and other metal and chlorine.
Rectifier transformers are combined with a diode or thyristor rectifier. The applications range from very large aluminium electrolysis to smaller scale operations. The transformers may have a built-in or separate voltage regulation unit.

AC Arc Furnace Transformers

Furnace transformers for long-arc (steel) and short-arc (ferroalloy) operations. ABB produces transformers for all furnace applications. A robust design guarantees mechanical strength for steel furnace operation and temperature control for continuous high loads in ferroalloy operation.

DC Arc Furnace Transformers

DC arc furnaces are mainly for steel production. Transformers for DC furnace operation normally come in a transformer/rectifier package. The full package can be manufactured and supplied by ABB.

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Large Drives Converter Transformers

Drives systems for pumping stations, wind turbines and traction feeding. The transformers are combined with a thyristor rectifier for variable speed drives (VSD) systems or frequency converters.
Customized solutions by dedicated people in focused factories.

Experience
ABB Industrial Transformers integrates the experience of highly dedicated people and techniques from several industrial transformer factories in various countries. This represents the largest technology base of its kind—worldwide.

Quality
ABB Industrial Transformers believes that Quality is a vital element of the product right from the start; it can never be achieved by checks and controls alone.

Quality assurance procedures are implemented even before the design work starts, ensuring correct interpretation of customer requirements. Sophisticated computer programs calculate electric, thermal and mechanical stresses, and our quality programme ensures that checks, tests, and inspections are carried out with precision. Our quality control procedures are used. The ultimate goal is to maintain overall quality—which results in high reliability and optimum transformer life cycle cost.

Built-in quality procedures are implemented even before the design work starts, ensuring correct interpretation of customer requirements. Sophisticated computer programs calculate electric, thermal and mechanical stresses, and our quality programme enables us to check, test and inspect all our processes. Sophisticated computer programs are used. The ultimate goal is to maintain overall quality—which results in high reliability and optimum transformer life cycle cost. Advanced monitoring systems are also available.

Partnership & Service
ABB Industrial Transformers designs tailor-made, high current solutions for all our industrial customers. We are committed to being a flexible and knowledgeable partner for you worldwide. Together we can analyze individual needs and help to ensure that your will receive the optimal transformer solution to meet your requirements.

Applications
For special applications, such as large pumping stations, wind tunnels and rolling stock, a transformer combined with a frequency converter will supply the input for a variable-speed system. For fixed railway feeding stations a conversion from normal grid frequency to railway frequency takes place in a similar way.

Large Drives Converter Transformers

Focused Factories
ABB Industrial Transformers now concentrates Research and Development, engineering, manufacturing and service for industrial transformers primarily at two specialized and globally focused factories within the ABB group, located at Legnano, Italy and Bad Honnef, Germany.

Know-How and Research and Development
ABB Industrial Transformers has direct access to all the combined transformer know how, technical experience and expertise within the ABB group. This represents an enormous legacy that has been achieved through dedicated employment, as well as a rich and undated knowledge in Research and Development. ABB Industrial Transformers is continuously enhancing the base and finding solutions for the future—now.

Large Drives Converter Transformers

Duty
Large drives are often related to the type of application. In pumping stations a high loading with limited variation over time can be expected. While in other applications they may be more intermittent duty cycle—fully load peaks.

Design
Switched transformers are mostly built with two secondary and four primary windings, allowing for a 12-pulse output. Switched transformers are normally built with a high primary winding system connected to a filter bank to take out harmonics caused by the converter. Due to the operation cycles of the converter, there are strong requirements for correct inter-winding impedance relations and accuracy.

Technical Features
Ratings: Up to 137 MVA
Secondary voltages: Up to 13,4 kV

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Applications
Electrolysis processes are used for the production of metals, such as aluminium, magnesium, copper and zinc, or chemicals, mainly chlorine. The largest installations are those for aluminium electrolysis with several transformer/rectifier units in parallel operation to achieve the required DC current. In all cases the rectifier can be with diodes or thyristors.

Duty
Electrolysis is generally considered to be continuous and stable processes, but with a constant high loading and current harmonics.

Design
Due to a large variety of applications there are several influencing factors to consider:
- Rectifier bridge connection: For medium to high DC voltage level.
- Rectifier single-way interphase connection: For low DC voltage levels combined with high DC currents.
- Thyristor or diode rectifier.
- Voltage range and step voltage.
- Double-decker: HV and LV windings in two levels and wye and delta connection to achieve 12-pulse reaction.
- Pulse numbers higher than 12: Requires additional phase shifting windings.
- LV winding arrangements: Adapted to minimize winding hotspots and the influence of harmonics.
- LV bushing arrangement: Adapted to rectifier design and to limit structural heating.

Voltage regulation
Thyristor rectifiers normally require transformer voltage regulation with a no-load-tap-changer (NLTC), if any. For short voltage ranges the NLTC can be situated in a HV tapped winding. Diode rectifiers will in comparison have a longer range and a higher number of smaller voltage steps in the transformer. A multi-coarse-fine onload-tap-changer (OLTC) or an OLTC/NLTC combination is preferred, together with LV-side saturable reactors for the voltage fine-tuning. The required double-wound or auto connected regulating transformer can, depending on transport or site limitations, be built into the same tank as the rectifier transformer or into a separate tank.

Technical features
- Unit ratings: Up to 160 MVA
- Secondary voltage: Up to 1500 VAC
- Unit process current: Up to over 100 kADC
**Applications**

Electric arc furnace (EAF) transformers are required for many different furnace processes and applications. They are built for:

- Steel furnaces, mainly long arc
- Ladle furnaces
- Ferroalloy furnaces and similar with short or submerged arc

**Duty**

Steel arc furnace transformers operate under very severe conditions with regard to frequent overcurrents and overvoltages generated by short-circuits in the furnace and the operation of the HV circuit breaker (‘furnace breaker’). The loading is cyclic, while in other applications the loading is more continuous at high utilization.

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**Series Reactors**

**Applications**

In large long-arc steel furnaces with high arc voltages there will generally be required to introduce extra reactance in order to stabilize the arc during operation. For this purpose, a linear series reactor will be used. The reactor may be built into the same tank as the furnace transformer, or supplied as a separate unit.

**Duty**

For operational flexibility the reactor will normally be supplied with a tap changer. Depending on the melting process and type of steel being produced this may be an on-load or no-load tap changer with the required number of steps.
Direct Regulation
The secondary voltage can be regulated by tapping the primary winding. Step voltages over the range will be unequal, due to the inherent winding design, but adaptations can be made to satisfy most requirements. A single core-coil unit makes this the most cost-effective regulation principle in a furnace transformer as long as a suitable on-load tap changer is available. A primary star-delta reconnection switch will expand the range.

Indirect Regulation
When equal and/or very small voltage steps or a very long regulating range is required, the alternative will be the booster regulation with two core-coil units directly connected in the same tank. The main unit will supply a fixed LV component and the series unit will supply a variable and reversible LV component. The two LV systems are connected in series for the desired LV voltage positions and range.

Over-voltage Protection
In order to protect the HV side of the transformer from incoming switching over-voltages, a system of RC filters and surge arresters (SA) should be fitted to the HV side of the transformer. On the LV side capacitors may be added to suppress over-voltages from the arc.

Technical Features
- Ratings: Up to 200 MVA
- Secondary voltages: Up to 1500 V
- Electrode current (steel): Up to 100 kA
- Electrode current (Fe-alloy): Up to 160 kA

Design
The reactor will have the same heavy duty as the furnace transformer itself. Therefore the design has to be very rugged in order to maintain stability and linearity of the reactance. The ABB reactors for this kind of application are built as coreless coils surrounded by a shielding structure of core laminations in a 3-phase arrangement.

Technical Features
- Ratings: Up to 60 MVAr
DC Arc Furnace Transformers

Applications
Most large DC arc furnaces are built for steel production. The use of a thyristor rectifier for the conversion to DC will normally reduce the requirement for on-load voltage regulation of the furnace transformer. The step voltages will be larger than for an AC furnace transformer and a no-load tap changer (NLTC) will in many applications be adequate.

Duty
Being a rectifier transformer for furnace operation, the DC furnace transformer will have to withstand the characteristic stresses of furnace operation, as well as the additional stresses related to rectifier operation, including generated current harmonics. Also, the HV side needs to be protected from frequent switching overvoltages.

Design
DC furnace transformers are mostly built with two axially displaced LV windings, normally one connected in delta and one in wye, each having a separate high voltage winding. In this double-decker design, the transformer is connected to two six-pulse rectifiers, adding up to a 12-pulse system or two parallel 6-pulse systems. The regulation of the LV transformer voltage is normally done by using a NLTC in the primary winding. The location of the 6-pulse rectifiers can be on the same side of the transformer or on opposite sides, as required by plant layout.

Intermediate yoke
DC furnace transformers in double-decker design, having two HV-LV voltage systems on the same core may have an intermediate yoke to enable largely independent operation of the two systems.

Technical Features
- Ratings: Up to 120 MVA
- Secondary voltages: Up to 1200 V
- Electrode current: Up to over 100 kADC