



INSTRUCTIONS FOR COMMISSIONING USE AND MAINTENANCE

OIL DISTRIBUTION TRANSFORMERS



ENGLISH

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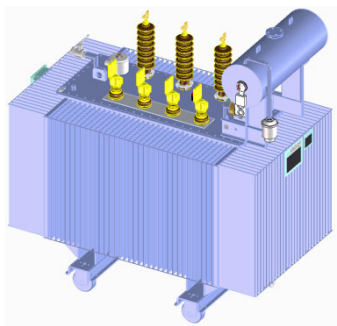
Company presentation

Since 1959, we have been dedicated to the electrical energy sector. A success story that began as a small artisan workshop, consolidated over the years to become an industrial leader in the electromechanical sector. Our brand summarises the experience and commitment of a close-knit team that has successfully asserted itself in the European and international market. If S.E.A. has become synonymous with technology, reliability, safety and quality for money, then it is without a doubt thanks to our managers, the creativity and experience of our designers, the professionalism and expertise of our engineers and the work and commitment of all. A collaborative team and the best technology are put to use to satisfy every request: single phase, three-phase and special transformers, liquid immersed, cast resin or air insulated transformers with a vast range of possible power and voltage configurations. A high-quality range of products intended for all types of users: large public and multinational firms, but also small-medium sized companies. A brand that is continuously growing and changing in a professional manner with sound business ethics to ensure its continuous evolution with respect to tradition. Today, the high level of quality achieved allows SEA to compete with the most important manufacturers of air insulated, cast resin and liquid immersed transformers worldwide. A sound company policy that aims to promote research, innovation and the development of new products, placing safety and quality first, has allowed SEA to become a major listed company.

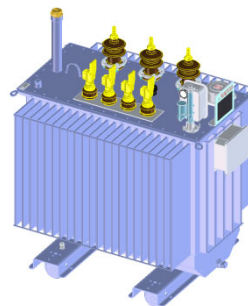
1 Scope of instructions for use

This document constitutes the use and maintenance instruction manual for transformers / reactors immersed in oil, featuring different types of cooling:

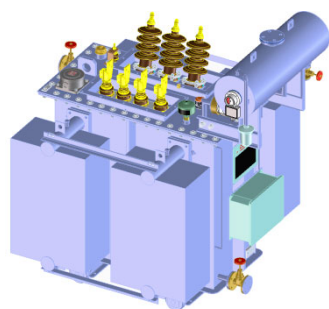
- Corrugated tank with conservator – TTO-C / TTO-C ECO+P / OTR
- Hermetic corrugated tank – TTO-E / TTO-E ECO+P / OTR
- Radiator tank OTN / OTR / OTF
- Tank with oil-water exchanger OTN / OTR / OTF



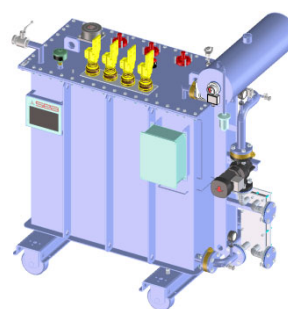
CORRUGATED TANK WITH CONSERVATOR



HERMETIC CORRUGATED TANK



RADIATOR TANK



TANK WITH OIL-WATER EXCHANGER

This manual contains instructions on how to use the transformer in respect of human health and safety. All personnel responsible for system design, installation, use and maintenance of the machine must consult the instructions contained in this manual in order to obtain best results and ensure maximum safety. The manual must always be kept with the equipment, stored with care and made available to all interested personnel.



- **CAUTION: BEFORE INSTALLING THE TRANSFORMER, ALWAYS CONSULT THE INSTRUCTION MANUAL AND TECHNICAL SPECIFICATIONS OF THE TRANSFORMER!**
- **THIS MANUAL IS INTENDED FOR TRAINED PERSONNEL**
- **THE MANUFACTURER IS NOT LIABLE FOR ANY CONSEQUENCES RESULTING FROM IMPROPER OPERATIONS CARRIED OUT BY THE USER**

The technical data sheets, assembly drawings, wiring diagrams and other specific documentation pertaining to the purchased transformer are an integral part of this manual.

2 General and safety information

2.1 Applicability

This manual applies to all oil-filled transformers / reactors.

This manual is intended exclusively for qualified technicians, trained on both technical and safety aspects. SEA is not liable for operations performed by personnel without the necessary professional qualifications.

2.2 Definitions

The following definitions apply for the purposes of this manual:

Transformer

Static electric machine with two or more windings, which, by way of electromagnetic induction, transforms a voltage and alternate current system into another system generally having different voltage and current values, of the same frequency, for the purpose of transmitting the electrical power.

Regulatory references

Oil-filled distribution transformers are calculated, designed, built and tested in accordance with IEC standards in force at the time of stipulation of the purchase contract (unless otherwise agreed between the client-manufacturer).

This manual does not replace or relieve in any way the obligation to strictly comply with all laws and standards in force in the destination country.

Identification of windings

Medium voltage winding: winding with the higher rated voltage “MV”; in the three-phase system the phases are indicated by 1U, 1V, 1W or alternatively A, B, C.

Low voltage winding: winding with the lower rated voltage “LV”; in the three-phase system the phases are indicated by 2u, 2v, 2w or alternatively a, b, c.

Classification of transformers based on type of cooling

The transformers can be identified based on their cooling system (as indicated in the standard IEC60076-2). This type of classification is expressed by a four-letter code having the following meaning:

- First letter: type of internal insulation
 - **O**: oil with flash point ≤ 300 °C
 - **K**: oil with flash point > 300 °C
 - **L**: oil with immeasurable flash point
- Second letter: internal fluid circulation mechanism
 - **N**: natural movement of fluid in both the cooling system and windings
 - **F**: forced movement of fluid through the cooling system, natural movement of fluid in the windings
 - **D**: forced movement of fluid through the cooling system, directed inside the windings
- Third letter: external cooling phase
 - **A**: air
 - **W**: water
- Fourth letter: external phase circulation mechanism
 - **N**: natural convection
 - **F**: forced circulation (pumps, fans, etc.)

Plate data

Each transformer is equipped with its own rating plate containing the serial number, year of manufacture, all electrical information required and set out by IEC standards. The plate must remain unaltered over time, must not be removed, damaged or made illegible.

IEC 60076-1 CEI-EN 60076-1				TEZZE DI ARZIGNANO (VI) ITALY www.seatrasformatori.it	
TRASFORMATORE IMMERSO IN OLIO PER ESTERNO TIPO ANNO N°					
Sr kVA fr Hz ☐ FASE		TIPO RAFFREDDAMENTO			
ALTA TENSIONE		BASSA TENSIONE			
Ur kV A kVA		Ur V A kVA			
Ur kV A kVA		Ur V A kVA			
LIVELLO ISOLAMENTO kV		LIVELLO ISOLAMENTO kV			
SIMBOLO COLLEGAMENTO		TEMPER. AMB. / ALTITUDINE °C mt			
Z % a kVA Po W		SOVRATEMP. OLIO / AVVOLG. K K			
Z % a kVA P _{k75} W		MASSA TOTALE / ESTR. kg kg			
Z % a kVA P _∞ W		MASSA OLIO / AVVOLGIM. kg kg			
Z % a kVA PEI %		MASSA NUCLEO / TIPO kg kg			
POTENZA CORTO CIRCUITO MVA kPEI %		TIPO OLIO			
PORTATA RIFERITA A N°2 FUNI METALLICHE					
					
		Massa totale trasformatore (kg)			
		Min. carico di rottura di ogni fune (kg)			
		Diametro fune (mm)			
		12 16 20 24 28			
TENSIONE PERICOLO DI MORTE - NON USARE ACQUA PER SPEGNERE INCENDI					

CAUTION: The CE marking is not required by the MACHINERY DIRECTIVE; it is only indicated if:

- the transformer is subject to European Regulation (EU) No 548/2014 (ECODESIGN)
- For transformers with both voltages less than 1 kV

Declaration of conformity with European Directives

For each transformer, a declaration of conformity is issued attesting to the positive outcome of testing as provided for by standards in force and the integrity of the equipment; where provided for, the CE marking will be indicated



DICHIARAZIONE DI CONFORMITÀ PER TRASFORMATORI ED APPARECCHIATURE IN OLIO DECLARATION OF CONFORMITY FOR OIL TRANSFORMERS AND OIL EQUIPMENTS	
Costruttore Manufacturer	S.E.A. Società Elettromeccanica Arzignanese S.p.A.
Categoria Category	XXX
Codice Code	TRXXXXXX
Potenza Rated Power	XXXX kVA
Modello Serial Number	MATXXXX
Anno di Costruzione Year of Manufacture	XXXX
Cliente Customer	XXXXX
Conferma Ordine S.E.A. Reference	VENXXXXX
DICHIARIAMO CHE IL TRASFORMATORE O L'APPARECCHIATURA IN OGGETTO È CONFORME A QUANTO PRESCRITTO DA: DECLARE THAT THE TRANSFORMER OR THE EQUIPMENT MENTIONED ABOVE IS IN ACCORDANCE WITH THE PRESCRIPTION OF:	
Norme internazionali International Standards	IEC 60076-1 IEC 60076-4 (Limitatamente ai reattori) / (limited to reactors)
Norme Nazionali National Standards	CEI EN 60076-1 CEI EN 60076-4 (Limitatamente ai reattori) / (limited to reactors)

DICHIARANTE E PERSONA AUTORIZZATA A COSTITUIRE IL FASCICOLO TECNICO DECLARANT AND PERSON AUTHORISED TO COMPILE THE TECHNICAL FILE	
Cognome Nome / Surname Name	Sartori Angelo
Posizione / Position	Direttore Generale / General Manager
Indirizzo / Address	Via Leonardo Da Vinci, 14 - 36071 Trazzè di Arzignano (VI) - Italy
Luogo / Place	Trazzè di Arzignano
Data / Date	XXXXX

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DICHIARAZIONE CE DI CONFORMITÀ PER TRASFORMATORI ED APPARECCHIATURE IN OLIO CE DECLARATION OF CONFORMITY FOR OIL TRANSFORMERS AND OIL EQUIPMENTS	
CE	
Costruttore Manufacturer	S.E.A. Società Elettromeccanica Arzignanese S.p.A.
Categoria Category	XXX
Codice Code	TRXXXXXX
Potenza Rated Power	XXXX kVA
Modello Serial Number	MATXXXX
Anno di Costruzione Year of Manufacture	XXXX
Cliente Customer	XXXXX
Conferma Ordine S.E.A. Reference	VENXXXXX
DICHIARIAMO CHE IL TRASFORMATORE O L'APPARECCHIATURA IN OGGETTO È CONFORME A QUANTO PRESCRITTO DA: DECLARE THAT THE TRANSFORMER OR THE EQUIPMENT MENTIONED ABOVE IS IN ACCORDANCE WITH THE PRESCRIPTION OF:	
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2.3 Warnings and main safety precautions

Transformers are electric machines that can operate with high and potentially lethal voltage levels. Failure to comply with legislation and safety procedures may cause accidents and the death of operators.



DO NOT TOUCH, RISK OF DEATH. ALL OPERATIONS ON THE TRANSFORMER MUST BE CARRIED OUT IN THE TOTAL ABSENCE OF VOLTAGE AND ONLY AFTER HAVING CONNECTED ALL METAL PARTS TO THE EARTH POTENTIAL USING THE SPECIAL INSULATING RODS



ALL WORKS MUST BE PERFORMED BY QUALIFIED TECHNICIANS PROPERLY TRAINED ON THE RISKS AND HAZARDS OF THE EQUIPMENT. THE TRANSFORMER MUST NOT BE TAMPERED WITH, FAILING WHICH ALL WARRANTIES SHALL BE INVALIDATED.

Failure to comply with the instructions provided in these instructions for use, as well as transport, installation and programming operations performed by unqualified personnel and not in compliance with the provided instructions, may compromise the correct operation of the equipment and cause serious damage to persons, property or the environment.

Under no circumstances may SEA be held liable for consequences resulting from the violation of standards in force, the instructions in this manual or for consequences owing to the insufficient training of professional figures.

Choosing the transformer

The transformer, cables and insulation distances must be selected by the system designer, based on the technical characteristics of the installation site (distribution, conversion, generation, elevator, etc.).

Moreover, it must be checked whether or not the installation site presents electrical phenomena that is anomalous or incompatible with the technical construction specifications of the transformer, for example the presence of harmonics, transitory overvoltages, overloads, low or high frequency phenomena, voltage interruptions, etc.

Should the aforementioned phenomena be found, contact SEA BEFORE PLACING THE TRANSFORMER INTO OPERATION.

Installation site

The transformer installation site must be compatible with its correct operation. Environments that are dusty, humid or with characteristics that may compromise the proper operation of the transformer must be avoided.

In the case of particularly aggressive environments, SEA is able to provide special solutions.

Following is a list of the **prohibition and hazard pictograms** used in this manual and on the transformer itself, for the purpose of warning personnel regarding the presence of operations hazardous to their own and others' safety.

Symbol	Description
	Access is prohibited to all UNAUTHORISED persons

Table 1 of prohibition symbols

Symbol	Description
	General hazard
	Electrocution hazard

Table 2 of hazard symbols

In order to satisfy all safety requirements, during all works on the transformer, the operator is also **obliged to wear the personal protective equipment** required in the place of installation. The following table provides a non-exhaustive list of the possible personal protective equipment.

Symbol	Description
	Work overalls must be worn
	Safety footwear must be worn
	Safety gloves must be worn
	A helmet must be worn
	A harness must be worn

Table 3: general personal protective equipment

Residual risks

The transformer, in certain circumstances and in the case of improper use, may expose the user and persons to potential risks. Following is a list of the main safety warnings, non-compliance with which may compromise the safety of persons and cause damage to the surrounding environment:

- All assembly, electrical connection, commissioning, functional testing and maintenance operations must be performed by qualified, trained and instructed personnel, in particular in relation to electrical risks. SEA S.p.A. shall not be liable for works and operations carried out incorrectly by unqualified personnel.
- It is prohibited for NON-qualified personnel to use and service the transformer.
- The warnings and safety precautions contained in these instructions must be carefully observed, as must the legal provisions in force on the matter of worker health and safety in the country where the equipment is used.
- The provisions and instructions issued by the local company supplying the electrical energy must be complied with.
- The transformer must NOT be used for scopes other than the transformation of electrical energy; all other uses different to the intended use shall be considered improper and therefore hazardous.
- It is the user's responsibility to assess, in accordance with legislation in force, the exposure of personnel to electrical and magnetic fields generated by the equipment and by the electrical conductors in the installation site, and, if necessary, limit access to qualified personnel and apply appropriate signage specifying the risk and prohibition. By way of example:



- Always respect the hazard signs where used.
- Any attempts to modify or repair the equipment by personnel that has NOT been authorised by SEA S.p.A. and has NOT been trained on safety standards, is prohibited. Only original spare parts and accessories or those expressly authorised by SEA S.p.A. may be used in order to maintain the safety conditions. The use of different components may compromise the safety and operation of the equipment!
- It is prohibited to tamper with or remove guards and safety devices.
- Each transformer is equipped with one or more rating plates: all electrical values reported thereon must be respected during installation and operation.
- It is prohibited to change the factory settings of transformer monitoring instruments without the prior authorisation and instruction of SEA S.p.A.
- If the transformer or its parts are disposed of, the used material must always be disposed of in accordance with standards in force in the country of use.

Selection and qualification of personnel

Qualification	Definition
Operator	The user's personnel exposed to the transformer and electrical systems powered thereby. The operator must not perform any works on the transformer and systems. Should the operator detect a malfunction or fault, they are obliged to inform a person of reference (person in charge of safety or maintenance).
Electrical maintenance technician	Qualified technician able to perform preventive/corrective maintenance activities on all electrical parts of the equipment subject to maintenance or repair. Qualified technician able to access all parts of the machine for visual inspection, check the condition of the equipment, make adjustments and calibrations. Qualified technician able to: • place the transformer in safe conditions, isolating it from external power supplies; • regulate the transformer and electrical systems to carry out maintenance, repairs and replace worn or damaged parts; • read wiring diagrams and check the correct execution of the operating cycle. They can operate in the presence of voltage inside electrical cabinets, junction boxes, monitoring equipment etc., only if they are an “expert person” (PEI). (See standard EN50110-1). In systems powered by medium voltage, it is expressly prohibited to perform works in the presence of voltage, the system must first be placed in safe conditions.
Mechanical maintenance technician	Qualified technician able to perform preventive/corrective maintenance activities on all mechanical parts of the equipment subject to maintenance or repair. Qualified technician able to access all mechanical parts of the machine to perform visual inspections, check the condition of the equipment, make adjustments and calibrations. Qualified technician able to: • work on mechanical parts to carry out adjustments, maintenance and repairs; • read pneumatic diagrams, hydraulic diagrams, technical drawings and spare parts lists. Note: they are not authorised to work on energized electrical systems (if present). Works carried out by the mechanical maintenance technician are always subject to the works carried out by the electrical maintenance technician to ensure the safe condition of the equipment.
Manufacturer's Technician	Qualified technician authorised by the Manufacturer and/or their distributor to perform complex operations insofar as they are familiar with the constructive characteristics of the equipment. This person intervenes in accordance with the requests of the user.
Carrier	Person responsible for transporting the transformer from the Manufacturer to the user. During transport, the transformer is placed in safe conditions, the carrier is responsible for ensuring the absence of risks associated with dynamic stresses on the equipment during its transportation. The carrier is responsible for guaranteeing the absence of damage to the equipment during its transportation.



Installer	Qualified technician responsible for positioning, connecting and commissioning the transformer. Once installation is complete, they will issue documentation attesting to correct installation and a test certificate (if requested by legislation in force in the country of installation).
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The qualifications reported in the table on this page necessarily fall within a category of persons defined as “trained”.

Qualification	Definition
Trained Person	A person that has been informed, instructed and trained on the work and any eventual risks deriving from improper use. They are also aware of the importance of safety devices, health and safety laws and safe work conditions.

Temporary works at height, with height greater than 2 metres:

If temporary works at height, > 2 m, cannot be performed in safe conditions and in suitable ergonomic conditions starting from a place suited to the scope, choose suitable work equipment most able to guarantee safe work conditions in compliance with the following criteria:

- a) Priority to collective protective measures with respect to personal protective measures;
- b) Dimensions of work equipment compatible with the nature of the works to be performed, the foreseeable stresses and risk-free circulation.

3 Transport

Distribution transformers are normally supplied “ready for installation”, this means they are completely filled with oil with all accessories already assembled (or in some cases sent separately).

Transport may occur in 3 conditions:

- a) Transformer not protected by packaging
- b) Transformer partially protected
- c) Transformer protected by packaging with case/structure in wood

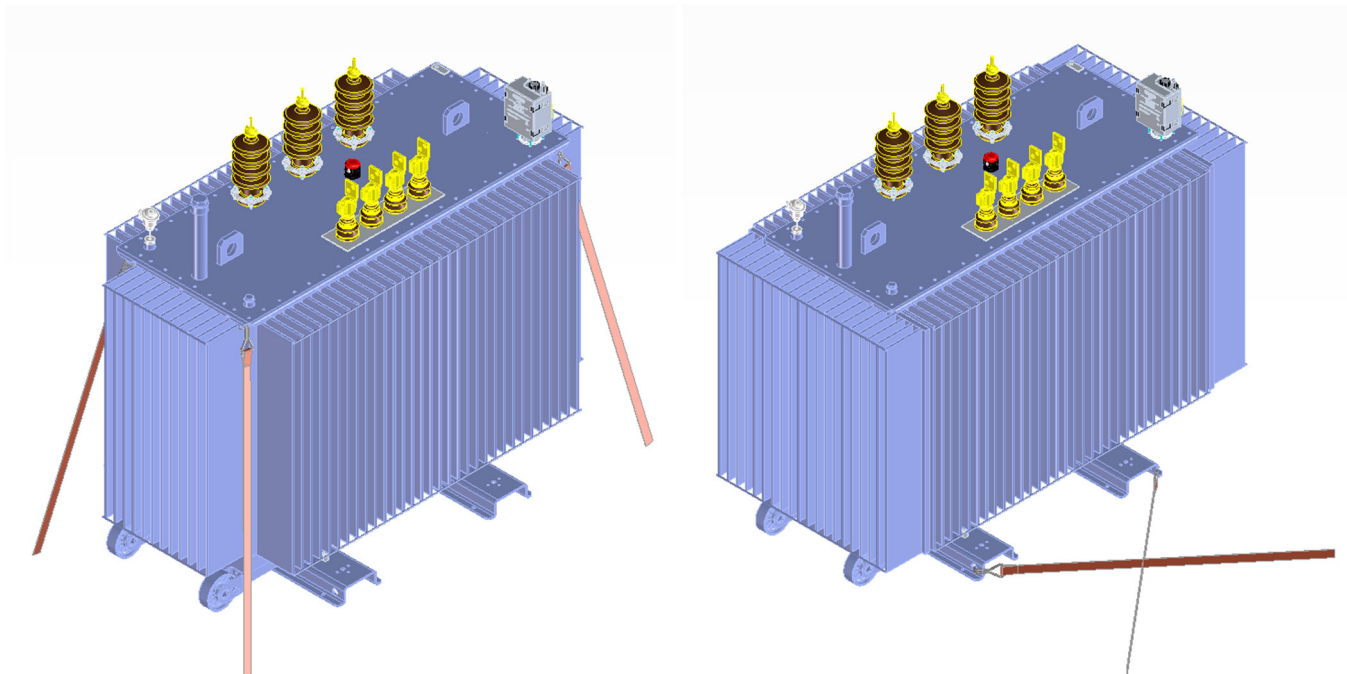


When the transformer arrives at the site, the following checks should be made:

- visually check that the transformer packaging is intact and any disassembled parts have not been damaged
- check the shock recorder or detector if present and follow the instructions
- document the condition of arrival of the transformer and any disassembled parts (if included) with photos
- check that all parcels received correspond to the waybill
- check that no parts of the transformer have been tampered with
- check that there are no oil leaks
- If damage is found or if any accessories are missing, the carrier must immediately be notified and a note must be made on the waybill;
- the written claim containing photos of the damage must be sent preferably on the same day and in any case by the next day, to
 - S.E.A. S.p.A..
 - Carrier
 - Insurance company

Transport by truck

The transformer must be safely anchored in the dedicated eyelets positioned under the cover near the corners, if these are not accessible, anchor the transformer using the eyelets available in the carriage.



CAUTION DO NOT USE ANY PART THAT IS NOT SPECIFICALLY INTENDED TO ANCHOR OR HAUL THE TRANSFORMER (NO RODS/REINFORCEMENTS OF CORRUGATIONS)

To guarantee improved stability of the load, position rubber sheets (or similar) under the supports intended to attach the wheels; the wheels (if included) are attached to the transformer in a safe position.

Transport via sea or rail

In these cases the transformer can be equipped with partial or total protections in wooden crates; anchorage and lifting points must be properly indicated on the wooden crate.

Shock recorder or detector (further to client request)

If a SHOCK RECORDER is to be used during transport, the equipment will be installed on a special support plate. When the transformer arrives at the site:

- the device must be removed
- the date and time of removal must be indicated on the instrument's label
- the instrument must be sent to SEA S.p.A. to assess the recorded data.

The shock recorder is part of the shipment; if it is missing or damaged, the client must file an inspection notification and send it to SEA.

As an alternative to the shock recorder, if requested, a SHOCK DETECTOR can be installed. This device contains a coloured liquid in suspension, if the transformer is subjected to impact greater than a specific level g during transport, the impact causes the liquid to spill, thus providing an indication. However, unlike the recorder, which constantly tracks the entire period of transport, the shock detector only provides an indication of whether or not impact occurred.



Note:

Note that the shock recorder provides an indication of possible impacts that may have occurred during transport, it does not provide information regarding any damage or defects in the transformer. We remind you that the shock recorder also indicates impacts caused by accidental impacts on the instrument itself. The integrity and/or any damage effectively incurred on the transformer can be verified by the manufacturer by examining the recordings made, their intensity and/or by requesting several instrumental tests or inspections.

3.1 Speed limits during transport and load fixing (Directive 2014/47/EU)

The transformer and its components must:

- allow handling and transport in safe conditions
- be packaged and secured to the transport means correctly in such a way as to avoid deterioration

during transport of the machine and/or its elements, sudden movements and hazards caused by instability should not be possible. During transport, the carrier is responsible for the safety of persons or property, also for that attributable to the load itself.

See the provisions set out in relation to transport in accordance with that reported in DIRECTIVE 2014/47/EU and in particular provisions regarding the fixing of the load (art. 13). Provisions set out by the European agreement on the transport of dangerous goods by road (ADR) must also be respected when applicable.

4 Handling

For handling, use only the intended devices; do not drag, push or lift the transformer using the cooling system (be it the corrugated tank or radiators) or corrugation rebars. Do not use the HV or LV bushings to guide the transformer during handling.

The transformer must always be handled at a speed that does not cause impact.



NOTE

- Lifting and handling operations must be carried out by specialised personnel trained on how to use the lifting equipment and aware of the risks to which they are exposed.
- It is mandatory to always wear personal protective equipment and ensure third parties respect the prohibitions (it is prohibited for personnel to transit through the loading/unloading/handling area).
- Avoid impacts



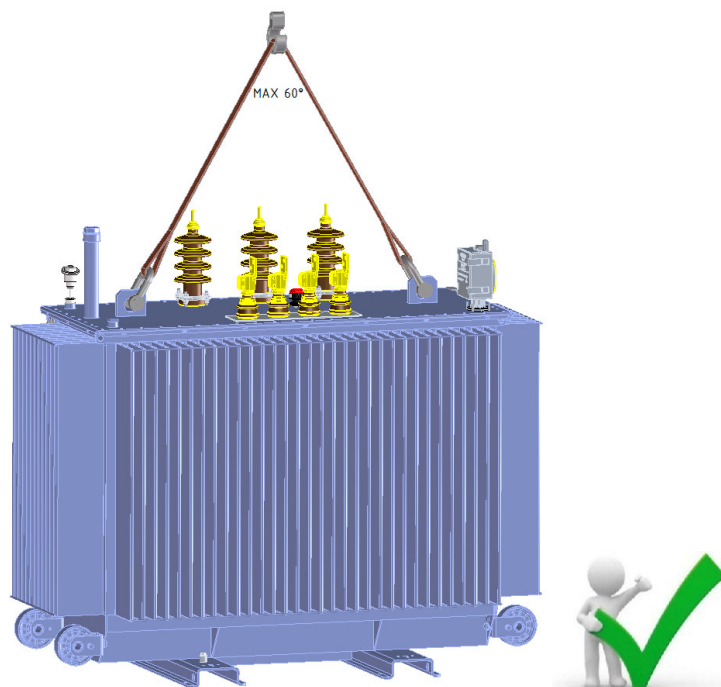
When lifting, hauling and rotating the machine, operators must use only the devices indicated below:

4.1 Lifting with lugs

Lifting lugs are sized to lift the transformer with a crane or bridge crane; consult the transformer plate for information regarding the weights to be lifted. All lifting lugs on the transformer should always be used. Each lifting lug must be used with its own rope. It is strictly prohibited to use only some of the lifting lugs. The hook on the end of the rope must have a safety device preventing it from accidentally slipping out of the lifting lug.

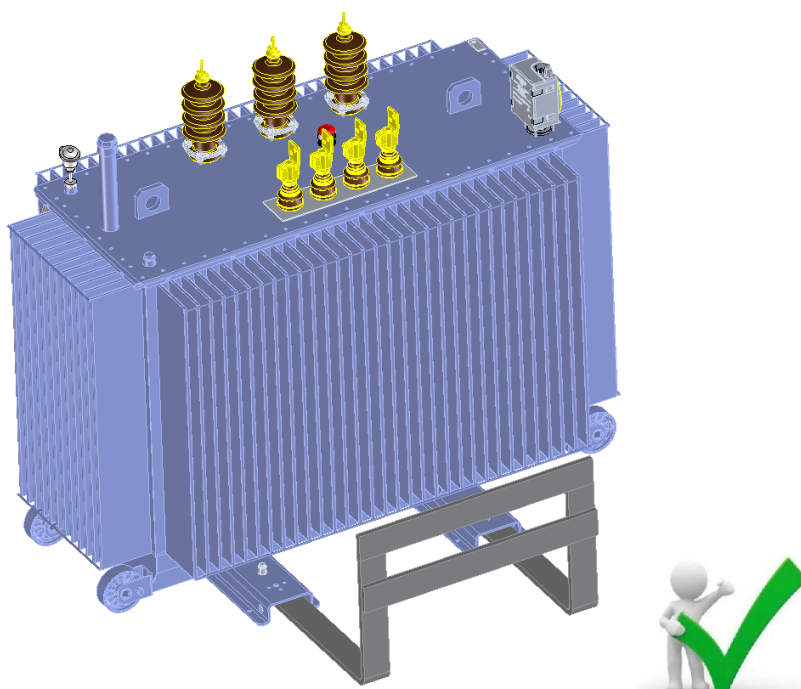


Ropes and lifting accessories must be selected with a **SUITABLE CAPACITY** based on the weight to be lifted and the number of ropes used.
The ropes must have a **MAXIMUM** angle between them of 60°.
Make sure the ropes do not collide with the transformer accessories.



4.2 Lifting with a forklift

The transformer can also be lifted with a forklift using the dedicated slots for the forks (see figure below). For more details regarding the set-up, see the assembly drawing supplied by SEA S.p.A. for the transformer.

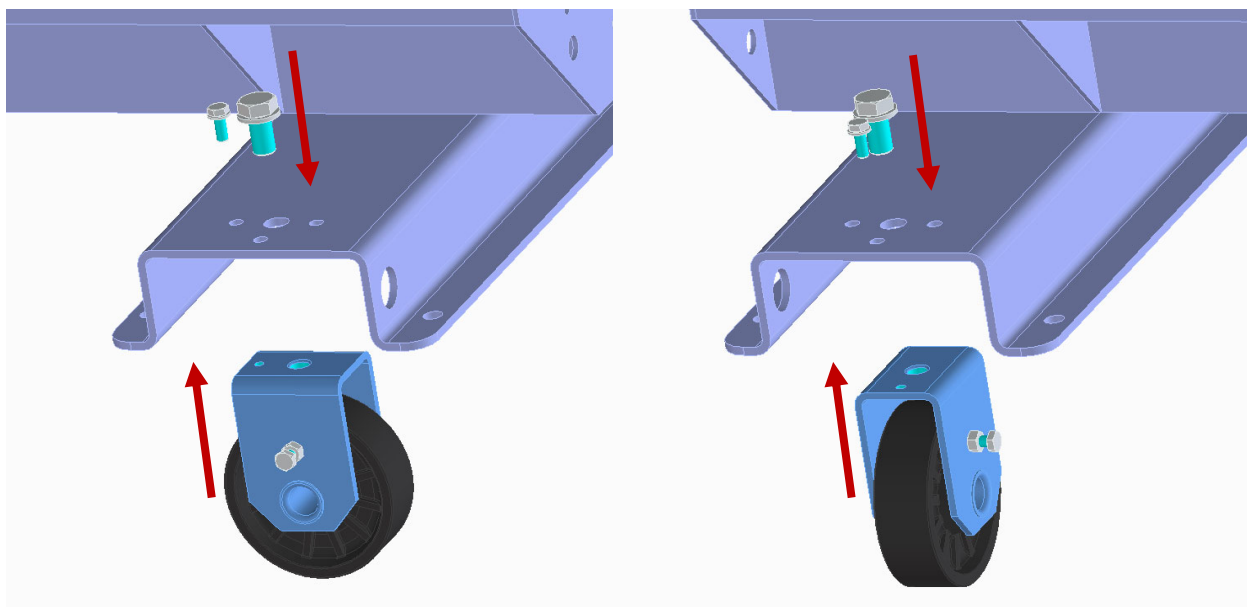
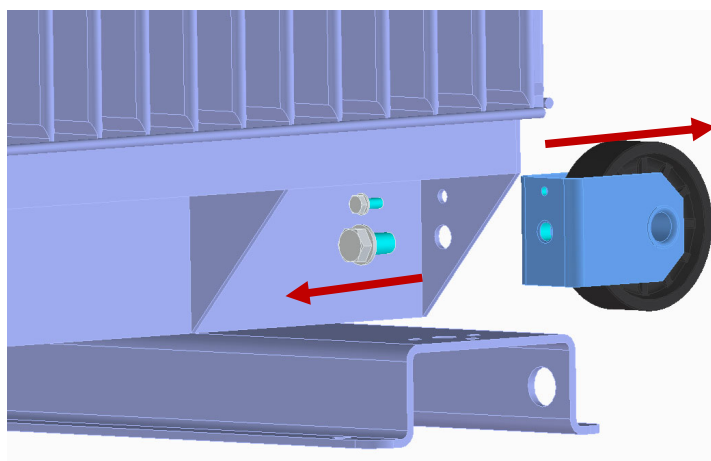


In this case also, any impacts that may damage the transformer must be avoided.

4.3 Fixing the wheels

To install the wheels (if present), proceed as follows:

- remove the wheels from their lateral position
- lift the transformer using the lugs (or lifting jacks, if present); to work in safe conditions, use suitable ropes with a suitable capacity as indicated on the rating plate of your transformer, place suitably resilient mechanical supports under the transformer while keeping the ropes in tension. Before lifting, make sure the instructions provided in the previous paragraph have been followed
- the transformer is equipped with 4 holes on the carriage for the installation of wheels
- position the wheels in the desired direction and secure them to the carriage using the supplied screws
- the single wheel and/or wheel support may be quite heavy. Safe handling



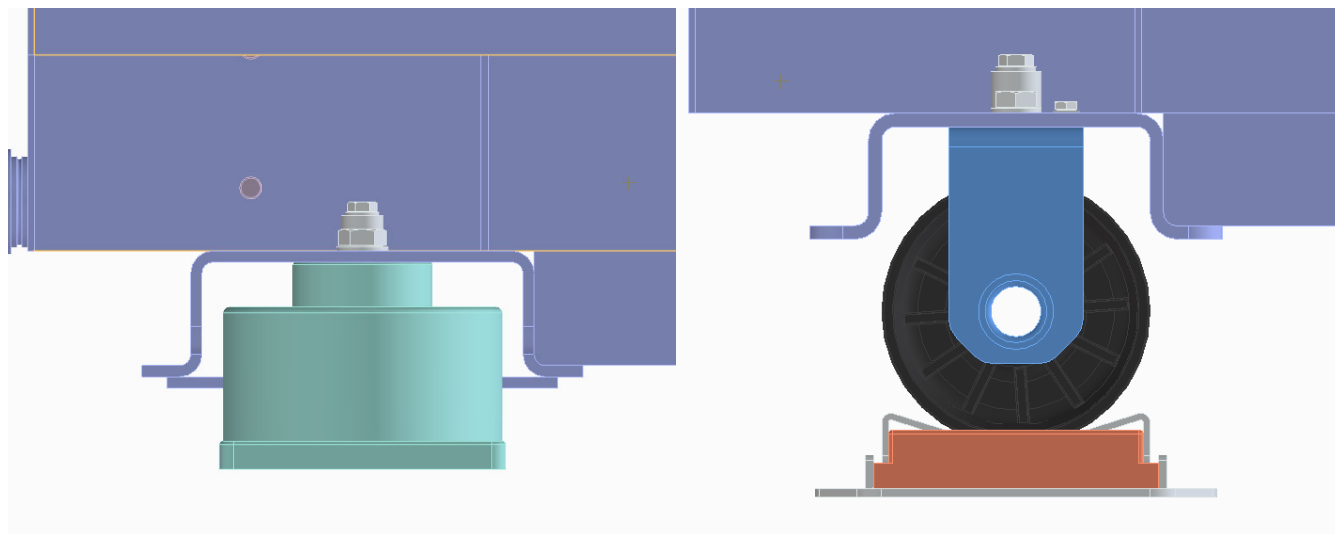
Only work with the transformer in the resting position, never transit or stop under the transformer during lifting.



The wheels are sized to suit the individual weight of the transformer. Do not handle with additional loads!

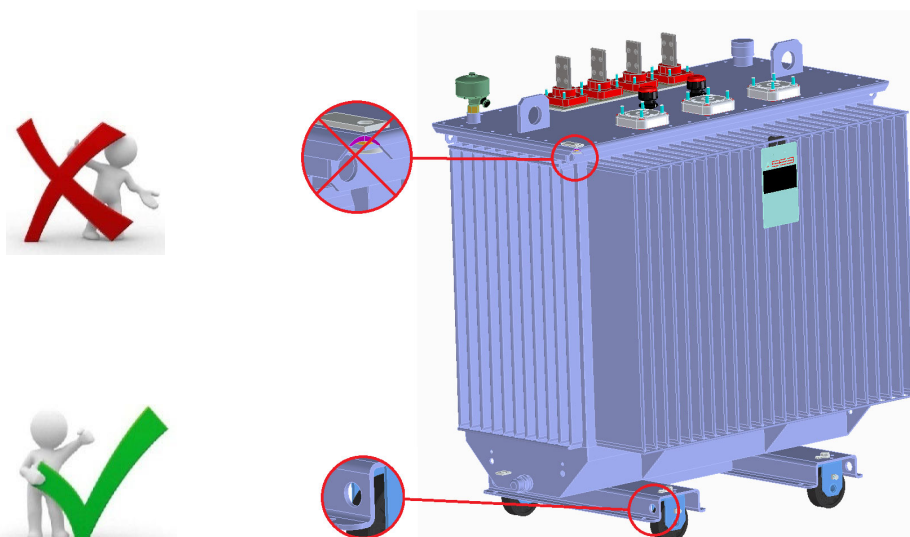
4.3.1 Installation of vibration dampers

Further to a client request, vibration dampers can also be supplied fixed to the transformer carriage, or rested directly under the transformer wheel. Both must be properly anchored to the floor using the holes in the mounting plate.



4.4 Haulage hooks

With the wheels installed, the transformer can be hauled either longitudinally or transversally, depending on the direction given to the wheels during installation. The transformer must be hauled by pulling on the holes present in the carriage, or alternatively on the clearly indicated towing eyelets. Each wheel is equipped with a lock screw; at the end of handling, block the wheel.





When moving the transformer on wheels, use only haulage or push aids such as the forklift. Do not manually push the transformer or use your body to slow it down.



***NEVER haul the transformer by anchoring it in any position other than the special purpose holes on the base.
When shifting and lifting the transformer, take care NOT to damage the accessories and other components!***

5 Inspection after transport and handling

Phase	Mode	Criterion
General check-up	Visual inspection	There should be no scratches and/or damage, or any changes with respect to the transformer identified by the attached assembly drawing
Check for any oil leaks	Visual inspection Check at 500 mm intervals from the bottom up	There should be no oil leaks from the bushings, carpentry, valves, tank/cover joint
Check accessories	Check the accessories installed on the transformer by comparing them with the final assembly drawing	The accessories must have proper indications (temperature, oil level, etc.)
Cleanliness of transformer	Check that the transformer is clean	Clean surfaces There should be no dirt or dust deposits, in particular on the high/low voltage bushings



SEA is not responsible for damage to surfaces / paint caused during on-site handling and installation.

5.1 Unpacking



If there are packaged parts, follow these general instructions:

- wear personal protective equipment to ensure operations are carried out safely;
- before removing the transformer from the packaging, check that the base is not blocked and if so, release the fastening devices;
- ensure the stability of the components;
- before lifting the transformer, make sure the ropes are compatible with the weight indicated on the rating plate and check that they don't damage any protruding parts of the machine;
- take photos of the supply and send them to SEA S.p.A.

If wooden crates are used for packaging:

- open the crates using prying tools, taking care not to penetrate the inside of the packaging with the tools, potentially damaging the equipment;
- pay attention to any splinters;
- after detaching the parts constituting the packaging, bend the nails;
- dispose of the waste in accordance with legislation in force in the country of installation and in any case in respect of the environment.

If plastic film is used for packaging:

- peel back the packaging material using a cutter, taking care not to damage the contents;
- dispose of the waste in accordance with legislation in force in the country of installation and in any case in respect of the environment.

6 Storage instructions

Once in the site, the transformers may need to be stored for short or long periods of time.

Distribution transformers can be stored in both indoor and outdoor locations.

Storage is considered the moment the transformer leaves the SEA S.p.A. premises.

We recommend following the instructions below:

- The transformer must be positioned on a NON-sloping surface, able to withstand its weight;
- Any disassembled accessories must be stored in dry, clean and possibly ventilated locations. Check the condition of the hygroscopic salts in the packaging in accordance with the requirements of standard UNI 9151;
- Once in the site, whether the transformer is stored indoors or outdoors, the packaging must be opened and the dryer must be installed within maximum 15 days (from its arrival at the first place of storage); the condition of the salts must be checked every six months. (this operation does not apply to hermetic type transformers).



In transformers equipped with conservator, install the dryer as soon as possible to avoid internal overpressure in the transformer (NOT APPLICABLE TO HERMETIC TYPE TRANSFORMERS)



Storage at temperatures less than -25°C must always be indicated beforehand to the SEA S.p.A. technical service centre.

7 Installation

7.1 Warnings

INFORMATION FOR INSTALLATION

- All installation operations must be performed by qualified technical personnel that has been trained on the risks and hazards that may arise during the operations themselves.
- SEA S.p.A. denies all liability for any injury or damage caused to persons, property and to the transformer itself, following works performed by untrained and/or unsuitable personnel.
- All works must be carried out in safe conditions in accordance with the recommendations of the legislation in force.
- It is mandatory to wear personal protective equipment and to ensure prohibition signs are obeyed by any third parties.

The client shall be responsible for checking that the network and installation site are suited to the transformer and under no circumstances may situations arise whereby the design limits of the machine are exceeded.

The following must be avoided:

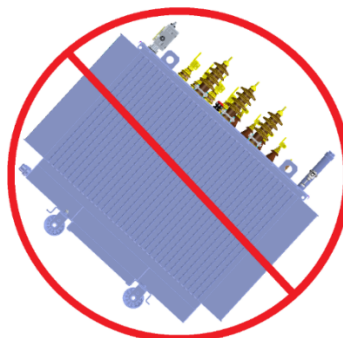
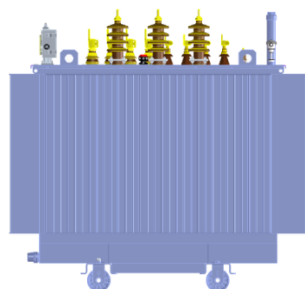
- repeated connection/disconnection from the network in brief time periods
- overvoltages beyond the limits of insulation
- high frequency resonance phenomena
- voltage or current harmonics beyond the design limits
- dust deposits that may cause a reduction in dielectric strength
- installations in non-compliant environments
- uses other than those indicated in the purchase specifications

the machine must also be suitably protected against surges/overvoltage using specific active or passive systems



CAUTION

- Always keep the transformer on a NON-sloping surface during all assembly/installation operations!
- Block wheel movement after positioning.



7.1.1 Emissions

During its operation, the transformer is a source of the following emissions:

-Heat

During its operation, the transformer emanates heat due to the losses generated in the windings and in the core. Installation venues must be suitably sized in order that said heat can be properly dissipated, thus preventing overly high temperatures from being reached.

-Noise

During the design and construction of the transformer, all necessary measures were adopted in order to reduce noise emissions as per the agreement with the end user. If the noise levels increase, this may be an indication of a malfunction of the equipment. Contact the SEA S.p.A. client service centre.

-Electromagnetic

Transformers must be considered passive elements with regard to emissions and immunity to electromagnetic disturbances (see standard CEI EN 60076-1). Therefore, the attention must be shifted to the LV connections through which high currents normally run. To reduce interferences with other sensitive devices such as monitors, control units etc. to a minimum, it is recommended to follow the simple instructions below:

- Keep the cables of the three phases + neutral grouped together
- Do not lay power cables and signal cables in the same raceway
- Do not pass power cables near devices sensitive to electromagnetic fields
- Ground the sheathing of signal cables
- Use electronic devices and transducers with a CE marking

7.1.2 Ambient conditions

Unless otherwise specified in the rating plate or data sheet, consider the following provisions:

- the transformer must not be installed at altitudes greater than 1000 metres a.s.l.
- maximum ambient temperature +40°C
- minimum ambient temperature -25°C

The transformer installation site must satisfy the following requirements:

- absence of flood risk
- respect of distances from energized parts (ref. Standard IEC 676-3)
- visibility and accessibility of installed accessories
- suitable ventilation
- maximum temperature 40°C (unless otherwise specified by the client)
- minimum temperature -25°C (unless otherwise specified by the client)
- installation altitude ≤ 1000 m a.s.l. (unless otherwise specified by the client)
- flooring or rail support suited to the weight of the transformer

absence of conductive dust or chemical substances

7.1.3 General functions and intended use

A transformer is a static electric machine, which is reversible; it can be powered on both sides and based on its conversion ratio it provides a greater or lesser voltage/current in output.

The transformer is subject to the characteristics reported in the RATING PLATE (voltage - current - frequency - phase displacement etc.), all improper uses must be avoided, for example, powering the transformer at a higher power or reducing the electric distances established by the standard and reported in this manual.

It must only be used for its intended purpose (that is, to transform the voltage/current), any other use is improper and is prohibited. S.p.A. shall not be liable for any injury or damage caused to persons or property if the equipment is used improperly or handled by personnel that has not been trained and instructed on its use.

7.1.4 Warranty

All SEA transformers are covered by a manufacturer's warranty based on the laws in force and the stipulated contractual terms; the warranty is limited to the repair or replacement of damaged parts at the manufacturer's discretion and shall not give rise in any case to the extension of the original warranty. The complete warranty clauses are reported in the sale agreement.

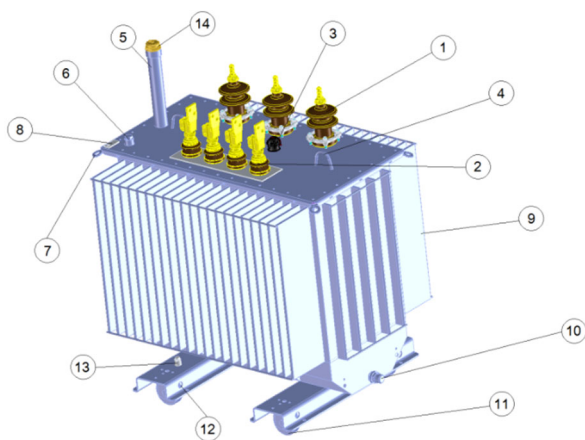
The warranty **is subject** to the following general terms:

- **Transport and handling during installation** must be performed in respect of the instructions and speed limits during transport, fixing and positioning (Directive 2014/47/EU) and/or any restrictive limits indicated by the manufacturer; instructions must be followed in the event shock recorders or shock detectors are installed.
- **unpacking and installation** must be carried out in the presence of qualified and authorised personnel;
- the **commissioning of the installed transformer** must be carried out in the presence of qualified and authorised personnel; the work sheet relative to the installation/testing must be completed.
- **the transformer must be used within the limits declared** in the contract and reported in the technical documentation.
- **maintenance** must be carried out at the scheduled times and using the methods indicated by the manual, using original spare parts by **S.E.A. S.p.A.** and assigning the works to qualified personnel.

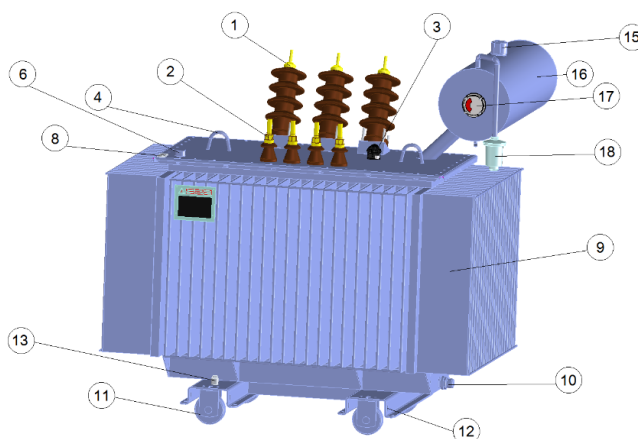
The warranty shall **expire** in the following cases:

- failure to comply with the **safety standards**;
- **removal or tampering with the** control and safety devices (warranty seals)
- **modifications to safety conditions** established by the Manufacturer;
- **improper use** of transformer;
- use of transformer by **untrained and/or unauthorised personnel** or failure to respect the skills of the various operators as indicated in the manual;
- **modifications or repairs** carried out by the user without the Manufacturer's written authorisation;
- partial or total non-compliance with the instructions;
- defects in the power supply;
- poor maintenance;
- use of non-original spare parts;
- exceptional events such as floods, fire (unless generated by the inefficiency of the transformer itself).

7.2 Standard accessories



HERMETIC TRANSFORMER



TRANSFORMER WITH CONSERVATOR

Position	Hermetic transformer	Transformer with conservator
1	High voltage bushings	
2	Low voltage bushings	
3	No-load voltage switch	
4	Lifting lugs	
5	Filling tube	N/A
6	Thermowell	
7	Anchor hooks for transport	
8	Transformer identification plate	
9	Cooling system	
10	Oil drain/sampling valve	
11	Sliding wheels	
12	Haulage hooks	
13	Grounding bushing	
14	Closing cap	N/A
15	N/A	Filling cap
16	N/A	Conservator
17	N/A	Oil level
18	N/A	Dryer

The transformer may also include additional components / accessories if requested by the client during the order stage:

PT100 probe	Plug-in bushings
Buchholz Relay	Current transformers
RIS or DGPT2 or DMCR	Ball or gate valves
Pressure relief valve	Cable box HV side
Thermometer and/or thermal image	Cable box LV side

7.3 Installation room

The room must allow (in addition to that established by regulations):

- respect of distances from energized parts
- visibility and accessibility of installed accessories
- suitable ventilation
- maximum temperature 40 °C (unless otherwise specified by the client)
- minimum temperature -25 °C (unless otherwise specified by the client)
- installation altitude max. 1000 m a.s.l. (unless otherwise specified by the client)
- flooring or rail support suited to the weight of the transformer
- absence of conductive dust or chemical substances

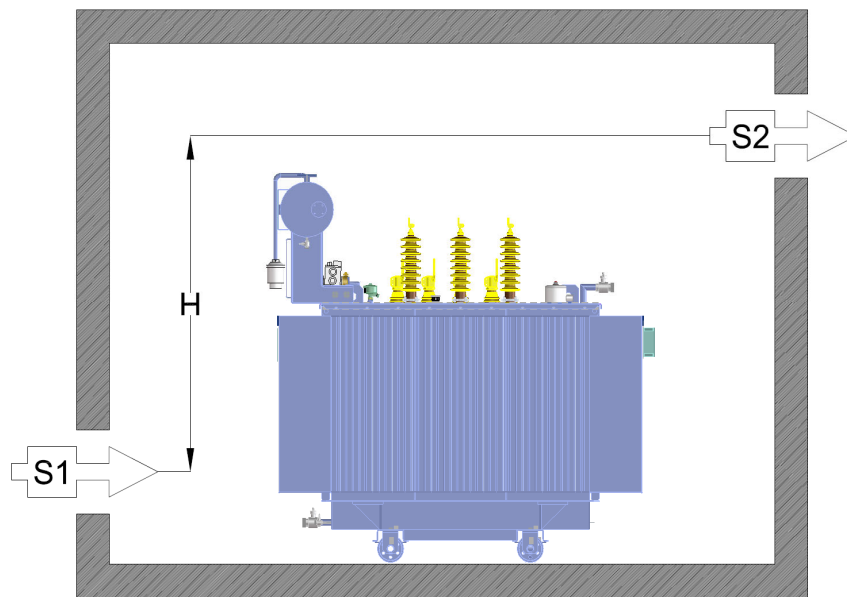
7.4 Ventilation

During its operation, the transformer emanates heat due to the losses generated in the windings and in the core. Installation venues must be suitably sized in order that said heat can be properly dissipated, thus preventing overly high operating temperatures from being reached.

-Natural ventilation

The installation site must be suitably ventilated to ensure the correct dissipation of the heat produced. In the event of cooling through natural air circulation (AN), the installation site should be equipped with at least two openings, one below (S1) to facilitate the intake of fresh air from the outside, one above on the opposite side to the intake (S2), suitable for the release of hot air; the two openings should be at a suitable difference in height (H). A fresh air intake equal to 5 cubic metres per minute must be guaranteed for each kW of loss to be dissipated.

In order to guarantee ideal circulation, the values S1, S2 and H must be related to each other as per the following example:



Calculation example:

P_{tot} = sum of no-load losses and load losses (expressed in kW) and any other losses to dissipate, in the installation site

S1 = net air intake area in m^2

S2 = net air outlet area (excluding any grid surfaces) in m^2

H = height between two openings in m

$$S1 \geq \frac{(0,19 * P_{tot})}{\sqrt{H}} \Rightarrow S2 \geq 1,11 * S1$$

Refers to an average yearly temperature of 20°C.

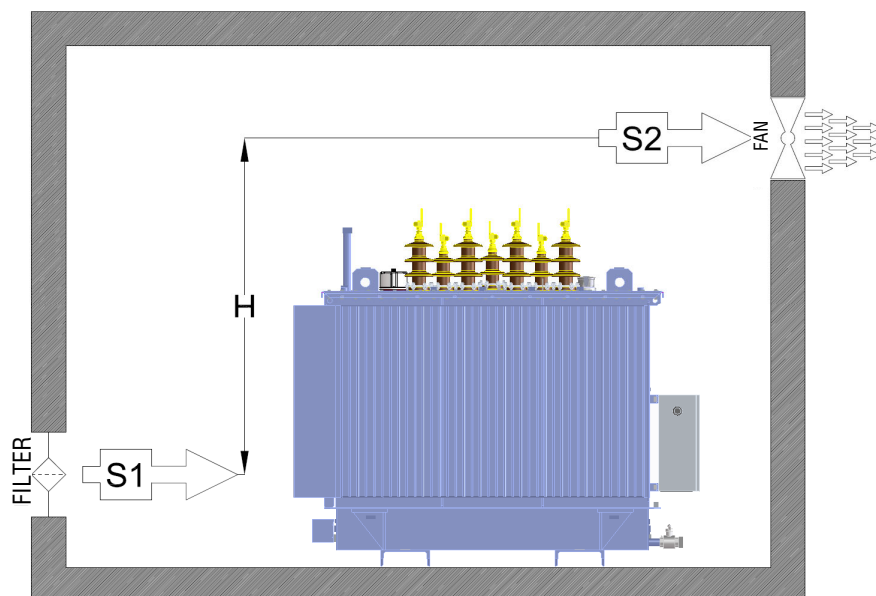


The entry of foreign impurities, water and other contaminants through the ventilation openings and power ducts must be prevented.

In order to obtain efficient heat dissipation, the transformer must be at a minimum distance of 30-40 cm from the wall and of 60-70 cm from other sources of heat.

-Forced ventilation

Forced ventilation of the installation site is necessary when the transformer is installed in an environment with scarce air circulation and when the average yearly temperature is greater than 20 °C. In this case it is possible to install an air extractor on the opening (S2) in order to extract the hot air accumulated inside the installation site.



Calculation example:

P_{tot} = sum of no-load losses and load losses (expressed in kW) and any other losses due to other equipment installed in the same site

S1 = net air intake area in m^2

S2 = net air outlet area (excluding any grid surfaces) in m^2

H = height between two openings in m

$$Fan \text{ flow rate} = 0,11 * P_{tot} \left[\frac{m^3}{s} \right]$$

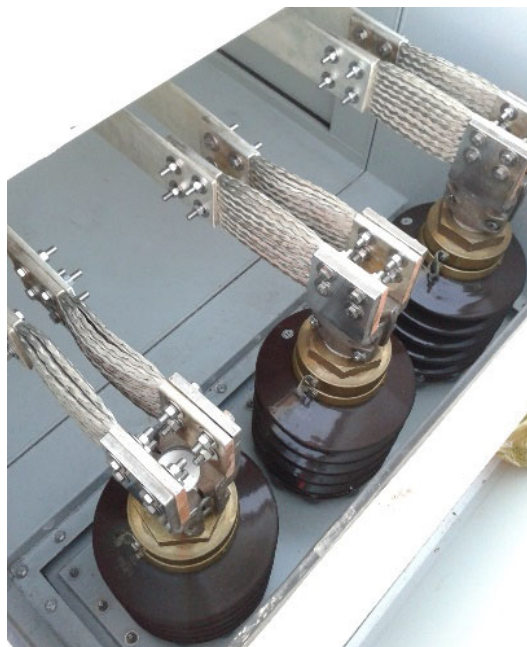
$$S1 \geq 0,22 * P_{tot} \quad (\text{Note : filter necessary})$$

Refers to an average yearly temperature of 20°C.

7.5 Connection on MV and LV side

7.5.1 Connection in busway

Avoid rigid connections; it is recommended to use a flexible connection (between busbar and bushing) so as not to exert mechanical stress on the bushing and avoid oil leaks.



7.5.2 Connection in cable - execution without cable boxes (IP00)

Fix and adequately support the cables connected to the transformer terminals so as not to transmit any mechanical stress to the medium/low voltage bushings; otherwise the bushing itself may be damaged with eventual oil leaks.

CAUTION! In the case of cables coming from BELOW, it is necessary to consider a suitable space based on their bend radius (indicated in the cable manufacturer's data sheets) so as not to cause any stress to the bushing.

7.5.3 Connection in cable - execution with cable boxes (IP41 or IP55)

Cables or barring must enter the cable box through the predetermined section indicated in the assembly drawing of the transformer.

Once again in this case, it is necessary to check that the cables are properly anchored so as not to cause any mechanical stress to the bushings; always follow the instructions in the cable manufacturer's data sheet in regards to the bend radius.

The entry of cables or barring must not alter the protection class of the cable box (suitable cable glands, etc.).



7.6 Insulation distances

For transformers without cable boxes (IP00), the suitability of electrical distances between energized parts and surrounding areas must be checked and must comply with legislation in force in the country of installation. In the absence of specific legislation in the country of installation, follow the provisions of standard IEC 60076-3.

For plug-in bushings these considerations do not apply, however it is nonetheless advisable to avoid direct contact.

7.7 Assembly of bolted joints on transformer

-Nuts and screws that require coupling with a calibrated torque wrench

All electrical connections must be tightened with a torque wrench; this category includes joints between the active part and the bushing, the fixing of connections to the inner/outer shaft of the bushings, internal and external grounding connections to the transformer, the fixing of the bushing to the cover. This category also includes the fixing of the busbar plates to the inner/outer shafts and the fastening of the bars to the plates themselves.

The conservator must also be fixed to its supports on the case and/or cover using a torque wrench according to the table of values.

SPECIAL CASES: Some manufacturers prescribe their own torques for their own accessories/instruments. In this case, the order of priority to respect is →MANUFACTURER →SEA STANDARD

-Nuts and screws that DO NOT require coupling with a calibrated torque wrench

Screws that connect steel, stainless steel, aluminium flanges that do not fall into the previous category must be fixed at the torque values indicated in the tables in the following paragraphs, but do not necessarily need to be tightened using a calibrated torque wrench.

-Cleaning

All surfaces characterising electrical contacts must be cleaned and covered with a suitable antioxidant lubricant in order to remove any traces of oxide from the surfaces and protect them against any future oxidation before their coupling.

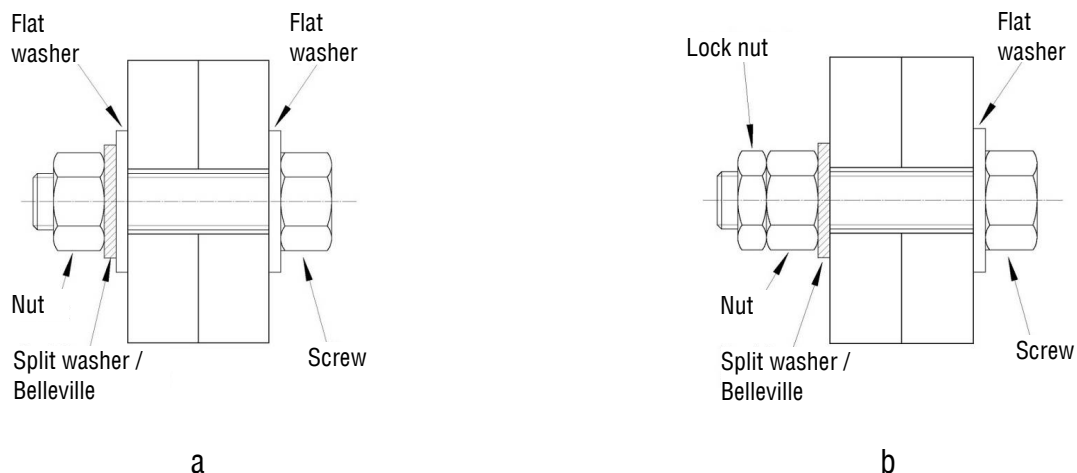
-Thread lubrication

All threaded joints in galvanized steel, bronze and brass must be fixed without any lubricant. All external threaded joints in stainless steel must be fixed by interposing nickel or nickel-graphite anti-seize lubricant.

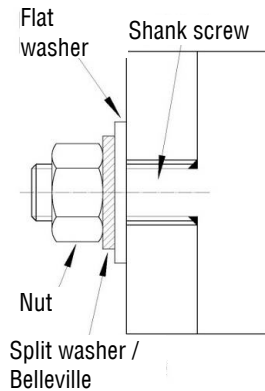
-Possible nut, screw and washer configurations

Standard joints

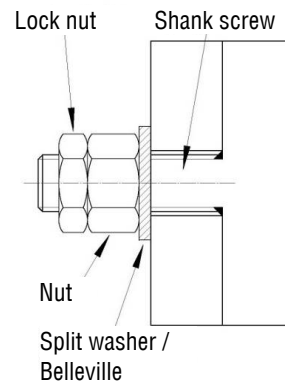
joints **a (without lock nut)** and **b (with lock nut)** represent the correct configuration of components, nut, split/conical washer, flat washer, screw when fastening two components with through-holes. At least one whole thread must always protrude from the final joint.



Joints **c (without lock nut)** and **d (with lock nut)** represent the correct configuration of components, nut, split/conical washer, flat washer, welded stud when fastening a component with through-hole to a component with welded stud. At least one whole thread must always protrude from the final joint.



c

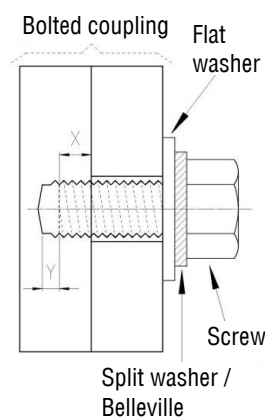


d

Threaded blind hole screw joint

the joint is represented by the coupling between a surface with threaded blind hole and a surface with through-hole. In this case it is important that upon completion of the coupling, the length of the nut inserted in the threaded hole is, in length (X), at least half the diameter of the screw. The remaining part of the threaded hole (Y) must be equal to about 1/3 of the diameter of the screw.

In general, the screw material must be the same material as the object fitted with the threaded blind hole. These connections, when made in stainless steel and made externally, must be treated with a nickel/nickel-graphite anti-seize product.



e

-Bolt coupling torque values

-The following table applies to two different categories of bolts: galvanized steel and AISI 304 stainless steel if joining materials with through-hole in steel, stainless steel, copper, aluminium.

Screw material	Galvanized steel	AISI 304 stainless steel with anti-seize lubricant
Screw size	Torque in Nm	
M6	5	4
M8	14	9
M10	27	19
M12	48	33
M14	77	53
M16	147	82
M20	294	157
M24	510	274
M27	745	407
M30	1009	554
M33	1382	750
M36	1774	965
M39	2293	1250

-The following table applies to two different categories of bolts: brass and bronze if joining materials with through-hole in steel, stainless steel, copper, aluminium.

Screw material	Non-lubricated brass	Non-lubricated silicon bronze
Screw size	Torque in Nm	
M6	2	3
M8	5	8
M10	10	16
M12	17	28
M14	27	45
M16	43	71
M18	59	97
M20	83	137
M24	142	235
M30	289	470
M39	657	1068

-The following table applies to two different categories of bolts: brass and bronze if joining materials with threaded hole in copper, aluminium.

Screw material	Non-lubricated copper (with threaded hole)	Non-lubricated aluminium (with threaded hole)
Screw size	Torque in Nm	
M6	1	0
M8	3	1
M10	6	3
M12	11	5
M14	18	8
M16	28	12
M18	39	16
M20	56	23
M24	96	40
M30	191	79
M39	431	176
M42	534	221
M48	804	333

-Screw classification and their values of use

Bolts used in metal carpentry have screws classified in accordance with UNI EN 20898, specified by two numbers, where the first indicates the tensile strength f_t (expressed in MPa) divided by 100 and the second the ratio between yield strength f_y / tensile strength f_t (expressed in MPa) multiplied by 10:

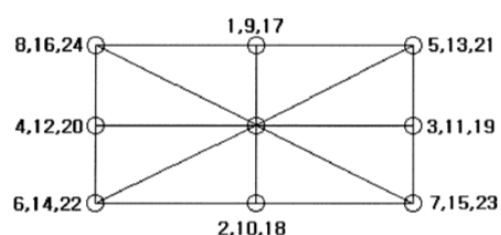
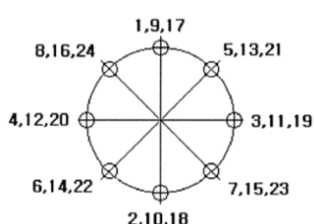
Class	Shear strength (f_k, V)	Tensile/compressive strength (f_k, N)		Tensile strength (f_t)	Elongation % ($A\%$)
4.6	170 MPa	240 MPa	240 MPa	400 Mpa	22
5.6	212 MPa	300 MPa	300 MPa	500 Mpa	20
6.8	255 MPa	360 MPa	480 MPa	600 MPa	16
8.8	396 MPa	560 MPa	640 MPa	800 MPa	12

These characteristic values are divided by a model coefficient and a safety coefficient of the material for the design calculations.

Class 8.8 is a *high resistance* class, while the previous classes are so called *normal* classes.

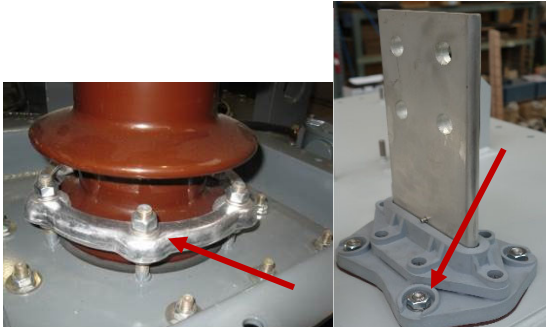
7.7.1 Tightening sequence for screws and nuts

In general, the tightening sequence of screws and nuts is the following:



7.8 Bushing tightening torques

Nut inside porcelain or polymer bushing		
Thread	Tightening torque	
M12	15 Nm	
M20	30 Nm	
M30X2	50 Nm	
M42X3	90 Nm	
M48X3	120 Nm	
M55X3	190 Nm	

Fastening of studs to bushing base (PORCELAIN / INNER or OUTER CONE / BUSBAR)		
Thread	Tightening torque	
M8	12 Nm	
M10	20 Nm	
M12	25 Nm	

Fastening of bolts to busbar plate		
Thread	Tightening torque	
M8	20 Nm	
M10	30 Nm	
M12	40 Nm	
M16	90 Nm	

Note: tolerance + 3 Nm

7.9 Pin bushings

If the transformer is equipped with pin bushings and the mobile part needs to be installed, the following recommendations apply:

- remove the protective cover of the fixed part on the transformer before connecting the mobile part of the feed-through connection.
- make sure the connection interface is clean and dry.
- connect and fasten the pin/mobile part following the manufacturer's instructions.

7.10 Installation of cable boxes

If the transformer is equipped with cable boxes to protect the terminals, supplied separately to the transformer, the following assembly instructions apply:

- position the transformer in the final stall before installing the cable boxes (in some cases lifting may be difficult with the cable boxes installed)
- check the assembly drawing for the correct layout for assembly
- position the gaskets in the coupling flange between the transformer cover and the cable box itself
- install the cable box
- use the inspection hatches on the cable box to access the cable connection
- install the supplied aluminium plate used to cross the connections.

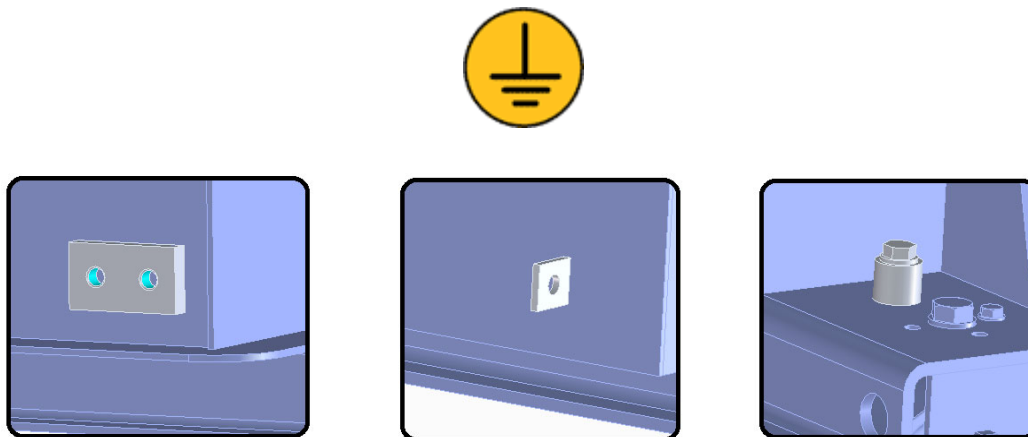
7.11 Installation of dryer

See the following instructions (if applicable)

 1. Unscrew the closing cap of the dryer tube	 2 The dryer, complete with salts, is sent hermetically closed and sealed so as to avoid any alteration of the salts themselves. Remove the plastic cap in the top and lower part of the dryer. Be careful not to overturn the dryer.
 3. Screw the dryer to the conservator connecting tube.	 4. Carry out the operations described in the dryer manual to make it 100% operational, otherwise the instructions can be found in the lower part of the equipment.

7.12 Ground connection

Each transformer is equipped with two plates or bushings for grounding arranged on the sides on the bottom of the tank. The plates are identified by a black symbol on a yellow background.



The screws and washers for connection to the grounding system are found on the plate; the cable must have a suitable wire gauge based on the short circuit current of the electrical system where the transformer will be installed.



IMPORTANT

The transformer must be grounded permanently and in accordance with best practices, in the predetermined points. The operations must be carried out by qualified personnel in compliance with legislation in force in the country of installation, with the issuance of a declaration of conformity if necessary.

7.13 Variation of primary voltage

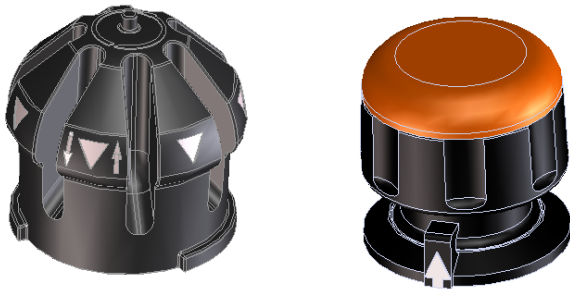
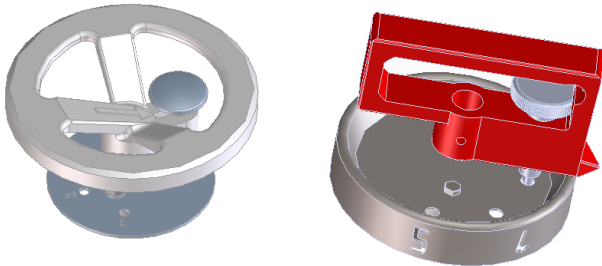
The transformer is often equipped with a tap changer switch, which allows the **no-load** variation of the ratio between primary and secondary voltage (see rating plate).



CAUTION! The tap changer switch must be operated only with the transformer disconnected from the network on both the primary and secondary side.

To operate the tap changer switch, perform the following manoeuvres:

- Disconnect the transformer from the power line
- Release the switch following the operating instructions, which may differ depending on the installed model:

	Completely lift the shunt and turn it in a clockwise or anti-clockwise direction until reaching the desired position, then release it so it falls back to its original position
	Lift the spring knob and turn the shunt in a clockwise or anti-clockwise direction until reaching the desired position, then release it so that the pin enters the relevant slot.
	Push the shunt back down, allowing it to turn in a clockwise or anti-clockwise direction until reaching the desired position, then release it so that the pin enters the relevant slot.



CAUTION! Always ensure that upon completion of the manoeuvre, the block is properly inserted in the new position.

The positions are normally marked +2 +1 0 -1 -2 or alternatively 1 2 3 4 5 and indicate, in order, the regulation of the primary voltage from maximum to minimum.

The nominal ratio shown on the rating plate refers to position 0 or 3.

The position is selected in order to adapt the primary voltage of the transformer as much as possible to the available voltage of the electrical system.

With the primary voltage constant, if the secondary voltage is not satisfactory, it can be adjusted with the tap changer switch in the following two ways:

- ✓ **Position the tap changer switch in position +2 / +1 or 1 / 2 to decrease the secondary voltage.**
- ✓ **Position the tap changer switch in position -2 / -1 or 4 / 5 to increase the secondary voltage.**

Caution, unless it is strictly necessary, it is preferable not to resort to the second hypothesis insofar as it may increase the noise and no load losses.

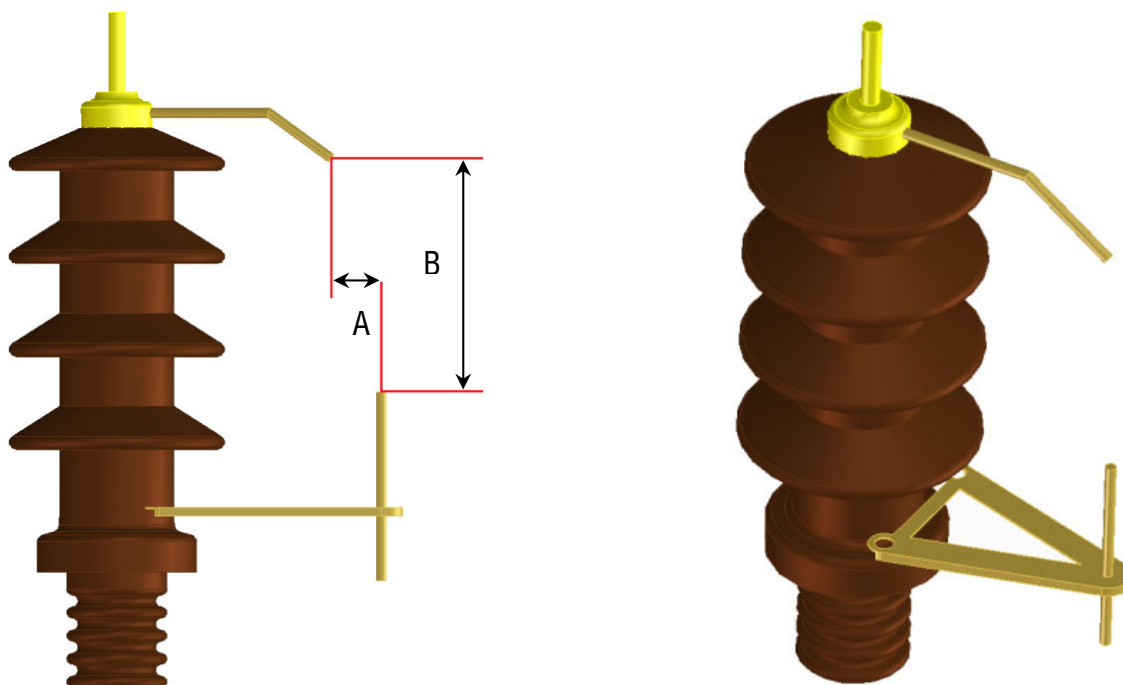
7.13.1 Primary load changer switch

The transformer can also be supplied with the possibility for two main primary voltages, alternatively; e.g. 10-15 kV, 10-20 kV, 15-20 kV (always refer to the rating plate for further details).

In these cases the cover includes, in addition to the RE shunt for the primary voltage, a second shunt indicating the two possible primary voltages. Follow the same instructions reported in point 4.10.9 to perform the switching manoeuvre.

7.14 Spark gaps

If the bushing is equipped with SPARK GAPS, check that the distance complies with that reported in the following table.



Insulation class	A [mm]	B [mm]
12	≥ 15	70
17.5	≥ 15	85
24	≥ 15	100
36	≥ 15	220

7.15 Post-installation checks

STAGE	INSTRUMENTATION	CRITERION	NOTES
Check transformer grounding connection	-Torque wrench -Multimeter	Check that the connection torque is correct and the suitability of the wire gauge Check the electrical continuity	
Check the ground connection of the surge arrestors (if included)	-Torque wrench -Multimeter	Check for the presence of the connection and its correct sizing. Check the torque. Check the electrical continuity	
Check the tightening torque of the MV connections	-Torque wrench	Correspondence of torque values with tables in manual.	See relevant table
Check the tightening torque of the LV connections	-Torque wrench	Correspondence of torque values with tables in manual.	See relevant table
Check the tightening torque of the ground connections	-Torque wrench	Correspondence of torque values with tables in manual.	See relevant table
Check that the connection cables are properly supported	--	The cables must be fixed to an independent structure. They must not transmit any mechanical stress to the transformer terminals.	

7.16 Thermometer setting values

S.E.A. recommends setting the thermometer with the following values:

- ALARM 100°C
- RELEASE 110°C

8 Commissioning

Before powering the transformer, the correct operation of the instruments/accessories installed on board must be checked in order to ensure its correct operation (follow table). To check the layout, see the auxiliary circuit diagram and the assembly drawing supplied with the transformer.



CAUTION

ALL the following operations must be carried out with the transformer disconnected from the NETWORK and properly GROUNDED IN ACCORDANCE WITH SAFETY DIRECTIVES (DE-ENERGIZED electrical works)!

THE OPERATIONS MUST BE CARRIED OUT by qualified technicians with good knowledge of both electrical systems and safety regulations.
It is mandatory to wear personal protective equipment and to ensure prohibition signs are obeyed by any third parties.



The following instructions apply to all types of transformers:

1	Check that the voltage on the rating plate is compatible with the system
2	Check that the tap changer switch is in the right position
3	Check that all connection bolts are properly tightened
4	Check that all cables and/or busbars are secured
5	Check that all accessories are visible and working properly
6	Check the safety distances
7	Check the ground connections

8.1.1 Transformer with conservator (corrugated tank)

COMPONENT	DESCRIPTION OF CHECK
Buchholz Relay	Check that the Buchholz Relay shut-off valves (if present) in the tank-main conservator connection are open
Dryer	Check that the dryer is properly installed
Tap changer switch	Check that the voltage tap changer switch is in the requested position before energizing the transformer.
Auxiliary circuits and installed accessories	Check the correct operation of the auxiliary instruments installed on the transformer, checking that the protections are correctly activated. See the transformer auxiliary circuit diagram.
Fans (if present)	Set the fan control selector in the electrical cabinet to “manual” mode and enable all fans. Check that the flow of air is properly orientated.
Connections	Check the correct fastening of all connections and/or busbars. Check that the cables or busbars connected to the transformer terminals do not transmit mechanical strain to the bushings themselves.
Grounding	Make sure the transformer is properly grounded.

8.1.2 Hermetic transformer (corrugated tank)

COMPONENT	DESCRIPTION OF CHECK
Seals	Check that the various warranty seals on the transformer have not been tampered with; if so, contact our client service centre.
Tap changer switch	Check that the voltage tap changer switch is in the correct position before energizing the transformer.
Auxiliary circuits and installed accessories	Check the correct operation of the auxiliary instruments installed on the transformer, checking that the protections are correctly activated. See the transformer auxiliary circuit diagram. Check that the clear tube of the integrated protection device RIS – DGPT2 - DMCR (if present) is completely filled with oil. Otherwise, contact our client service centre.
Fans (if present)	Set the fan control selector in the electrical cabinet to “manual” mode and enable all fans. Check that the flow of air is properly orientated.
Connections	Check the correct torque of all connections and/or busbars. Check that the cables and busbars do not transmit mechanical stress to the bushings.
Grounding	Make sure the transformer is properly grounded.

8.1.3 Transformer with conservator (radiator tank)

COMPONENT	DESCRIPTION OF CHECK
Radiators	Check that the radiator-tank shut-off valves are open. The breather and drain valves must be closed. Check that there are no oil leaks after installation.
Buchholz Relay	Check that the Buchholz Relay shut-off valves are open.
Dryer	Check that the dryer is properly installed
Tap changer switch	Check that the voltage tap changer switch is in the correct position before energizing the transformer.
Auxiliary circuits and installed accessories	Check the correct operation of the auxiliary instruments installed on the transformer, checking that the protections are correctly activated. See the transformer auxiliary circuit diagram.
Fans (if present)	Set the fan control selector in the electrical cabinet to “manual” mode and enable all fans. Check that the flow of air is properly orientated.
Connections	Check the correct torque of all connections and/or busbars. Check that the cables and busbars do not transmit mechanical stress to the bushings.
Grounding	Make sure the transformer is properly grounded.

8.1.4 Transformer with conservator (cooling with oil/water exchanger)

COMPONENT	DESCRIPTION OF CHECK
Buchholz Relay	Check that the Buchholz Relay shut-off valves (if present) in the tank-main conservator connection are open
Dryer	Check that the dryer is properly installed
Tap changer switch	Check that the voltage tap changer switch is in the requested position before energizing the transformer.
Auxiliary circuits and installed accessories	Check the correct operation of the auxiliary instruments installed on the transformer, checking that the protections are correctly activated. See the transformer auxiliary circuit diagram.
Connections	Check the correct torque of all connections and/or busbars. Check that the cables and busbars do not transmit mechanical stress to the bushings.
Grounding	Make sure the transformer is properly grounded.
COOLING SYSTEM OIL SIDE	
COMPONENT	DESCRIPTION OF CHECK
Check the operation of each cooling unit	Check the opening of all shut-off components in the hydraulic circuit (gate valves, butterfly valves). Check the correct direction of the oil flow using a suitable indicator.
Oil flow indicator	On start-up, check the following: - the correct direction of the oil circulating pumps - the flow of oil highlighted by the indicator. - the operation of the electrical contacts of the indicator itself
COOLING SYSTEM WATER SIDE	
COMPONENT	DESCRIPTION OF CHECK
Check the operation of each cooling unit	Check the opening of all shut-off components in the hydraulic circuit (gate valves, butterfly valves). Check the correct flow rate and direction of the flow of water.

8.2 Criteria for parallel connection with another transformer

If a parallel connection must be made with another transformer already in operation:

- Check the compatibility of the data on the transformer rating plates
 - The transformers must have the same phase displacement and must be properly connected respecting the phase sequence and correct polarity.
 - The transformers must have the same transformation ratio within the allowed tolerances. ($\pm 0.5\%$) they must be connected to the corresponding outlet at the same voltage
 - The transformers must have the same short-circuit impedance as a percentage of the allowed tolerances ($\pm 5\%$). Secondly, the ratios between the inductive and resistive part ($x\%/r\%$) must also be checked. The values must be within $\pm 5\%$
 - The power of transformers to connect in parallel must never exceed the ratio between 0.5 and 2 (half or double the power)
- Use a voltmeter to check the correspondence of the phases by measuring the voltage between phase “one” of the transformer already in operation and phase “one” of the transformer to be connected in parallel. The value should be zero.
- Check the closure of the measuring circuit
- Connect the transformers respecting the polarity and phase sequence

Do the same for phase 2 and phase 3.

Complete the commissioning of the transformer by closing the LV switch and energizing the electrical cabinet.

8.3 Location of instructions

The manual is supplied with the equipment. The User is responsible for storing it in such a way as to preserve its condition. The manual must also be available to all professional figures involved in the transportation, installation, commissioning, operation, maintenance and disposal of the transformer.

If the manual is lost, damaged or destroyed, request another copy from the Manufacturer.

9 Maintenance and periodic inspections

9.1 Safety precautions



CAUTION

ALL the following operations must be carried out with the transformer disconnected from the NETWORK and properly GROUNDED IN ACCORDANCE WITH SAFETY DIRECTIVES (DE-ENERGIZED electrical works)!

THE OPERATIONS MUST BE CARRIED OUT by qualified technicians with good knowledge of both electrical systems and safety regulations.

It is mandatory to wear personal protective equipment and to ensure prohibition signs are obeyed by any third parties.

9.2 Routine annual maintenance

INSPECTION OF OUTER PART	
COMPONENT	DESCRIPTION OF CHECK
Winding temperature indicator (thermal image)	Visual inspection: check whether the outer part of the equipment presents any damage.
Oil temperature indicator	
Oil level indicator	Visually inspect the dial on the instrument to check the correspondence of the levels with the indicated temperature: Minimum level: the dial is consistently red Maximum level: the dial is consistently white Intermediate indications between MAX and MIN: the dial will be part one colour and part the other colour. The fill level indicated must be in relation to the temperature indicated by the thermometer on board the machine (if present).
Pressure relief valve	Visually inspect the instrument.
Silica-gel salt dryer	Check the colour of the salts: the drying pearls should be orange, otherwise regenerate the salts. Check that there is oil in the plastic container underneath.

INSPECTION OF OUTER PART AND OPERATING TEST	
COMPONENT	DESCRIPTION OF CHECK
Electrical cabinet	Visual inspection of installed devices, check: the seal of the protective casing against water infiltrations, the correct operation of the electrical heater (if present).
Auxiliary circuits	Check the correct operation of the accessories installed on board the transformer by testing the operation of the electrical contacts (see the transformer auxiliary circuit diagram).
No-load voltage switch	It is important to make 2-3 full strokes of the switch (<u>WITH THE TRANSFORMER DISCONNECTED FROM THE NETWORK</u>).
LV and HV bushings	Porcelain bushings → clean the surfaces in porcelain using a cloth dampened in some alcohol (do not use solvents). Pin bushings → no particular cleaning is required; blow compressed air if necessary and check the condition of the rubber parts.
Fans	Visual inspection. Before performing any operations on the fans, make sure the protections against accidental contact are installed. Maintenance operations can only be performed after having disconnected the fan from the power supply. Keep the air supply and ejection ducts clean. Ensure the absence of vibrations. Check that the impeller is not subject to strain that might compromise its use. Checking the correct absorption of the fan may also help in this regard. Do not use aggressive or solvent-based detergents for cleaning.

9.3 Special maintenance

To be carried out every two years

INSPECTION OF OUTER PART AND OPERATING TEST	
COMPONENT	DESCRIPTION OF CHECK
Transformer	Check for the absence of oil leaks from all joints.
Coatings	Check the surface coatings; in the presence of rust, perform routine maintenance in order to eliminate the corroded parts.
Insulating oil (mineral-ester)*	Check the dielectric strength: take a sample of oil from the sampling valve on the bottom of the transformer tank (see oil sampling procedure); then proceed to measure in accordance with the provisions of standards IEC 60422: Insulation class HV <72.5 kV dielectric strength >55 kV
Insulation oil (silicone)*	Check the dielectric strength: take a sample of oil from the sampling valve on the bottom of the transformer tank (see oil sampling procedure para. 7 and assembly drawing ref. Section 2); then proceed to measure in accordance with the provisions of standards IEC 60156: Insulation class <72.5 kV dielectric strength 40 kV

*NOT APPLICABLE TO HERMETIC TYPE TRANSFORMERS



NEVER tamper with any type of opening cap, in particular for hermetic transformers, until the transformer has returned to ambient temperature and has been disconnected from the network.

High temperatures may give rise to overpressure; there is a risk of being struck by spurts of hot insulating liquid.



IMPORTANT

Oil is a dangerous material: it must be handled and eventually disposed of in strict compliance with environmental safety standards!

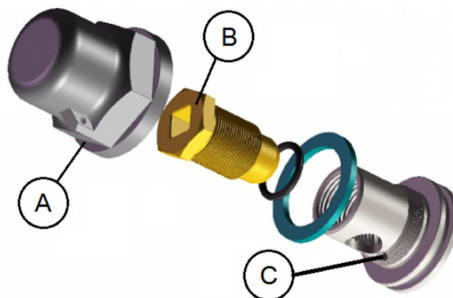
Always refer to the oil safety data sheet.

9.4 Oil sampling

To take a sample of oil to carry out a dielectric strength test, follow the procedure below (caution, not applicable to hermetic type transformers).

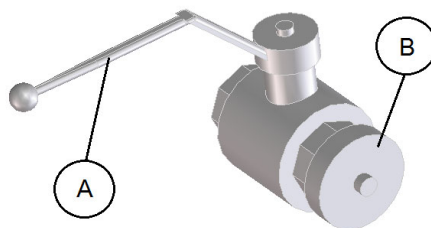
Use the valve normally positioned on the lower part of the transformer.

-Option 1 - VALVE DIN42551



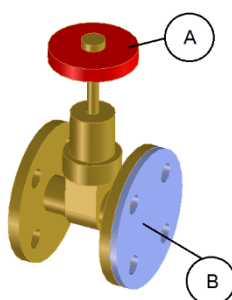
Remove the protective cap A, slowly loosen screw B until the oil starts to flow out of hole C

- Option 2 - BALL VALVE



Remove the protective cap B, slowly operate lever A until the oil starts to flow out.

- Option 3 - GATE VALVE



Remove the blind flange B, slowly operate knob A until the oil starts to flow out.

Empty about half a litre of oil and collect it in a **clean tank**, thus making it possible to re-insert the oil back into the transformer from the filling cap.

Empty another litre of oil, **the test sample**, collecting it in a second clean and dry container, which must be subsequently sealed.

If the dielectric strength is unsatisfactory, the oil must be treated; perform the treatment operations in accordance with the standard of the supplier of the service, or contact the SEA client service centre.

10 Operating conditions

- Operating in safe conditions

Once installed, the transformer operates continuously without the need for supervision by the operator. When malfunctions occur on the upstream systems (high voltage) or downstream systems (low voltage), request the intervention of electrical maintenance staff to place the equipment in safe conditions.

Transformer energizing and de-energizing operations occur using the switchgear located in the medium and low voltage cabinets, which must be developed in compliance with Legislation in force in the country of installation.

- Operating in exceptional conditions

The transformer is designed and developed according to the contractual specifications agreed upon with the Client, in compliance with the guidelines set out by standard IEC 60076-7.

Eventual operation in conditions different to the rated conditions shall cause the early termination of the transformer's service life.



The user of the transformer is responsible for monitoring the operation of the equipment to determine the end of the transformer's service life. SEA S.p.A. shall not be held liable in the event of accidents resulting from the operation of a transformer beyond the end of its service life.

- Signs to observe

The following protection accessories may be installed on the transformer:

- Oil temperature thermometer;
- RIS or DGPT2 or DMCR;
- Oil level;
- Thermal image;
- Pressure relief valve;
- Buchholz;

For an explanation of the situation indicated by the above-mentioned instrument, see the following chapter.

11 Troubleshooting guide

COMPONENT	POSSIBLE FAULTS	SOLUTION
Oil level indicator	Oil level too low	Correct the oil level in accordance with the filling procedure.
	Oil level too high	Check that there are no oil leaks.
Dryer	The drying pearls are colourless	Dry the drying pearls in the oven at a temperature of 130°C-140°C. After drying the colour of the salts should return to the original one, orange; in this case the product can be reused.
Connection of bushings	Corrosion phenomena	Clean the connections with metallic brushes and apply grease for the electrical contacts.
	Blackening of the connection	Check the correct tightening of the bolts; operate in accordance with the instructions in the tables of the manual.
Porcelain of bushings	Dust deposits	Clean the porcelain surfaces using a cloth dampened in some alcohol (do not use solvents).
	Surface damage	Have the type of damage assessed in order to confirm the correct operation of the transformer or the need to replace the feed-through connection. This assessment must be shared with the manufacturer; for this scope, it is recommended to contact the SEA client service centre.
Grounding connection	Corrosion	Clean the connections with metallic brushes and eventually facilitate contact using specific products for electrical contacts.
	Untimely interventions by ground protections	Check the correct tightening of the connection bolts.
No-load tap changer switch	- The shunt won't move - Switching doesn't take place.	Clean the shunt properly using a releasing agent, then try the manoeuvre again. If switching doesn't take place despite the correct execution of the manoeuvre, contact the SEA client service centre.

COMPONENT	POSSIBLE FAULTS	SOLUTION
Buchholz Relay	Lowering of oil level and therefore of the float with consequent activation of alarm switch	CAUTION: the Buchholz Relay may trip due to a fault that can easily be solved, but also due to an important failure of the transformer. It is recommended to contact the SEA client service centre
Oil temperature indicator and winding temperature indicator	Incorrect reading Untimely intervention of protections	Follow the use and maintenance instructions of the manufacturer of the equipment both to record the reading of the values and to regulate the operation of the contacts.
Pressure relief valve	Valve intervention Untimely signalling of contacts.	The valve is equipped with an optical signal to indicate the open condition. If the instrument intervenes, contact the SEA S.p.A. technical service centre. The intervention of the protections without the valve opening may be due to the infiltration of water inside the terminal block of the contacts. Open and clean the terminal block.
Cooling system OFWF	- Leakage from oil/water circuit sealing joints	Check the correct tightness of the joints.
	- Malfunction of oil pump	If faults are found in the circulating pump, check the use and maintenance manual of the pump itself and contact the SEA S.p.A. client service centre if necessary.
	Oil flow indicator: The minimum contact trips	Incorrect electrical power supply of pump Circulator not properly filled with oil (presence of air bubbles). Gate valves in cooling unit closed.
	Oil flow indicator: The maximum contact trips	Take action to reduce oil flow.
Radiators	Broken radiator element	Close the lower and upper gate valves of the compromised radiator and replace them.

COMPONENT	POSSIBLE FAULTS	SOLUTION
	Leakage from tank-radiator joints	In case of oil leaks that cannot be resolved directly on-site, contact the SEA S.p.A. client service centre.
Transformer	Excessive noise	Check that the supply voltage complies with the data on the rating plate.
Gaskets	Oil leaks from various gaskets.	Replacing any of the gasket seals requires a dedicated procedure. Replacing some of the gasket components is a complex operation; in this case, it is necessary to contact the SEA client service centre to agree on replacement. If the gasket in question is of secondary importance, SEA may agree to send through the procedure for the operation.
Overcurrent protections during commissioning*	High starting current	Use the tripping curve of the protections to determine the best calibration for commissioning.

* Protections may trip during connection for many different reasons. Check that there are no other problems (short circuits, etc.) before performing additional start-up attempts in order to preserve the integrity of the transformer for as long as possible.

12 Decommissioning and disposal



IMPORTANT

At the end of their service life, transformers must be disposed of in accordance with applicable national laws in force in the country where the equipment is installed.

It is mandatory to comply with the environmental legislation of the transformer's destination country.

SEA S.p.A. denies all liability for incorrect disposal.

For illustrative purposes, and remembering that the producer of the waste is responsible for attributing the identification codes, following is a list of possible EWC codes indicating which are recyclable "R" and which are non-recyclable "D".

Oil distribution transformers

Main component	Waste	EWC code	Type of disposal	% of incidence
Windings	Conductors	120199	R	26.424%
	Bushings	150203	R	1.773%
Total Windings				28.197%
Core	Reinforcements	120199	R	2.356%
	Bushings	150203	R	0.068%
	Magnetic plate	120199	R	36.544%
Total Core				38.968%
Transformer	Accessories	120199	R	0.379%
		160214	R	0.124%
	Carpentry	120199	R	10.306%
	Conductors	120199	R	0.459%
	Connectors	120199	R	0.046%
	Bushings	160216	R	0.803%
	Mineral oil	130307	R	20.717%
Total Transformer				32.834%

13 FAQ - Frequently Asked Questions

Is it normal for the transformer to heat up?

Yes, during normal load and no-load operation, the transformer produces heat due to the losses generated in the windings and in the core.

It is important to always check that the installation environment has the necessary ventilation characteristics for the installation of the transformer.

Is it important to know the ambient temperature where the transformer will be installed?

Yes, it is essential because it directly impacts on the heat exchange between the transformer and the surrounding environment. This information is essential for the design stage, and unless otherwise specified, the ambient temperature must never exceed the following limits:

-40°C at any time

-30°C monthly average of the hottest month

-20°C yearly average

and must not be less than:

-25°C

Is it normal for the transformer to make a buzzing sound?

Yes, during normal operation the transformer emits a buzzing sound due to the vibration of the plates constituting the magnetic core.

If the noise is too high, check:

- Check that the transformer is not working in overexcitation.
 - a) Using a measure, check that the voltage of an untapped winding has a maximum deviation of $\pm 2.5\%$.
 - b) If the deviation is higher, reduce the system voltage or adjust the transformer switch taps.

How do I dissipate the heat generated by the transformer?

To guarantee best transformer conditions, the installation site must be properly ventilated. For more information regarding natural or forced ventilation, see the use and maintenance manual (see para. 7.4)

Can I use the rebars in corrugated tanks for anchorage during transport and to secure the transformer?

Absolutely not. The rebars are welded into the corners of the corrugations, anchoring them would cause the inevitable breakage of the weld with subsequent leakage of oil from the tank.

Can I use rigid connections for the LV connections?

It is strongly advised against insofar as a rigid connection with barring between the busway and LV bushing may cause future oil leaks at the base of the bushing. It is absolutely recommended to use flexible ribbon or braids to make the last connection between the busway and the LV bushing.

In case of a cable connection on the LV side, the cables must be supported in such a way as not to transmit mechanical stress to the bushings, which would result in oil leaks.

And what about MV connections?

Likewise, the cables must be supported so as not to exert mechanical stress on the bushing, pay particular attention to the bend radius of the cable (in the cable manufacturer's data sheet).

Is it possible to energize the transformer and give it a full load at low temperatures?

Yes, it can be energized at low temperatures, in any case the transformer must be gradually loaded so that the oil has time to warm up, becoming less viscous and thus allowing the best oil/winding heat exchange.

Is it possible to mix different types of oil?

Absolutely NOT, this may cause the formation of foam and/or alter the properties of the oil.

If necessary, contact the SEA client service centre for information about the type of oil in your transformer and its miscibility with other oils.

Can I draw oil samples from hermetic transformers?

No, avoid opening any supply or discharge device in the transformer tank, including the valves on any accessories/instruments to avoid the risk of compromising the hermetic properties of the transformer.

What do I do if the RIS/DGPT2/DMCR oil level drops?

Immediately contact the SEA client service centre, which will evaluate the situation and if necessary send the procedure to restore the oil level and hermetic properties of the transformer.



14 How to contact us

For all doubts, clarifications or additional information regarding our products, contact our Sales Department or Technical Service Centre. The contact details are:

Tel.:	+39 0444 482100
Fax.:	+39 0444 482519
Address:	Via L. Da Vinci, 14 - Tezze di Arzignano – VI - (ITALY)
Email:	info@seatrasformatori.it
Assistance:	support@seatrasformatori.it
Website:	http://www.seatrasformatori.it



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