

SIEMENS

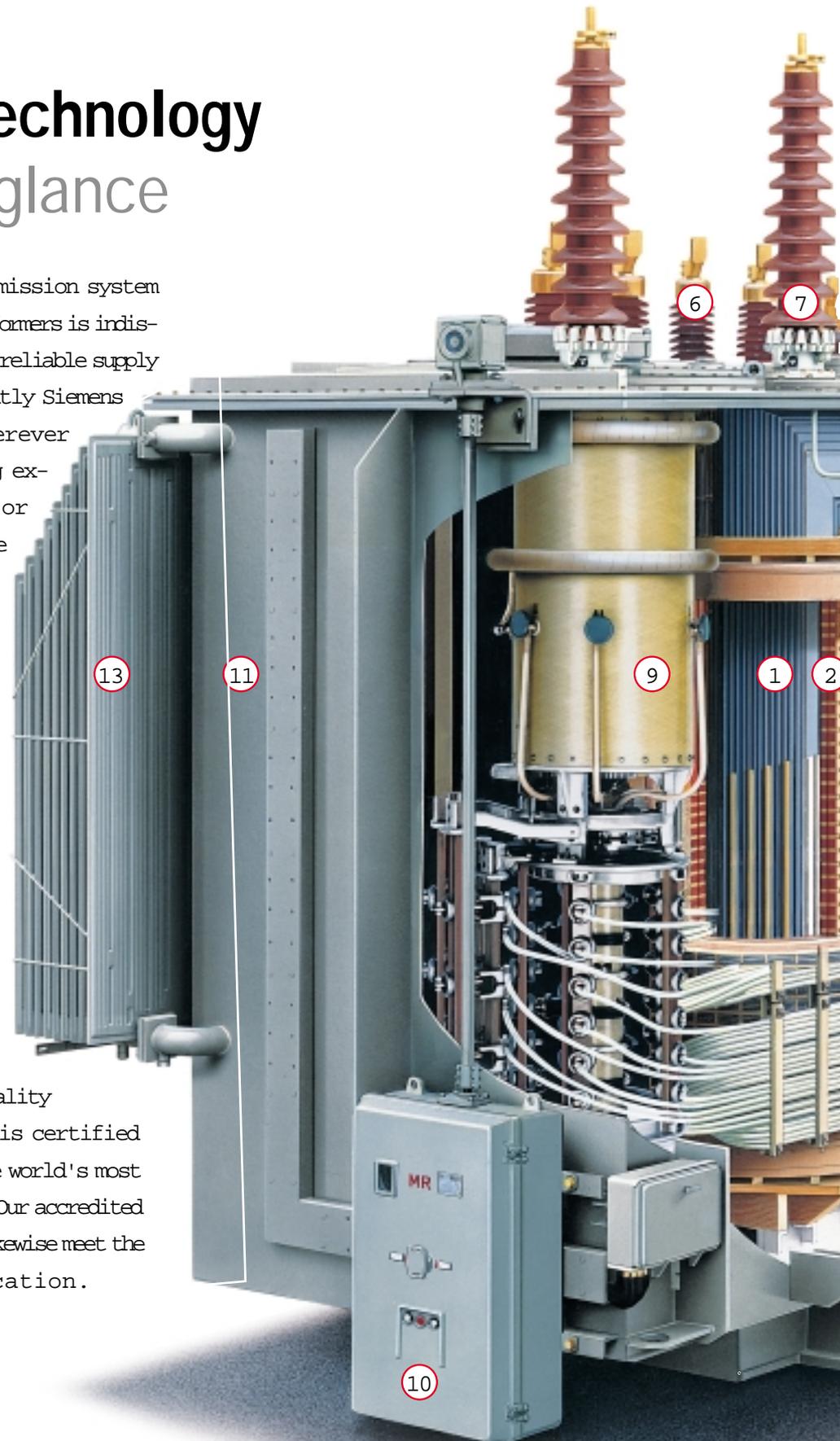
Power Transformers 10 to 100 MVA

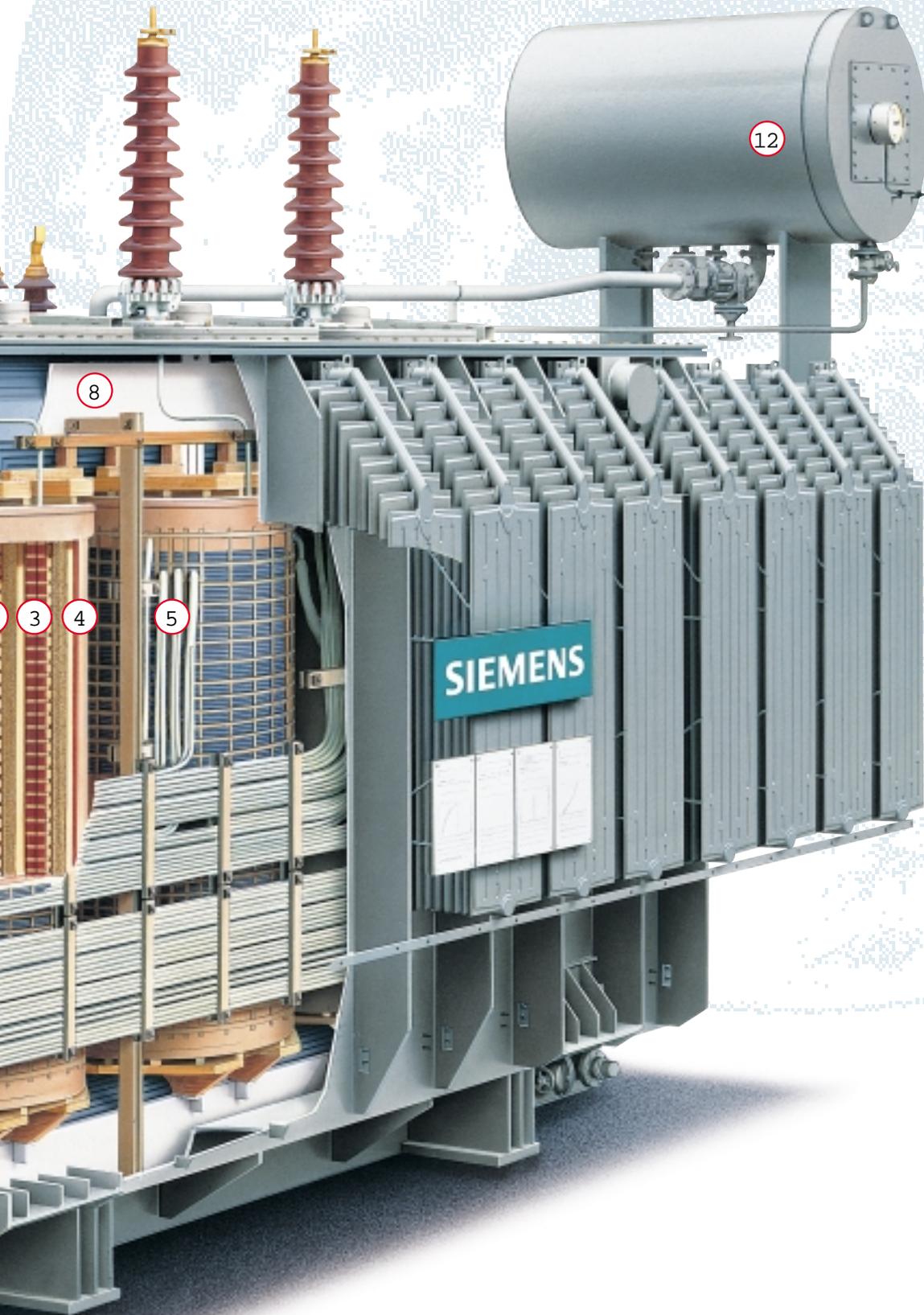


Transformer technology at a glance

An extensive transmission system with efficient transformers is indispensable to ensure a reliable supply of power. Consequently Siemens will be found wherever networks are being expanded, updated or established for the first time.

All over the world, power transformers from Nuremberg enjoy a great reputation. What the Nuremberg plant manufactures reflects today's state of the art and testifies to the highest levels of quality and reliability. Our quality management system is certified to DIN ISO 9001, the world's most stringent standard. Our accredited test laboratories likewise meet the latest specification.





In the 10 to 100 MVA rated power range, the most common voltage ratio is from 110 to 132 kV to 30, 20 or 10 kV. These transformers have off-load or on-load tap changers to adapt them to network conditions.

We manufacture these units to VDE 0532, IEC 76 or to national specifications. We offer individual solutions to problems satisfying all the requirements with respect to type of operations, low noise and low losses, connection technology, type of cooling, transportation and installation.

View into a 40-MVA network transformer:

Voltage ratio:
 $110 \pm 16\% / 21 \text{ kV}$
 Vector group: YN d5
 Type of cooling: ONAN

Components

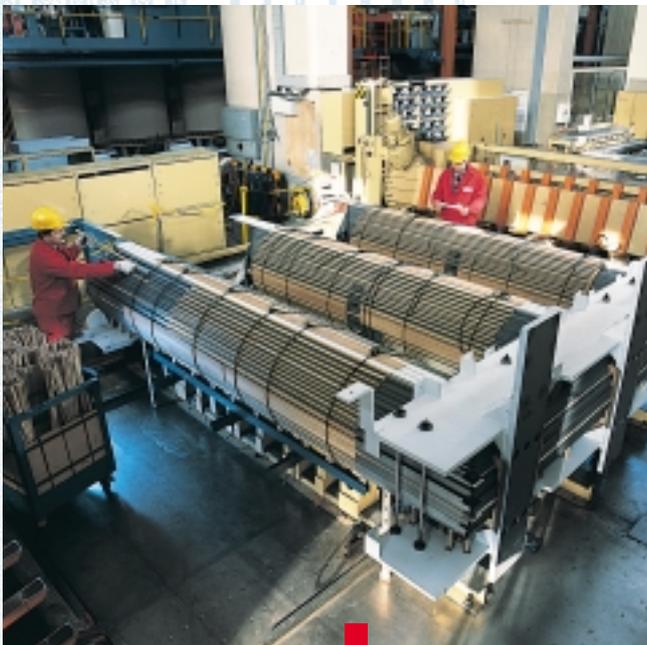
- ① Three-limb core
- ② LV winding
- ③ HV winding
- ④ Tapped winding
- ⑤ Tap leads
- ⑥ LV bushings
- ⑦ HV bushings
- ⑧ Clamping frame
- ⑨ On-load tap changer
- ⑩ Motor drive
- ⑪ Tank
- ⑫ Conservator
- ⑬ Radiators

Iron core

Transformers are of the core type. Core limbs – wound and non-wound – are arranged in one plane and connected by yokes.

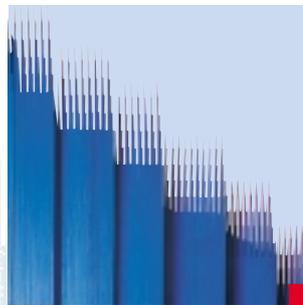
As required by the loss evaluation and the customer's noise-emission requirements, 0.3 mm and 0.23 mm thick Hi-B laminations are used, which may also be laser or plasma-treated.

Step-lap stacking has proved to be the best technique and is standard in our company.



Rapid and precise stacking of core laminations on special stands:

The joints are step-lapped.



Computer-controlled longitudinal and cross-cutting equipment:

These are capable of cutting sheets flexibly, without burr or bending, into their final shape.

Step-lapped core:

The best way to keep noise and losses low.



Core of a 24-MVA transformer:

The cross-sections of the bolt-free limbs are finely graded and are practically circular in shape.

Windings

For high voltages $U_m \leq 145$ kV, layer windings made of paper-insulated transposed copper conductors are preferred.

Low-voltage and high-voltage windings as also the tap windings, are wound on top of one another to form a compact integrated system.

The advantages: high short-circuit strength, compact dimensions, few soldered joints.

The cylindrical windings are arranged concentrically and separated by axial oil ducts.

Careful treatment is particularly important:

The windings are subsequently tested, pressed and dried.

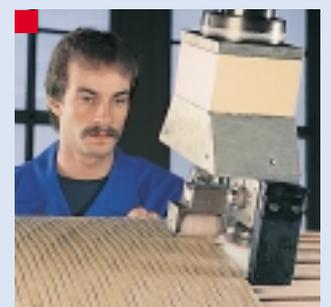
Transposed conductors reduce stray losses in the windings:

These consist of a number of varnish-insulated transposed flat conductors.



Winding benches for layer windings:

The insulated conductors are wound in layers under constant pressure and tension.



Voltage variation

In order to adapt the voltage ratio to the requirements of the system, the transformer has a special winding with tapplings. The voltage ratio can thus be changed either by a no-load tap changer after switching off the transformer, or under load with an on-load tap changer.

On-load tap changer for large transformers:

Here, tap selector and diverter switch are separate and arranged on top of one another. The oil in the diverter switch compartment is kept apart from the transformer oil.

Motor drives are available for operating the on-load tap changers. These can be controlled either locally or by remote control. No-load tap changers are normally set manually.



The on-load tap changer has a motor-drive mechanism:

It is mounted on the tank and connected to the tap changer via a bevel gear.



Drum-type no-load tap changer:

This is used for adjustment of the voltage ratio when the transformer is de-energized.



Tank

In addition to the core and winding, the tank is the third main component of a transformer. It accommodates the core-and-coil assembly and the oil filling, often weighing several hundred tonnes. This calls for a statically secure and oil-leak-proof design, with the weight optimized.

The tank parts are made of blast-cleaned steel plates up to 30 mm thick. These plates are first put together to form segments and then welded oil-tight to form the tank.

Perfect protection against corruptions is in demand:

The tanks are treated in the steel grit blasting chamber and are given their anti-corrosive finish in the spray booth. If, additionally, galvanizing is also required, we apply a standard zinc dust paint coating.



View of the welding line:

This is where the tank segments are joined together by submerged-arc welding – mostly automatically.



The modern Surface-Treatment Centre:

The tanks are given their finish in the steel grit blasting chamber and the varnishing chambers.



Assembling the components

In the preassembly shop, the core-and-coil assembly of the transformer is put together from the core, windings, clamping devices, on-load tap changer and the leads.

After the dried core-and-coil assembly has been inserted into the tank, the transformer is evacuated and filled with transformer oil. Then accessories like motor drive, control cabinets, bushings, monitoring devices, etc. are attached to the tank.

Before the transformer leaves the factory, it is subjected to exhaustive final testing in the test bay.



The heart of the transformer – the core-and-coil assembly – is put together out of the various components:

The assembly team on the working platforms is always at the right height. These platforms have motor drives to adjust their height.



The last step of manufacturing:

The core-and-coil assembly, dried under vacuum at 135 °C in the vapour-phase plant, is inserted into the tank.



The quality of manufacture is assured from materials ordering to transformer delivery to the customer:

The final mechanical and electrical check of the finished product is a particularly important phase.

Cooling

The efficiency of the cooling is a crucial factor determining the operational safety and the life span of a transformer.

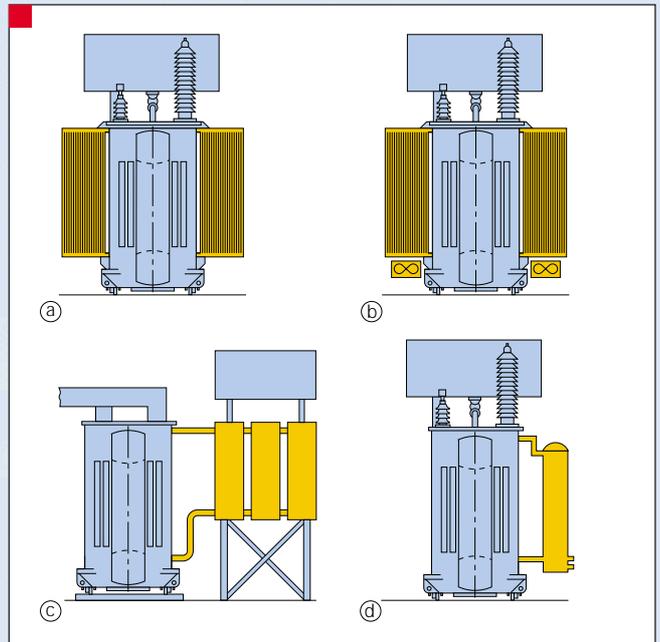
The type most frequently used is ONAN (natural) cooling. The heat loss is absorbed by the transformer oil and given off to the surrounding air via radiators. With ONAF cooling the radiators are additionally cooled by fans. The cooling system may also consist of separate radiator banks, or water coolers.

Types of cooling:

- Ⓐ natural air cooling with radiators (ONAN)
- Ⓑ radiators additionally cooled by fans (ONAF)
- Ⓒ cooling by separate radiator banks
- Ⓓ water instead of air as cooling medium.

Better heat dissipation:

Additional, temperature-controlled fans providing vertical air flow to cool the radiators.



For particularly low-noise installations:

Enclosed transformers with separate radiator banks outdoors.



Conservators for open or closed systems are available:

With the closed TUPROTECT® system, the oil does not come into contact with the surrounding air. The oil expansion is compensated by an air bag.

Water as the external coolant:

Oil-to-water coolers are attached to the transformer.



Operating worldwide



Our Company's experience in the transformer field goes back one hundred years. Tens of thousands of installations are equipped with our transformers. Their technology, quality and reliability are appreciated around the globe.

Electric power is generated and immediately consumed here:

Numerous transformers are in operation in Jeddah's industrial area. The illustration shows 73-MVA generator transformers.



Particularly environmentally acceptable:

This 25-MVA network transformer in a south German substation has an exceptionally low sound pressure level: 36 dB (A).



In Switzerland:

Two 40-MVA transformers with separate radiator banks for the Burgdorf substation.

Siemens' good reputation has spread to Latin America too:

10-MVA transformers in a Venezuelan substation.

A transformer for the desert:

Wide temperature fluctuations, sandstorms. No problem. Siemens technology is good for decades.





In Africa too:

The distribution of electric energy via Siemens transformers. 15 and 30-MVA units in Nigeria.



An 80-tonne crate for Pennsylvania, USA:

Its contents: a 43-MVA transformer, made in Germany.



Tailor-made for narrow space:

Where space is scarce the transformer is being tailor-made. The illustration shows a 73-MVA generator transformer.



15m below ground:

These two 40-MVA power transformers (on the left) are situated 15 m below ground in the town of St. Gall, Switzerland. In 1996, a mobile crane was required for precise installation of the two 72-tonne devices (on the right). An additional feature of these transformers: their dissipated heat is used to heat the surrounding buildings.



One customer requirement:

A colored transformer design for an environmentally friendly power station in South Germany.

In Germany:

The likelihood that the power from the socket is delivered by a Siemens transformer is particularly high in this country.



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