



LIQUID IMMERSED TRANSFORMERS

TTO

TRANSFORMING THE FUTURE



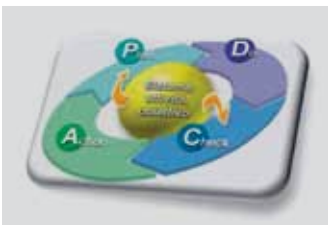
SEA has been designing and manufacturing liquid immersed, cast resin and air insulated transformers, positioning itself among the industry leaders since 1959

IQTRAFOTEC®

Innovative construction solutions, modern and technologically advanced processes, detailed checks throughout the entire design and construction chain assure the total quality of the product. SEA has established procedures to assure the TOTAL QUALITY of its products availing itself on its own know-how and adapting it to innovative manufacturing processes and strict control procedures. This type of technology has been identified by SEA with the name IQTRAFOTEC®, a brand guaranteeing a continual commitment to improve the product and its manufacture, considering 4 main areas such as:

- Safety of the working environment
- Quality of the product
- Saving of materials and reduction of waste
- Lowest environmental impact during manufacture, maintenance and after use.

TTO High Quality Standards



MANAGEMENT SYSTEM

The Quality of our products is achieved by processes that are continuously refined, combining experience in the electromechanical sector since 1959 with the most modern technologies, and approved in accordance with the most important Standards concerning the Quality (EN ISO 9001) and Environmental (EN ISO 14001) Management System. Moreover, TTO transformers comply with the IEC and DIN Standards, with the possibility of correspondence with other International Standards or Customer Specifications (BS, ANSI, IEE, GOST, etc...).



PRODUCTION QUALITY

The high reliability of the products results from a continuous perseverance in achieving high quality standards during all "supply chain" phases. Especially during the production cycles there is a strict compliance with the implemented control parameters, which assure both the suitability of the assembled components and the performance of the finished product, all this even through tests carried out at our internal laboratories equipped with the most modern instruments available for type-testing or special testing, if the customer requests it.



CUSTOMIZED SOLUTIONS

Our catalog TTO standard catalog shows a very wide range of products and our design and construction skills cover the most various needs (conversion, test room, start-up, etc.); moreover, it extends the use of transformers of this series also to all the other sectors (Oil&Gas, wind power, civil and urban) in which a machine specially designed to customer specifications is required. For greater power and higher voltages, the series OTN, OTF and OTR are available.



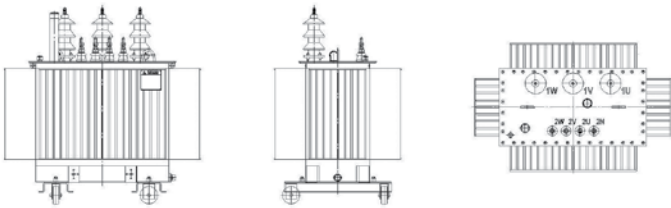
ENVIRONMENTAL ASPECTS

The constant research aimed at improving efficiency merges with the commitment to minimize environmental impacts. This is another essential issue on which SEA focuses its corporate policy. All this has an impact on both the construction process and the realization proposals for our TTO transformers. The use of a transformer, as we all know, can produce, in case of failure, severe environmental impacts, such as, for example, various oil leaks or fire. Right with a view to reducing these serious risks, SEA focused on the most effective security systems assembled on the transformers themselves and on the type of insulating liquids used for filling them, which can be also biodegradable, upon request.

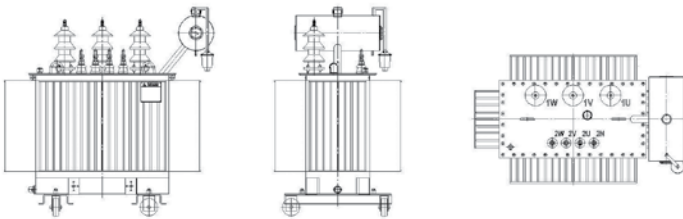
Designed to meet our Customer's needs, from small to large industrial users

For more of 50 years, SEA has been designing and producing this type of transformers, adopting constructive solutions, the unification of details and modern and technologically advanced equipment. These transformers immersed in insulating liquid with corrugated case, developed according to 3 different construction methods:

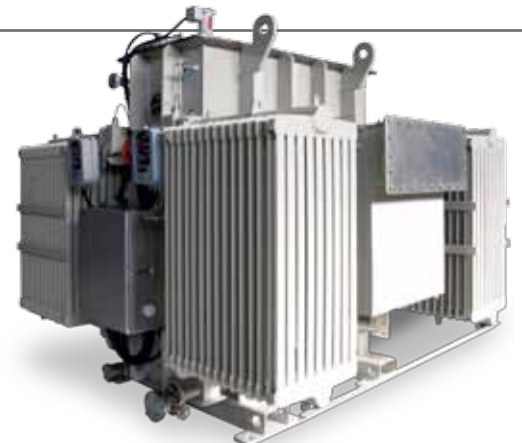
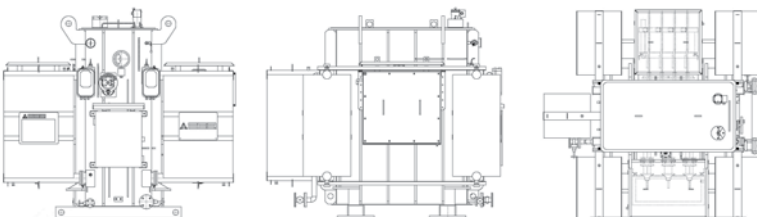
HERMETIC TRANSFORMERS WITH INTEGRAL FILLING



TRANSFORMERS WITH CONSERVATORS



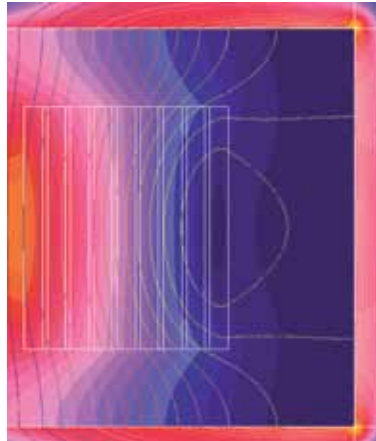
HERMETIC TRANSFORMERS WITH NITROGEN CUSHION (RADIATOR CASE)



THE DESIGN

From concept to realization

Years of experience developed into strict calculation procedures, modern design and verification programs are the basis of the technology that allows the engineers of SEA to face successfully any technological development and the most complicated design solutions requested by our customers. SEA avails itself of technologies, machinery and equipment for realizing all possible technical and construction solutions involving the transformers of the TTO series. This versatility allows optimizing the thermal sizing, insulation and resistance to overloads or heavy usage cycles for maximum application reliability and flexibility required by customers or by the design firms.



THE MAGNETIC CORE

Low vibrations, low losses, a beating heart with high performance

The continuous research of the best materials is focused on efficiency increase, as well as on reducing vibrations and, consequently, the noise level of the transformers during their use. To achieve these objectives, the core consists of magnetic metal sheet plates with oriented grain, high-permeability and low specific losses, separated from each other by an inorganic insulating means.

In particular, the cut and assembly of the core are made in such a way as to create junctions according to the "STEP-LAP" way to reduce noise, as well as no-load losses and current. The magnetic pack is pressed by bent sheet metal profiles and suitable connections with or without through hull bolts when it is necessary to further reduce losses and the localized heating of the core.

The overall result is a high dimensional accuracy, low loss factor values and an excellent space factor.

Moreover, SEA is also able to propose solutions with amorphous sheet metal at very low no-load losses. When the size requires it, axial channels are created within the core in order to obtain a uniform temperature field.

THE WINDINGS

High reliability, compactness and precision

The high efficiency of TTO transformers is also due to the high quality of the windings, which are the result of a continuous development also of the applied technology: everything guarantees a high reliability under extreme service conditions. The basic elements that characterize the winding are the insulating paper and the type of conductor. LV winding consists of an aluminum foil or copper electrolyte conductor. Winding machines of the latest generation allow the construction of windings with both round and oval shape. The particular type of paper used as interlayer adheres to the surface of the conductor during the furnace drying treatment, making the winding very compact and robust against electrodynamic stresses. The output terminals are constituted by aluminum or copper plates welded in an inert atmosphere.

The MV winding is made with copper or aluminum wire or strip enameled or isolated with pure cellulose paper, using automatic or semi-automatic computerized machines; usually, it is wound directly above the LV winding, in this way, it is possible to obtain a complete very compact and robust MV+LV column, which are necessary requirements to withstand any electrodynamic forces resulting from short circuit.

The switching sockets are obtained directly on the outer part of the windings, selectable through tap-changers specifically studied for the various requirements of insulation, current, and mechanical strength necessary for the end use. Final assembly and mounting are carried out with care and precision by specialized personnel. Before the positioning in the case, all transformers are checked to verify the correctness of the connections, of the turn ratio and of the vectorial group and only after a properly recorded thorough drying cycle the final oil filling takes place.

At this stage, the transformer is completed with standard accessories or according to the information provided by the customer.

THE SWITCHING: THE NEED TO ADAPTING TO THE NETWORK CONDITIONS

NLTC Tap changer

TTO transformers can be adapted to the voltage adjustment needs of the final user with great flexibility by idle switching of the primary or multiple voltages on the secondary winding.

OLTC Tap changer

In those cases of applications requiring both civil and industrial underload adjustment, it is possible to equip the transformer with an on load tap changer as already made by SEA several times.

BOX-TERMINALS

One customization for each installation requirement

The INDOOR and OUTDOOR maximum installation flexibility - from the offshore, up to the lowest temperatures or desert environments - is available with a full range of BOXES protecting the terminals with all degrees of protection and all connection options.

The protection degrees can be studied with customized solutions to meet any need that may arise.



TANK-COVER-COOLING

A durable reliability

The insulating liquid used is absolutely free of PCBs and PCTs.

It is possible to ask for the filling with high flash point oils (e.g. silicone oil) or high biodegradability oils with organic esters base (e.g. MIDEL 7131) in order to assure their decomposition in nature in the event of an accident.

Due to the special constructive design of the winding and active part, it is also possible to get a strong insulation power with reduced distances, protecting the same against humidity.

The "insulating" oil has also a double function:

Dielectric: It fills every interstice and impregnates the solid insulation means; in this way, it is possible to get a strong insulation power with reduced distances, protecting the active part against humidity.

Thermal: It removes the heat from the hot parts and dissipates it to the case by natural convection.

The cover is bolted to the case after the interposition of a rubber seal or sintered material.

The case, in corrugated sheet metal to allow oil expansion and disperse the heat generated by the transformer, is manufactured by fully robotized bending/welding plants and is carefully tested at cycle end to assure tightness to hot oil.

Strict durability tests are carried out on the various types to assure that the case can withstand fatigue cycles (voltage and withdrawal) resulting from thermal oil expansion. The internal parts are sandblasted and painted with hot oil resistant products. The case, cover and other metal parts are carefully sandblasted and painted with single-layer water paint, capable of combining excellent performance over time and the protection of the environment. Upon request, it is possible to supply special coating systems for chemically aggressive environments, increased thickness/hardness cycles for sandy abrasive environments or hot galvanization.

TESTING ROOM

Quality beyond the test

SEA has 3 modern testing rooms as well as of special equipment for performing routine, type and special tests according to the regulations or as required in the specifications of the customers. Moreover, SEA has a large archive of type tests and special tests (short circuit, thermal tests, behavior at very low temperatures) performed on many transformers delivered to customers all around the world.

OUR TARGETS



PERFORMANCE AND OVERLOAD

Efficiency studied to optimize the system.



ECONOMY

During the operations, purchasing and maintenance.



SILENCE

Often these transformers are installed close to towns.



COMPACTNESS

Designed for very low dimensions in width.



ECO+POWER

Specifically designed to meet the new requirements in the renewable energy production.



RESISTANCE

Very robust and treated to withstand to extreme conditions.

Solutions studied to cover all the production requirements in terms of both construction and installation, bearing in mind that the objective of the transformer manufacturers and a precise need of end users is to anticipate any faults and limit the possible consequences in case of failure of the transformer itself:

- More than 20 types of accessories for the safety of the transformer
- Several types of bushings (made of porcelain, epoxy resin, silicone rubber and condenser bushings...)
- Various types of protections for the achievement of the desired IP degree
- Various types of off-load and on-load tap changers in order to meet the customer's various needs
- The possibility of a complete range of products suitable for the C5 corrosiveness class in offshore environments

Now we list the most commonly used accessories identified according to their function, depending on their use or in the conservator or hermetic transformer type.



Oil Temperature Indicator / Winding Temperature Indicator

This is a cost-effective and reliable device for the local indication of oil temperature in the higher layers or of the windings temperature.

There is the possibility of setting two levels, one for the alarm and one for the disconnection, so as to protect the transformer in case abnormal temperature levels are detected.



Buchholz Relay

It is a device, interposed between conservator and cover the connecting tube, which intercepts and "collect" any gas bubbles coming from the inner side of the transformer, which indicate a localized overheating due to a fault; when the value defined by the Standard CENELEC EN 50216-2 is reached, it allows signaling the alarm through the lowering of the upper floating element. Instead, the tripping of the transformer is possible in two cases:

- Through the continuous gas formation after the alarm signal, through the lowering of the lower float the disconnection occurs, letting the tripping switch trip (the increasing gas further lowers the oil level)
- Through the release of oil due to leaks from the transformer case: this event causes an increase in the oil speed from the conservator to the cover and when this limit is exceeded, the tripping switch trips



Standard Air breather

Air dryers are used in liquid immersed transformers and they have the function of absorbing humidity air that is necessarily sucked by the conservator during the thermal contraction of the liquid itself easing its dielectric capacitance. There is a wide range of models in relation to the amount of liquid present in the transformer. For assuring its proper operation, it must be inspected periodically as the salts contained within the same pass from the humidity-free condition (orange) to a saturated stated (green), according to the environmental stress.



Standard oil level indicator

The oil level indicators with magnetic joint are normally used in the transformers conservators, with the aim to give a visual signal of the contained insulating liquid. They have the switches to signal the alarm in case the liquid reaches the minimum and/or maximum level. The oil level indicators dials can have the dimensions of 140, 220 and 340 mm with axial or radial movement of the floating rod.

The axial type is very often used in case of transformers with nitrogen cushion. In addition other three types are available for distribution transformers, they have magnetic joint, without switches but only with oil visible indication. The last device with only visible indication has been studied and realized in order to be assembled on the tank cover of the transformers without conservator, called hermetics.



Pressure relief device

A sudden and violent internal short circuit in the transformers in insulating liquid produces a large volume of gas which, if not promptly evacuated, may result in the explosion of the transformer itself. There is the possibility of using a simple pressure relief device or a relief device equipped with protection and tripping signal when the pressure is affected by these instantaneous and uncontrolled increases with consequent hazards for both safety and the environment.

They can be equipped with a simple protection or with a conveyor in case one wishes to collect and convey the spilled oil. The switch allows emitting an electrical signal, if the pressure relief device opens.

The application of one or more pressure relief device and their section must be proportional to the volume of oil contained in the transformer.



DGPT or RIS

This is a tool resulting from the need to integrate the functions carried out by some accessories for electrical transformers, into a single compact and reliable device. As a matter of fact, it joins in a single device the following essential parameters of an hermetic transformer:

- Internal overpressure
- Oil temperature
- Insulating liquid level or gas formation

In case of abnormal signals, the device via the related switches will signal either an alarm or a tripping of the transformer.



Elastimold bushings

The resin bushings with plug connection and outer cone guarantee the control of partial discharges.

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.

Always notify the type of rapid connection desired.



Busbars and Inner cone bushings

The Busbars bushings EN 50387, ENEL DJ1107-1109 and BS 2562/1979 are suitable for transformers filled with insulating liquid for both indoor and outdoor applications with protective cap.

The bushings consist of a bar protected by a galvanic coating and co-molded into an insulating resin flange.

They are also available with special lengths and drillings according to customer's request.

With regard to the resin bushings with plug connection and inner cone coupling interface, they are manufactured in compliance with DIN 47637 - ENEL DJ1111 and DJ1108.



Composite bushings

To increase the general safety level in a transformer, it is possible to use bushings made of composite material instead of using those with traditional porcelain that can, in the event of impact, break causing oil leakages and contaminating the surroundings.

This reduces also the risk of fire since the air part of the conductor (copper or aluminum) consists of a first epoxy resin coating, which is then externally coated with silicone rubber.

They assure the control of partial discharges and the ability to be assembled even horizontally.

They are also interchangeable with porcelain bushings in compliance to the EN 50180 standard and are suitable for use according to the C5 corrosiveness class with reference to ISO 12944. It shall be underlined that this type of bushings is not equipped with condenser but signal only the presence or not of the voltage passing inside them via a capacitive socket.



Antivibrating pads

These rubber supports, to be assembled under the wheels of the transformer by the customer, assure the consequent reduction of noise and possible structural resonances.

For special applications, it is also possible to design and supply antivibration pads made according to customer's specifications.



Marshalling box

It is possible to assemble a Marshalling box that has also the function of acting as electrostatic screen between primary and secondary.

Moreover, it allows a strong reduction of the capacitive coupling between MV and LV winding and, consequently, also a reduction of overvoltages transferred among the same windings that, in some cases, may damage any sensitive loads.

**TO HAVE AN INSTANT CONTROL ON ALL ESSENTIAL PARAMETERS OF A TRANSFORMER,
SEA CAN PROVIDE PART OF THE ACCESSORIES WITH AN ANALOG OUTPUT 4 ÷ 20 mA
OR A RS485 DIGITAL OUTPUT MODBUS PROTOCOL**

THE TRANSPORT AND THE SITE ASSEMBLING

SEA can deliver the transformer everywhere in the world

Thanks to the experience gained over many years and to its qualified personnel SEA performs the shipping and reassembling on site, agreeing from time to time with the customer on the most appropriate approach.

For shipments carried out to particularly critical sites or if requested by the customer SEA can equip the transformers with a sophisticated "impact recorder" that allows to keep the quality of the transport monitored.



SERVICE

SEA is able to meet your needs with a modular and flexible intervention plan through which you can take care of your transformer, keeping it in perfect working order

In addition you can count on a clear and defined price, including labor and spare parts, which shelters you from any surprise. A qualified Technical Service is made available for any questions or needs that may arise during assembly or operation of all our products.

■ Transport, unloading and positioning on site

Thanks to its team of technicians SEA is able to deliver the transformer in a "turnkey" solution to the end customer.

■ Assistance to commissioning

One of our technicians will personally assist you during normal control operations prior to the first commissioning of the machine.

The verification of the correct assembly of all accessories and some simple routine checks are essential for a reliable operation and the long life of the transformer.

■ Hiring of transformers

■ Diagnostics and Consultancy

Using sophisticated portable equipment, SEA is capable of monitoring and recording the most relevant electrical quantities for the transformer and the system: voltage, currents, harmonics, impulsive overvoltages and noise, oil dielectric strength, temperature and noise. Data recording can be of great help in the diagnosis of a failure or to suggest to the customer changes and improvements to its system.

■ Routine and extraordinary maintenance

Many repairing and assistance works (replacement of accessories and seals, repairs of small leaks that require welding without the need to empty the oil tank, oil checking and processing, paint touch-up, oil top-ups) can be performed directly on site, thus saving time and avoiding the risks and inconveniences that may result from the movement of the transformer.

■ Supply of spare parts

Supply or supply and assembly on site of transformer accessories.

■ Support Services

Specifically designed to give the customer the possibility to get always the best performance from its transformer.

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