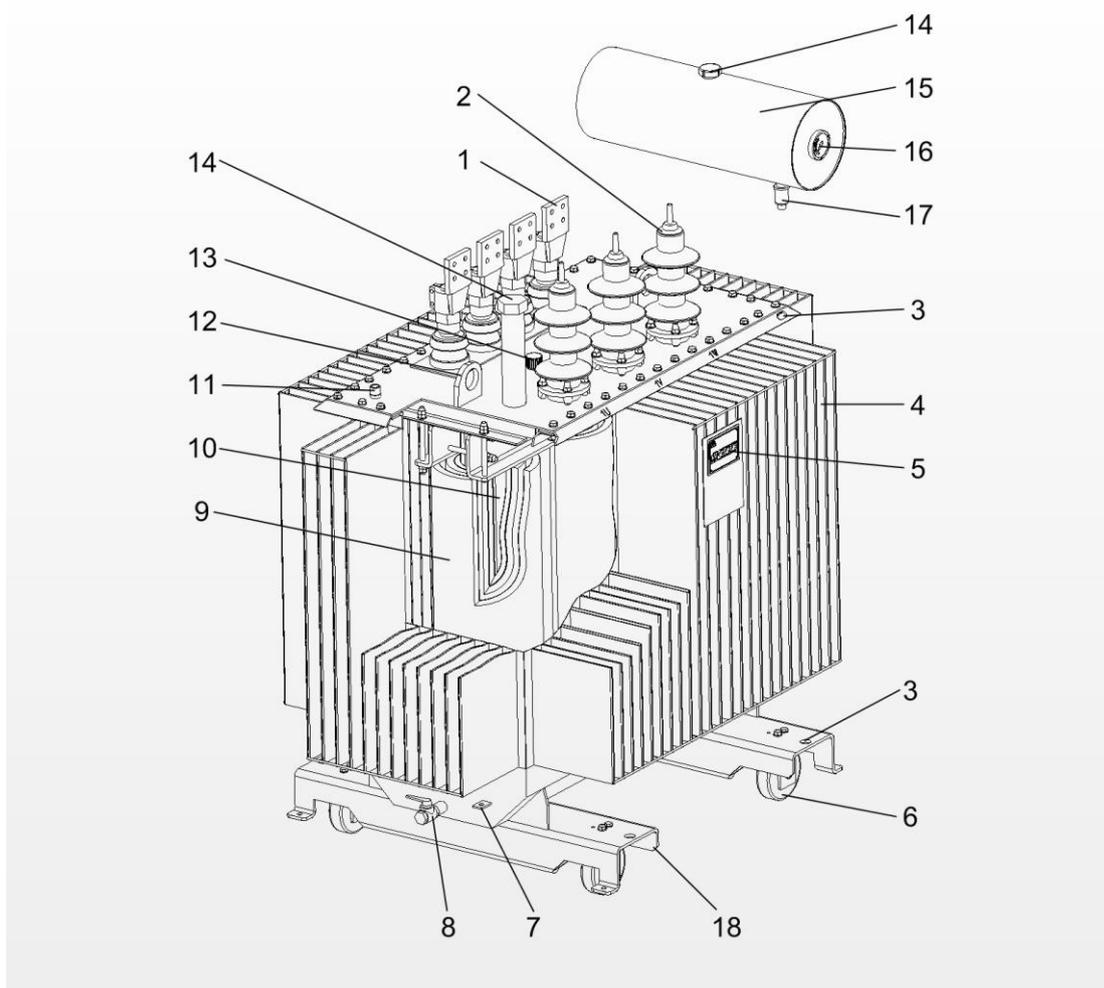


# Oil-immersed Transformers



## Manual for Installation, Operation and Maintenance

## Technical Characteristics



### Standard Accessories

1. Low Voltage insulators
2. Middle Voltage insulators
3. Movement eyebolts
4. Wings or radiators for heat dissipation
5. Electrical characteristics plate
6. Wheels directable at right angles
7. Earth terminals
8. Oil discharge and extraction valve
9. Windings
10. Magnetic core
11. Thermometer well
12. Lifting eyebolts
13. Regulation tapping
14. Filling tap
15. Conservator (if not hermetic)
16. Oil level indicator (if not hermetic)
17. Silica gel connection (if not hermetic)
18. Truck

### Accessories available upon request

- Thermometer with two electric contacts
- Buchholz relay
- DGPT2 or RIS (if airtight)
- Antiburst valve
- Elastimold connections

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## PART I - INTRODUCTION

### 1.1 Introduction

The oil immersed transformer is a machine that does not need many installation and starting checks but the checks that have to be carried out are important because of machine production characteristics; periodic checks and maintenance are just as important.

There are two different types of oil immersed transformer:

- hermetically sealed
- with conservator

Some accessories described in this manual may not be present on your transformer. Always consult the technical documentation (you should have a copy) and/or the delivery note to check the list of accessories that are present.

### 1.2 Reference norms

- IEC 60076 Standard      Power transformers
- IEC 61378 Standard      Converter transformers

## PART II - INSTALLATION

### 2.1 Transport

The transformer must be transported vertically. Make sure that it was not damaged during transport as soon as it reaches its destination. Inform the shipping agent of any damages and also of any problems or complaints.

Unless otherwise agreed, the oil immersed transformer is supplied without any external protection and is solidly fixed to the transport lorry by belts. The wheels are fixed to the towing dolly in the safety position.

For special transportation needs, or if explicitly specified and agreed upon when ordering, the transformer is supplied with airtight packaging (for example if being transported by sea) or in wooden crates (for simple anti-knock protection).

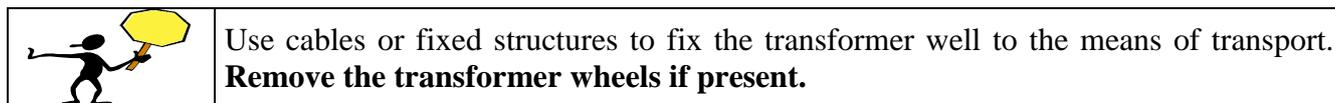
### 2.2 Moving

Each transformer has:

- 4 wheels or slides for moving;
- hitches;
- 2 (or 4) eyebolts for lifting.

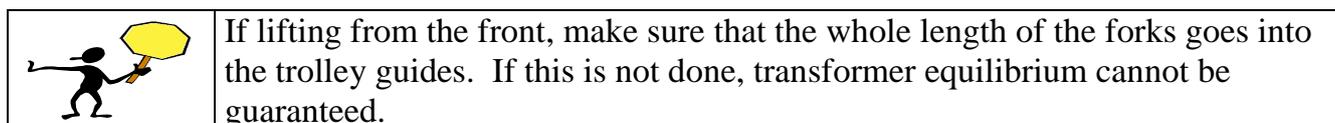
Small movements can be made with a suitable hydraulic jack, placing them against the cross members of the towing dolly. IT IS FORBIDDEN to lever the crate, the fins and all the other transformer accessories.

If lifting with cords choose the correct cord width to be used, keeping in mind that the same number of cords should be used as there are eyebolts, and that the angle between the cord vertexes should never exceed 60°.



To move with the wheels:

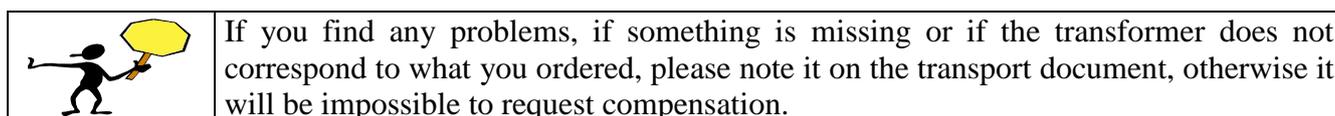
- position the wheels in the correct direction;
- use the trolley crossbeams to push or pull the transformer. You can also use the tow eyebolts under the lid to move it;
- never use the other parts of the crate or the accessories to push and/or pull the transformer.



### **2.3 Receiving and storing**

When you receive the transformer, please make sure that:

- the packaging (if present) has not been damaged;
- there are no surface signs;
- the crate or the dissipation elements (fins or radiators) have not been damaged or misshapen;
- there are no oil leaks;
- all accessories are present;
- etc...



For more speed, we advise you to take photos of the problem and send them, complete with your complaint, to our Sales Office:

Unitrafo Electric AB  
 Askims Industriväg 1A  
 SE-436 34 ASKIM  
 SWEDEN  
 Tel +46-31-68 56 20  
 Fax +46-31-68 58 11  
 e-mail: [info@unitrafo.se](mailto:info@unitrafo.se)

If the transformer is not used immediately it can be stored for short periods, even outdoors. If storing over long periods, place the machine in a closed, clean area with a temperature of between -25°C and 40°C.

The containers of transformers with expanding container must be mounted. The expansion

container should then be filled a little more than normal (from 20°C up to around half of its height) so that it never remains completely empty even at low temperatures. If there is an air drier, mount it and periodically check the state of the salts (blue = efficient salt). Remove the excess oil before starting the transformer.

## **2.4 Installation**



The transformer must be installed by **specialist technicians as indicated by law and in respect of safety.**

The transformer must be installed so that the cooling surfaces are well covered by air currents. Keep a minimum distance of 30 cm between the cooling surfaces and the cell walls, and 50 cm between nearby transformers. The cabin must allow air to circulate at 4-5 m<sup>3</sup>/min for every KW of loss. If the air circulation is not strong enough, the transformer can suffer. An environment where the following limits are not exceeded is normal:

- minimum temperature -25°C;
- average yearly temperature 20°C;
- average daily temperature 30°C;
- maximum temperature 40°C.

When required, the transformer can be designed for temperatures other than those mentioned above. In those cases it will be stated in our specification belonging to your order.

## **2.5 Positioning the transformer**

The transformer is usually equipped with a dolly with wheels that move at right angles. To make moving easier, we recommend positioning sliding tracks that make positioning easier and avoid any machine movement.

Current regulations make it obligatory to construct collecting wells or other things that stop the flaming oil from flooding outside the cabins or the enclosure for transformers with more than 500 kg of oil. An oil collection tank is also necessary when there is a machine that holds the quantity of oil indicated by law, when the spaces for collecting more than one machine are prepared, and also when a first transformer with a power that does not contain 500 kg of oil is being used.

## **2.6 Electric connections: MT, BT and Earthing**

All the powered parts of the transformer must respect the correct insulation distances as indicated in the table below (Table 1).

The connections should be well fixed so that the weight of the cables or short circuit resistance does not stress the insulators for no reason.

Each transformer has 2 pins or plates for earthing on its sides, to connect the transformer efficiently to the earthing system.

All dimensional and descriptive information is indicated in the transformer layout drawing, which is provided with the final inspection certificate.

Connect all the signalling and protection devices using flexible copper wire with a minimum section of 1.5 mm<sup>2</sup>. If power circuits are being used (fans, TA, etc.) check the absorption and then the capacity of the connections.

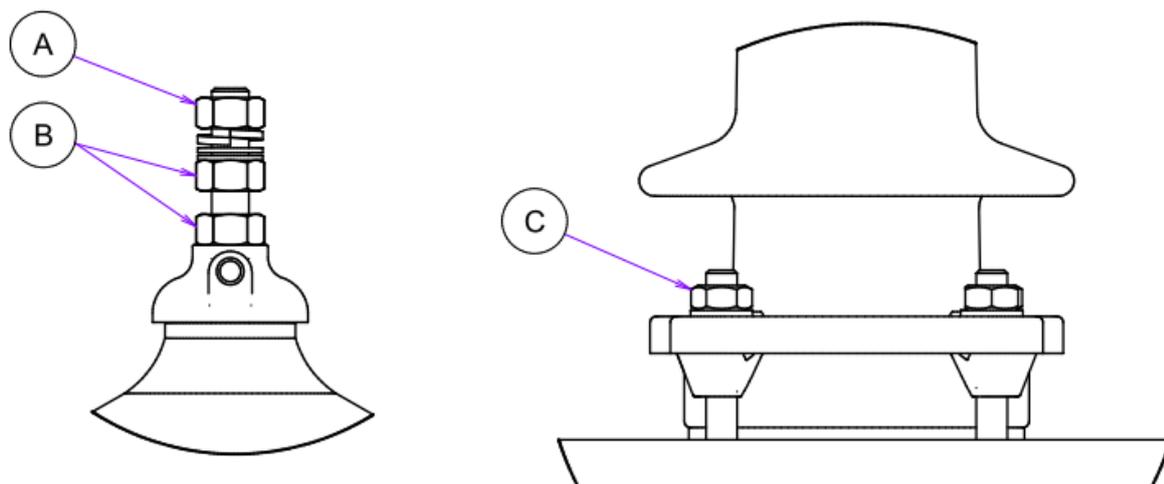
**Table 1**

MAX. INSULATING VOLTAGE	INSULATION VOLTAGE (KV)	NOMINAL VOLTAGE AT ATMOSPHERIC IMPULSES PEAK VALUE (KV)	INSULATION DISTANCE (mm)
<1,1	3	-	-
3,6	10	20	60
	10	40	60
7,2	20	60	90
	20	75	120
12	28	75	120
	28	95	160
	28	110	200
17,5	38	95	160
	38	125	220
24	50	125	220
	50	145	270
	50	150	280
36	70	170	320
	70	200	380
52	95	250	480

The tightening torques for the nuts and bolts are given below:

**Table 2**

NUTS AND BOLTS	M6	M8	M10	M12	M14	M16	M20	M24	M30	M42	M48	M55
BUSHING TYPE				250A			630A		1250A	2000A	3150A	4000A
TORQUE	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm
METAL CONNECTIONS ON FLAGS [A]	4	8	15	30	40	50	80	100				
FIXINGS BOLTS [B]	4	8	15	30	40	70	130	160				
TIGHTENING BOLTS [C]				13			30		60	100	145	155
DGPT2/RIS		13										



**NOTE:** If the oil immersed transformer has Middle Voltage insulators with plug connection, the following information is needed when purchasing the mobile section:

- cable section
- diameter on primary insulator
- external cable diameter
- 

### **2.7 Working in parallel**

Two or more transformers can only work correctly in parallel if the following requirements are satisfied:

- Identical transformation ratio with a tolerance of 0.2%, maximum 0.5%;
- Equal short circuit voltage with 10% tolerance;
- Same vector group;
- The torque between the powers must not exceed three (if different).

Before closing the parallel on the secondary bars you must carry out a parallel test. To do this, create an electric union bridge between the secondaries and the transformers, which makes it possible to compare the phase voltages. It is a good idea to electrically connect the neutral also. Use a voltmeter to measure the existing potential between the corresponding phases. If the value is constantly zero, it means that all the parallel conditions have been satisfied and the Low Voltage switches can be closed.

**GBE S.p.A. cannot be held responsible for any damage caused by incorrect transformer connection.**

## **PART III - STARTING**

### **3.1 Visual checks**

The oil immersed transformer should be checked visually and externally before starting.

The oil immersed transformer has an active part (nucleus with windings) inside a tank filled with oil. If the tank has been knocked or moved incorrectly there could be leaks or sweating. In this case, to make sure the transformer is working correctly and to avoid unpleasant environmental problems, please contact our Technical Department to decide if it is better to intervene on-site or to repair the transformer in our plant.

### **3.2 Electric and mechanical checks**

A list of the most important checks is given below. As already indicated, the transformer must be started by specialist technicians.

- Make sure that the system characteristics correspond to those on the transformer plate;
- Make sure that all the middle and low voltage wires, and the intervention and earthing circuit wires are correctly positioned and moored;
- Make sure that one of the two extremities of the middle voltage cable screening is earthed;
- Make sure that the transformer secondary, if with neutral, has the same earthing directly in the cabin;
- Make sure that the bolts are tightened with suitable tightening torque (see Table 2);
- Make sure that the transformer accessories are correctly positioned and wired for correct operation.

### **3.3 Working temperature**

The oil immersed transformer is made with class A insulating material that stands up to a maximum working temperature of 105°C. We recommend the working temperatures given below.

Insulation material class	Alarm Temperature	Trip temperature
A	100°C	105°C

### 3.4 General indications for the main accessories

#### Dial thermometer

This instrument shows the temperature of the oil at the hottest point. The thermometer has a bulb sensor that should be inserted in a sump and fixed with a ring nut. To measure the temperature correctly, the sump must be completely filled with oil. If the thermometer has contacts, refer to the previous paragraph for setting the release temperature.

#### Commutator for regulating the voltage

The transformer is normally equipped with a 3 or 5 step commutator to regulate the voltage to the secondary when it is different from the value that is required.

The positions are normally marked +, 0, - or ++, +, 0, -, -- and indicate in order from maximum to minimum voltage passing by the nominal. The markings can be numbers as well as symbols; with numbers, 1 corresponds to maximum voltage.

Commutation occurs at the primary and acts as indicated:

- Commutator towards +: the BT lowers;
- Commutator towards -: the BT rises.

The modification must be made **exclusively when the transformer is not working**, and without current.

To change the position of the commutator:

- Unscrew the protection block “A” (normally a red plastic hood)
- Lift handle “B” and rotate it in the required direction
- Lower the handle to its original position and tighten the protection.



**Note:** Do not take the commutator towards “-“ if the mains voltage is greater than the nominal voltage. This variation increases the noise and increases losses in the transformer iron.

#### Primary Voltage exchange selector

If the transformer has more than one primary voltage (for example: 10-15 KV, 10-20 KV, 15-20 KV), the voltage can be changed using the selector on the lid, which is together with the handle for regulating the voltage. The voltage can be changed following the instructions given for voltage regulation.

#### Spark gaps

These are electrical protections for the transformer and work like surge arresters. For them to work correctly, the distances according to the insulation class of the transformer (see Table 1) must be guaranteed.

- **NOT provided on hermetically sealed transformers**

**Oil level:** These are mounted on the conservator and give the level of oil present. The oil expands according to how much it is heated, and so the needle moves. At room temperature and with the machine not working, the index must be positioned at a temperature that is almost equal to the room temperature. The dial must always be in the white area. If it moves into the red area, add oil. For indications on the type of oil to use, consult our Technical Department.

**Silica gel:** These are salts inside a unit mounted on the conservator. The salts hold air humidity in non-airtight tanks. If the salt is blue, it is working correctly. If it is not blue, it must be oven-dried at approx. 120-150°C until it returns to its original colour or replace it.

**Buchholz relay:** There are two types of Buchholz relay: vertical or passing. The choice of relay generally depends on the power of the transformer. The relay is also a control instrument and it checks if the transformer is working well or not. It can be equipped with electrical contacts for connection and external checks. The Buchholz relay must be completely full of oil, and if it is not it should be bled using the screw on the top of the relay.

- **Hermetically sealed transformers**

**Thermometer and Pressure Relay:** These instruments monitor the transformer temperature and operation and have contacts for alarm and trip.

**Important note:** Do NOT open any airtight tap on the transformer. Opening any valve or tap causes the loss of transformer airtightness which annuls the warranty. If one of these taps or valves has been opened by mistake, you must consult our Technical Department.

### **3.5 Checking the oil after long storage periods**

If the transformer has not been used for more than 6 months, we recommend checking the oil rigidity before starting. Extract the oil from the valve in the lower part of the tank. Remove the protection lid and the sealing tap. Open the tap and allow at least half a litre of oil to flow out before extracting at least one litre of oil as a sample to be checked. Close the oil in a clean, airtight container.

**First Simple Test:** Heat the oil to 120-130°C in a test tube. If you hear a cracking sound or if foam appears, the oil contains water. Treat and dry the oil before starting the transformer.

**Test with Instrument:** The best results are obviously obtained when using oil testing apparatus. With diameter 250 mm spheres with 2.5 mm interspace, the average discharge pressure should be at least 40 KV/mm. Allow the sample to rest for half an hour when carrying out the test.

**NOTE:** Oil must be treated by specialists using a suitable machine. This test can be carried out on site and avoids the formation of greater problems.

## PART IV – OPERATION AND MAINTENANCE

### 4.1 Maintenance

Oil immersed transformer maintenance must be done while the transformer is not working and while it is directly connected to earth. If working in particularly dirty areas and in special charge conditions, we advise increasing the frequency of the interventions.

### 4.2 Periodic interventions

Some routine maintenance operations that may be necessary during the working life of the transformer are given below.

Operation	How often	Description
<b>Oil level check *</b>	Every 6 months	Make sure that the level needle is above the room temperature and in the white area. Contact our Technical Department for indications on the oil to use for topping up.
<b>Silica gel salt check *</b>	Every 6 months	Must be blue. If pink, oven-dry the salts at 120-150°C or change them. Make sure that the transparent capsule under the silica gel is at the correct level.
<b>Insulator cleaning</b>	Every year	If the insulators are porcelain you can clean them using a cloth dampened with alcohol. Make sure that the contact zone of resin insulators is protected by pure Vaseline grease.
<b>Accessory check</b>	Every 2 years	All the transformer accessories must be checked periodically to make sure there are no transformer faults. It is also a good idea to check the contact wiring and the electric connections.
<b>Oil rigidity *</b>	Every 2-3 years	The checked oil must be extracted from the tank lower valve. After having removed the protection cap, allow the first half litre to flow out. After this extract at least one litre of oil as a sample for the tests. Keep the sample in a clean, airtight, and closed container. The extracted oil must guarantee an insulation level of at least 40 KV/mm. If it does not, have the oil treated by specialist technicians.

\* This operations are not applicable on hermetically sealed transformers.

### 4.3 Special maintenance

Special maintenance must be carried out by specialist technicians. For further information, please contact our Technical Department.

### 4.4 Troubleshooting

Some of the most common problems that may arise are given below together with an easy solution. Please remember that our Technical Department is always available whenever help is needed.

<b>Problem</b>	<b>Causes</b>	<b>Solution</b>
Oil thermostat activates	Incorrect thresholds set Excess load Strained current  High room temperature	Check the settings Limit the load Measure the strain and filter the current Ventilate the area
Buchholz relay activates	Residue air in the relay	Bleed the relay several times. If the problem persists, contact our Technical Department
Excessive noise	Supply voltage too high  Rigid connections Mechanical resonance	Regulate the socket commutator Insert fuses Insert anti-vibrators
Protections activate at starting	Insertion current	Increase switch delay

## **PART V - CONCLUSIONS**

### **5.1 Warranty**

The warranty is valid for production defects during the period of time that has been agreed.

	<p>The warranty is limited to replacement or reparation of the unit in our factory in Vicenza, Italy, transports excluded.</p> <p><b>Any type of consequential damages, caused by the breakdown of the transformer, is excluded from the warranty.</b></p>
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### **5.2 Conclusion**

Our Sales Office is available for any information that may be necessary.

We thank you for purchasing our transformer and we guarantee that the information given herein is helpful for using the product well and correctly.