



ENGLISH



TT0 Transformers

Distribution transformers immersed in **insulating liquid**



TTR



TT0



OTN, OTR, OTF



REACTORS



TTH

TECHNOLOGY

Magnetic core

The core is formed by grain oriented magnetic sheets, with a high permeability and reduced specific losses, separated by an inorganic insulation (carlite).

The special cutting and assembly of the core allow the "STEP-LAP" joints which reduce noise as well as losses and the no load current. The magnetic sheets are pressed by core clamps, realized by bent sheet shapes.

Low Voltage Windings

The LV winding consists of an electrolytic aluminum or copper sheet conductor. The winding may be round or oval. The special paper used as an interlayer adheres to the surface of the conductor during the drying phase, making the winding more compact and sturdy, suitable to withstand heavy electrodynamic stresses.

The outlet terminals are realized by aluminum or copper plates welded in inert atmosphere.

Medium Voltage Windings

The MV winding is realised by an enamelled copper wire or strip insulated with pure cellulose paper, using automatic or semi-automatic computerized machines.

It is generally wound directly above the LV winding.

The results is a complete MV+LV coil, very compact and



sturdy, suitable to withstand possible electrodynamic stresses caused by a short circuit.

The commutation leads are obtained directly from the outside part of the winding.

Off load tap-changer

Every transformer is equipped with a 5 position tap changer ($\pm 2,5\%$) which enables the alignment of the nominal voltage of the MV winding to the available voltage.

The adjusting of tap changer should take place when the transformer is disconnected from the network by using the knob on the lid.

The knob can be locked at every position of the 5 available in order to prevent accidental manoeuvring.





Assembly of the active part

The final assembly is carried out with care and accuracy.

The three complete LV+MV coils are assembled on the corresponding core legs then follows the yoke assembly, the lid locking, the electric connections and the thermal treatments.

Before inserting them in the tank, all transformers are checked to verify the correctness of the connections, of the turn ratio and the vectorial group.

Final assembly

After careful drying cycle and carrying out a final control of vectorial group, the complete active part is assembled inside the ondulated body and finally filled with oil.

During this stage, the transformer is equipped with the standard accessories or as provided for by the customer's specification.

Insulating oil

The fluid generally referred to as "insulating oil" has a double function:

- dielectric: enters any interstice and impregnates the solid insulating materials (paper, pressboards); this gives a high insulation strength with reduced distances, and protects the active part from humidity.
- thermal: removes the heat from the active parts and transfers it to the tank by natural convection.

The mineral oil used with the TTO transformers complies with IEC rules, it is free of PCB and PCT and is carefully dried to guarantee an optimal dielectric performance.

The mineral oil is inflammable so the oil transformers should

be used in compliance with the local regulations. Fire risk may be minimized by using silicon oil according to IEC60836 or synthetic ester based like MIDEL7131®. This fluid is biodegradable and non-hazardous, safe for use even in the most ecologically-sensitive areas.

Tank and lid

The lid is bolted to the tank, the sealing is guaranteed by a suitable rubber gasket or sintered material.

The tank is realized by ondulated sheet, which allows the oil expansion and the dispersion of the heat generated by the transformer. The manufacturing process, including the bending and the welding of steel sheets is totally robotized and all tanks are carefully tested at the end of the cycle for the hot oil tightness. Severe life tests are periodically carried out on the different types to ensure the body resistance to fatigue cycles (expansion and shrinkage) deriving from the thermal dilation of the oil.

The body bottom is reinforced by bent sheet shapes used as skid for the bidirectional wheels connection as well.

Painting and surface treatment

The internal parts are cleaned and varnished with hot oil resistant products.

The body, lid and other metal parts are carefully sanded and painted with a water monolayer varnish which combines an excellent performance in time and environment safeguard.

The final average thickness is not lower than 120 micron.

Special painting cycles for chemical aggressive environments, cycles with increased thickness/hardness for sandy environments or hot galvanization, are available on request.

TESTING

All transformers are tested at our test room with routine tests in compliance with IEC60076, that is:

- measurement of winding resistance
- measurement of the transforming ratio and control of the connection group
- measurement of the losses and short circuit voltage
- measurement of the no load losses and no load current
- checking of the insulation with applied voltage
- checking of the insulation with induced voltage

All kinds of type tests and special tests indicated by regulations can be carried out on customer's request:

- heat run test
- impulse withstand test with full and chopped wave
- measurement of noise level
- measurement of the harmonic contents of the no load current
- measurement of the homopolar impedance
- measurement of the winding capacitance
- dynamic short circuit withstand test (to be carried out by an authorized external lab)
- other special tests to be agreed with the customer upon request

Archive of type tests

SEA has a large archive of type and special tests carried out on many oil distribution transformers delivered to customers worldwide. The archive is available at all times for our customers to consult.

INSTALLATION

Room temperature and load conditions

The TTO oil transformers have been designed to supply the nominal power in a standard distribution network with conditions defined by IEC 60076 rules. Heights over 1000 meters, room temperatures higher than 40 °C or specific conditions of the network or load (presence of overvoltages, harmonics, overloads...) cause a dielectric, mechanic or thermal stress to the transformer which has to be considered during design in order to not compromise its reliability and duration.

Please contact our technical department for every specific requirement.

Segregation cell

The only live parts under voltage of an oil transformer are the MV and LV bushings .

Transformers equipped with IP00 bushings should be segregated inside a wall or grid cell to prevent accidental contacts.

The cell should enable a proper air exchange (at least 4,5 m³/minute of air for every kW of losses) and be sized in order to allow the inspection and maintenance of the transformer. There should be at least 400/500 mm of free space all around the transformer.

MV AND LV CONNECTIONS

The SEA TTO transformers with standard execution are equipped with MV and LV brown porcelain bushings without protection (IP00).

Connection instructions are of common practice for installators.

We recommend supporting and locking the bars, stranded wires pipes and connection cables, so as their weight and most of all the electrodynamic stresses in case of short circuit do not affect the transformer.

All types of connection or busbars are available on customer's specification, for instance:

- flange for busbars duct at LV side
- cable box at MV side with or without cable gland
- cable box at LV side, with or without busbars and cable glands



MAIN FEATURES

The SEA TTO transformers are immersed in insulating liquid. As they can be used outside within the most difficult industrial environments and their price is competitive, the SEA TTO Transformers represent the ideal solution for every industrial installation.

They are available in the version with oil conservator or hermetic type with integral filling which requires less maintenance because the oil does not come in contact with the air. They are usually filled with PCB and PCT-free mineral oil.

TTO transformers may also be requested with greater fire safety silicon oil filling IEC60836 or synthetic ester based like MIDEL7131®.

This fluid is biodegradable and non-hazardous, safe for use even in the most ecologically-sensitive areas.

They have a flexible body with undulated sheet enabling the

oil to dilate during the normal thermal cycling of the transformer.

STANDARDS REFERENCES

The SEA TTO transformers comply with the IEC and DIN Standards. On request, transformers in compliance with other international Standards or with the Customer's specifications may be manufactured.

Please contact our engineering or commercial departments for further details.



RANGE

Our standard catalogue covers up to 3150 kVA. The conditions of the standard design are:

- Maximum room temperature: 40°C
- Oil temperature rise: 60 °C
- Winding temperature rise: 65 °C
- Installation: up to 1000 m asl
- Frequency: 50 or 60 Hz

- Connection group: Yzn up to 50 kVA – Dyn over 50 kVA
- MV voltage: up to 36 kV
- MV adjustment: $\pm 2 \times 2,5\%$
- LV voltage: from 400 to 433 V at no load

Our design and manufacturing capacity may satisfy the most various needs (conversion, start up, test room...), and widen TTO transformers use to all those other sectors where a custom design is required.

ACCESSORIES

STANDARD ACCESSORIES

- N. 4 bidirectional wheels
- N. 2 grounding terminals
- N. 1 identification plate
- N. 2 or 4 lifting lugs (according to rated power)
- N. 4 connections for haulage
- No load tap changer
- Oil level indicator without contacts (for conservator type only)
- Thermometric pocket

ACCESSORIES ON REQUEST

Many accessories are available for the TTO Oil transformers for safety, protection, measuring or just to comply with the customer's specification. A list of the most commonly used is given below. For other needs, please contact our technical or commercial department.

Two-contacts dial thermometer

A cheap and reliable device to obtain the oil local temperature in the highest layers and control (through the two contacts) the alarm and trip relays in the control room.

Buchholz Relay

(for transformers with oil conservator only)
This device is interpositioned inside the connection pipe between the lid and the conservator. It intercepts and collects possible gas bubbles coming from the active part (indicating a localized overheating caused by a hot spot or discharge) and gives an alarm signal when reaching a specific quantity. In case of serious breakdowns (oil wave toward the oil conservator) it gives a trip signal.

Dryer

(for transformers with oil conservator only)
Filters air entering in the conservator eliminating humidity. In this way the air entering in contact with the oil inside the conservator is dried, preventing

the oil from absorbing the humidity and worsening its dielectric properties. For proper performance, it should be inspected and regenerated periodically.

Level indicator with contact/s

(for transformers with oil conservator only)
In addition to the visual indication, it gives a signal when the oil reaches its minimum/maximum level.

Overpressure valve

(recommended for hermetic transformers)
In case of an elevated internal overpressure (caused by a breakdown) the valve releases internal pressure outside preventing or limiting the mechanical damages caused to the tank, which may cause oil leakages. The version with electric contacts for release signal is available on request.

Integrated safety system

(recommended for hermetic transformers)
Combines 3 signals/protections in one single device: oil level, internal overpressure, oil temperature.

Plug-in connections MV side

(fixed part only)
Line connections MV side are designed to be connected to medium voltage cables with plug terminal. The plug connection allows a very rapid connection of the cable to the transformer and can be touched also when the transformer is under voltage. The transformer can be left without the segregation cell by properly protecting the LV side as well. In any case, pls. follow current local rules for the safety of installations under voltage. Always notify the type of rapid connection desired.

Antivibration supports

The standard version includes special rubber supports supplied loose for the customer to position under the wheels of the transformer. They greatly reduce the vibrations transmitted to the structure and therefore the noise and possible structural resonances.

Antivibration supports designed on the customer's specification may be designed and supplied for special applications.

MV double voltage

MV winding has been designed to work on two different voltage levels (e.g. 10-20 kV) and the selection is made through the commutator with control on the lid.

Auxiliary service box, protected model

Centralizes the possible auxiliary services and protects the terminal board.

Electrostatic screen between primary and secondary

It greatly reduces coupling capacity between MV and LV winding. This drastically reduces the overvoltages transferred from MV to LV which in certain cases may damage any sensitive loads.

Spark gap rods

CUSTOMER SERVICE

SEA SpA provides a highly qualified Customer Service to contact for any problem or need emerging during assembly or maintenance of the TTO transformers

Telephone assistance

Contact our offices (mon-fri 09,00 a.m. ÷ 5,30 p.m.) at +39 0444 482100 or Email: info@seatrasformatore.it

On-site assistance

In case of problems and positive site conditions, one of our engineers will be sent to carry out repairs or supervision on-site.

