

ENGLISH



# TTR Transformers

Dry type transformers with **cast resin** MV windings



TTR



TTO



OTN, OTR, OTF



REACTORS



TTH

## TECHNOLOGY

### Magnetic core

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

The special cutting and assembly of the core allow for the "STEP-LAP" joints which reduce noise as well as losses and the no load current. The magnetic sheets are pressed by the galvanized core clamps. The insulation and varnishing of the core are realized in an F temperature class.

### Low voltage windings

The secondary coil is realized by an electrolytic aluminum foil conductor interwinded with an insulating film in pre-preg class "F", then subjected to the oven drying process.

The outlet terminals are realized by aluminum busbars welded in inert atmosphere and firmly locked to the frame with spacer insulators.

This type of structure guarantees:

- high resistance to moisture and industrial aggressive atmospheres
- great dielectric sturdiness
- excellent mechanical performances versus short circuit stresses

On customer's request, copper windings or windings on customer's specifications are available.

### Medium Voltage Windings

High voltage winding is carried out by automatic machines

and consists in a set of electrolytic aluminum tape coils. The insulation between turns is obtained through a polyester film.

The entire coil is framed by glass fiber net, dried in depth and subsequently vacuum incorporated with a class F epoxy resin mixed with quartz and trihydrated alumina.

This allows an excellent mechanic sturdiness and compliance with classes C1 and C2 of IEC rules.

Thanks to our 30 years experience and the implementation of automatic devices (which control and record all the critical parameters of the process) we can guarantee extremely reduced partial discharges, an essential requirement to manufacture quality, reliable and long lasting coils.

The adjustment links (generally  $\pm 2 \times 2,5\%$ ) are obtained directly at the center of the coil.

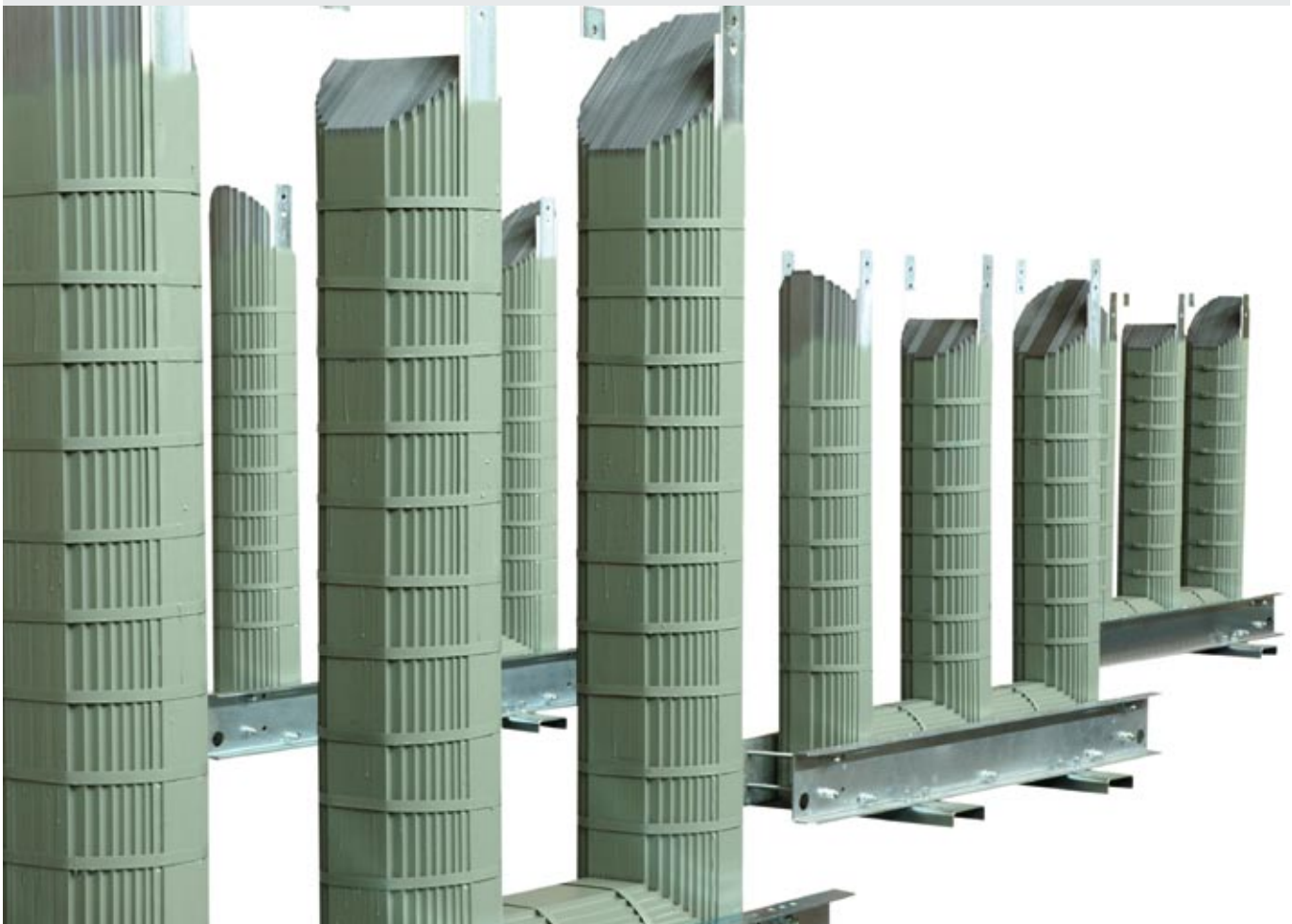
### Final assembly

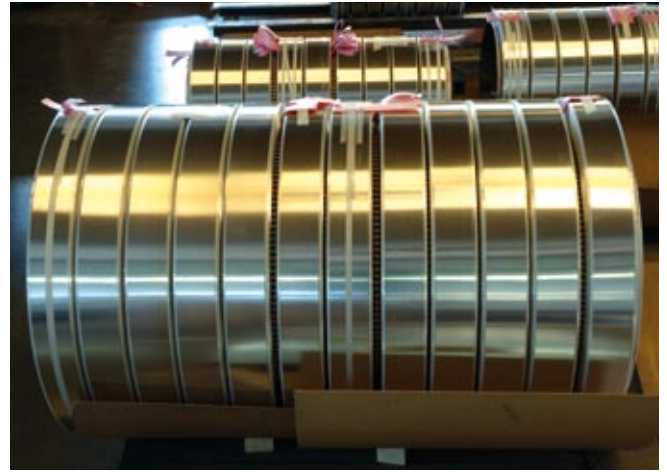
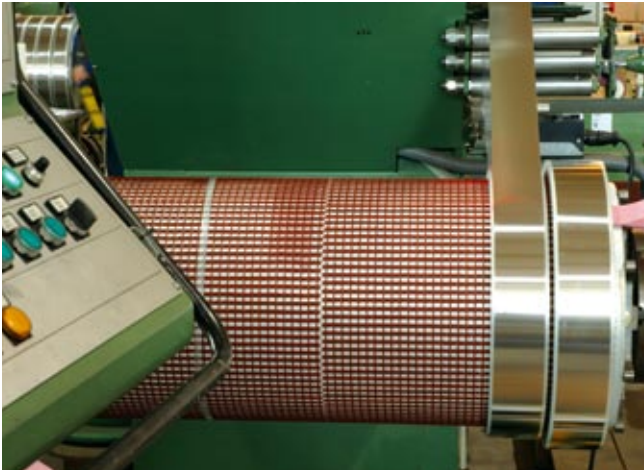
The final assembly is carried out with care and accuracy. Assembly accuracy is fundamental to guarantee an optimal performance of the transformer when subjected to the electrodynamic stresses caused by short circuits.

The Low Voltage is mounted on the core and held in place by special glass fiber spacers.

The LV connection bars are locked one to the other and to the core clamps by fiber glass insulators.

The Medium Voltage winding is braced by spacers which allow small axial expansions when the load current flows through the winding.





## TESTING

Every transformer is tested at our test room with routine tests in compliance with IEC60076-11, that is:

- measurement of winding resistance
- measurement of the transformation 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
- measurement of partial discharges

On customer's request all type and special testings provided for by the rules may be carried out:

- heat run test with simulated load method
- heat run test with opposition method
- impulse withstand test with full and chopped wave
- measurement of the noise level
- measurement of the contents of harmonics in no load current
- measurement of homopolar impedance
- measurement of the winding capacitance
- dynamic short circuit withstand test (to be carried out by an authorized external lab)
- fire resistance test and checking of response to climate classes (to be carried out by an authorized external lab)
- other special tests to be agreed upon with customer from time to time (electromagnetic emissions, thermal shocks...)

### Archive of type tests

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

Here are some examples:

### Toxicity tests by BREDA RESEARCH INSTITUTE

In compliance with the test methods provided for by Standards CEI 20-37 on a resin sample, a toxicity percentage lower than 0,1% has been recorded for gases released during combustion.

### Fire behaviour tests by CESI Milan

This test has been carried out on a sample composed by a complete leg (core, LV winding, HV winding) of a 1600 kVA SEA transformer (certified BC-96/025387)

### Various tests on insulating materials

Samples made of the same resin used for the autoextinguishing test have been analyzed by IMQ (certification n. 0150436 of 03/08/93)

### Environment and climatic tests

SEA transformers from the TTR series comply with environment classes E0, E1 and E2 certifying transformer's suitability to withstand specific exercise and/or humidity conditions.

At CESI (certification AT- 96/014963) the test certifying the compliance with class E1 has been carried out and passed.

At CESI (certification AT 97/011469) the test certifying the compliance with class E2 has been carried out and passed

At CESI (certification AT- 96/014963) the test certifying the compliance with class C1 has been carried out and passed.

At CESI (certification AT- 97/006808) the test certifying the compliance with class C2 has been carried out and passed.

### Low temperature tests

At CESI (certification MP-10925) the thermal cycle test has been carried out (4 cycles from -20 °C to +20 °C in 24 hours)

At the MAGRINI's lab (certification RP LS 05/205) the thermal shock test at -50°C has been carried out and passed.

### Dynamic short circuit withstand test

We hold several certificates of dynamic short circuit tests carried out at CESI on transformers featuring different powers and voltages.

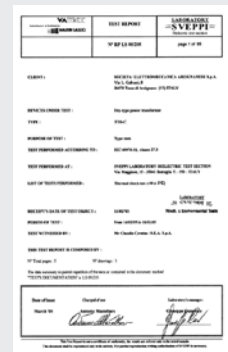
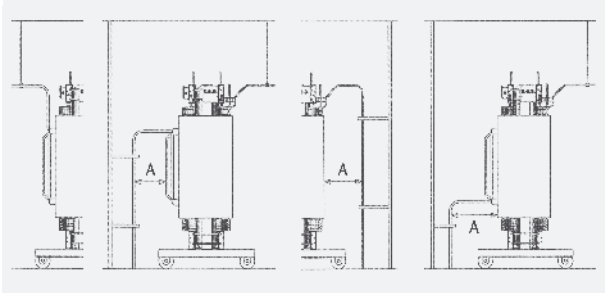


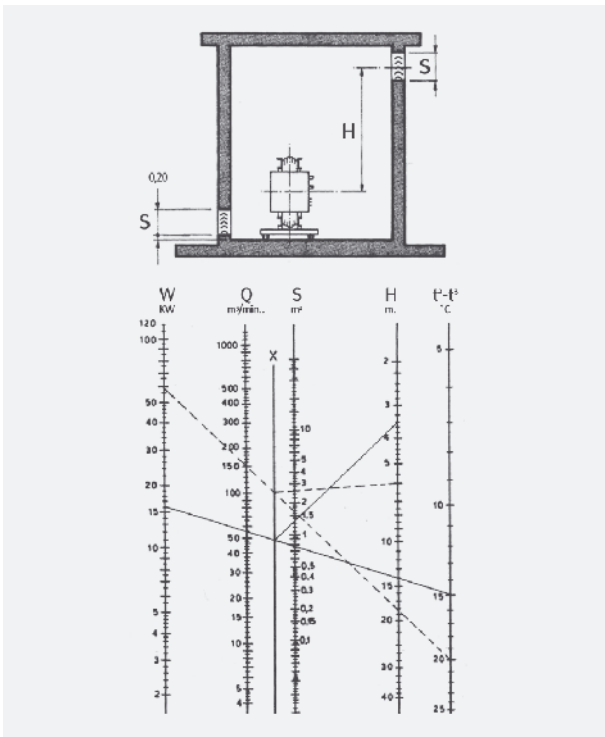
Table 1

Insulation Class	Distance from a solid and smooth wall	Distance from a grilled or sharp-cornered wall
7,2	90	300
12	120	300
17,5	160	300
24	220	300
36	320	400

Table 2



kV	12	17,5	24	36
A (mm)	120	180	240	360



## INSTALLATION

### ROOM TEMPERATURE AND LOAD CONDITIONS

The resin transformers from the TTR series have been designed to supply the nominal power in a regular distribution network, the conditions of which are defined by IEC 60076-11 Standards. 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 not to compromise its reliability and life.

### ROOM DIMENSIONS

Many components of the resin transformer may be easily touchable when the machine is operating. The same MV coils insulated with epoxidic resin and the connections for closing of triangle circuit, generally insulated by heat shrinkage tube must be considered as "live parts" thus the machine has to be properly segregated.

The cell should allow for a proper air exchange (at least 4,5 m<sup>3</sup>/minute of air for every kW of loss). The distance of the walls from the live parts should comply to the current local rules and in any case be shorter than those indicated in table 1.

### PROTECTION ENCLOSURE

The transformer is generally delivered in a IP00 protection degree. On customer's request, the transformer may be supplied with a cabinet for indoor installations featuring a protection degree in compliance with the customer's indications. In this case the cabinet itself protects the transformer from accidental contacts. The installation room should in any case feature dimensions and distances as to ensure a proper air exchange (there should be approximately a 500 mm distance between the cabinet wall and the room wall, to allow for both a proper air circulation and the regular inspection/maintenance of the transformer).

### CONNECTIONS

The SEA transformers type TTR with standard operation provide for the LV busbars designed for top side connections and bottom side MV line connections.

Connection instructions are of common practice for the installators.

We recommend properly supporting and connecting the busbar and the connection cables so that their weight and most of all electrodynamic stresses due to eventual short circuit do not influence transformer's performance.

Special attention should also be given to the MV cable: the outermost insulation of cables shall be considered at ground potential, therefore shall be kept at a certain distance from the transformer live parts in the same way as for the other accessories, in compliance with table 2. On request we can supply connections and busbars based on customer's specification.

## GENERAL FEATURES

TTR Transformers are dry transformers with englobed MV resin windings, which represent a valid alternative to the traditional oil immersed transformers.

Since 1975, SEA has been designing and producing this type of transformers positioning itself as one of the leading firms in the sector thanks to construction solutions adopted, unification of details and to modern technologically advanced production facilities .

SEA TTR transformers have been designed to satisfy our Customers' needs, from the single user to the large industrial groups, assuring:

### HEALTH PROTECTION AND MAXIMUM SAFETY

The materials used are auto-extinguishing and do not release toxic gases in case of fire.

### INSTALLATION ECONOMY

They do not require the construction of oil collection tank

### EXERCISE ECONOMY

They minimize maintenance interventions and extend transformer's life

### VERSATILITY AND PERFORMANCES

They can support overloads and perturbations which can be found in every installation

### MAXIMUM RELIABILITY

Control and quality are guaranteed at every single stage of the design and manufacturing process

The absence of inflammable fluid makes easier plant engineer's work, who can carry on the project more freely. This advantage is specifically appreciated for the installations where exercise safety is fundamental, for instance in hospitals, public premises, airports, subway lines, mines, oil platforms, nuclear plants, ships, etc...



## STANDARDS REFERENCE

SEA transformer comply with the following Standards:

- IEC 60076-11
- CENELEC HD 464 - HD 538

The construction based on other rules and/or Standards may in any case be required and verified by our engineering and commercial department.

## RANGE

The standard catalogue covers up to 3150 kVA and 36 kV.

Our design and construction capacity can satisfy the most various needs (autotransformers, applications for converters, for traction, for testing rooms, etc...), with powers up to 25MVA. Please contact us for your specific needs.

## 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
- Tapping terminal board on MV side
- Threaded pins provided with bolt for MV terminals connection

### ACCESSORIES ON REQUEST

#### Dial thermometer with two-contacts

It's a cheap and reliable device to indicate the temperature of the central leg and gives signals (through the two contacts) to alarm and trip relays in the control room.

#### PT 100 thermoresistances

May be requested on LV windings and/or on core. If connected to a suitable electronic device they allow logging (and possibly remote transmission) of windings and/or core.

#### PT100 electronic unit

Supplied loose for assembly on the control room panel by the customer. It logs the signals coming from the PT100s (max 4) and indicates the measured temperature. It includes two relays with adjustable threshold for the alarm and release signal as well as an auxiliary contact to control a possible set of fans for forced ventilation.

#### PTC thermoprobes

May be requested on LV windings and/or on core. If connected to a proper electronic relay, they allow a system signalling a prefixed threshold.

PTC do not allow temperature measure neither indication, they just give a threshold control. It is therefore necessary to have a set of PTC and a relay for every threshold required.

#### PTC relays

They are assembled directly on the transformer, or on request, loose supplied.

#### Plug connections Elastimold type MV side (only fixed part)

The line connections on MV coils are designed in order to be connected to medium voltage cables with Elastimold plug terminal.

The plug connection allows a very quick connection thus being of great advantage in case the has to be manipulated frequently. It should however be noted that the use of plug connections on resin transformers doesn't modify in any way design constraints for the protection against contacts to live parts since the entire MV coil is considered as live part (please see the "cell dimensions" section).

#### Movable parts Elastimold type at MV side

Elastimold movable parts may be supplied to make disconnectable MV cable terminals. Movable parts should be selected based on the characteristics of the cable used for the installation. We recommend therefore enclosing a technical sheet of the cable with your request.

#### Antivibration supports

Standard version is composed of special rubber supports supplied loose to be positioned by the customer under the transformer's wheels. They allow a great reduction of the vibrations transmitted to the structure and therefore of the noise and possible structural resonances.

Antivibration supports may be designed and supplied for special application in compliance with customer's specification.

#### Protecting cover for the tapping links

It is realized by a plexiglass lid anchored to the coil to protect the links zone. It is necessary if the transformer is installed in particularly hostile or polluted environments (high level of humidity,

dust, small solid matters, etc). It doesn't reduce the design restraints for the protection against contacts to live parts since the entire MV coil is considered as live part (please see the "cell dimensions" section).

#### Auxiliary service terminal board, protected type

Centralizes possible auxiliary services and protects the terminal board.

#### Set of electrofans for forced air (AF) cooling

Includes a set of fans (from 2 to 6, based on transformer type and power) fixed to transformer's base. They allow increasing of nominal power of the transformer by about 25÷40%, based on the customer's needs.

For a proper performance, the set of fans needs a control and command switchboard (see Electronic device for PT100 monitoring) to be ordered separately.

#### 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.

## CUSTOMER SERVICE

SEA SpA gives a qualified Technical Assistance for any problem or need that may arise during the assembly or maintenance of TTR 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](mailto:info@seatrasformatore.it)

#### On site assistance

In case of problems and if the site allows it, one of our technicians will assist you in repairing or supervising the product on site.

