

Oil immersed Transformers

Manual for Installation, Operation & Maintenance



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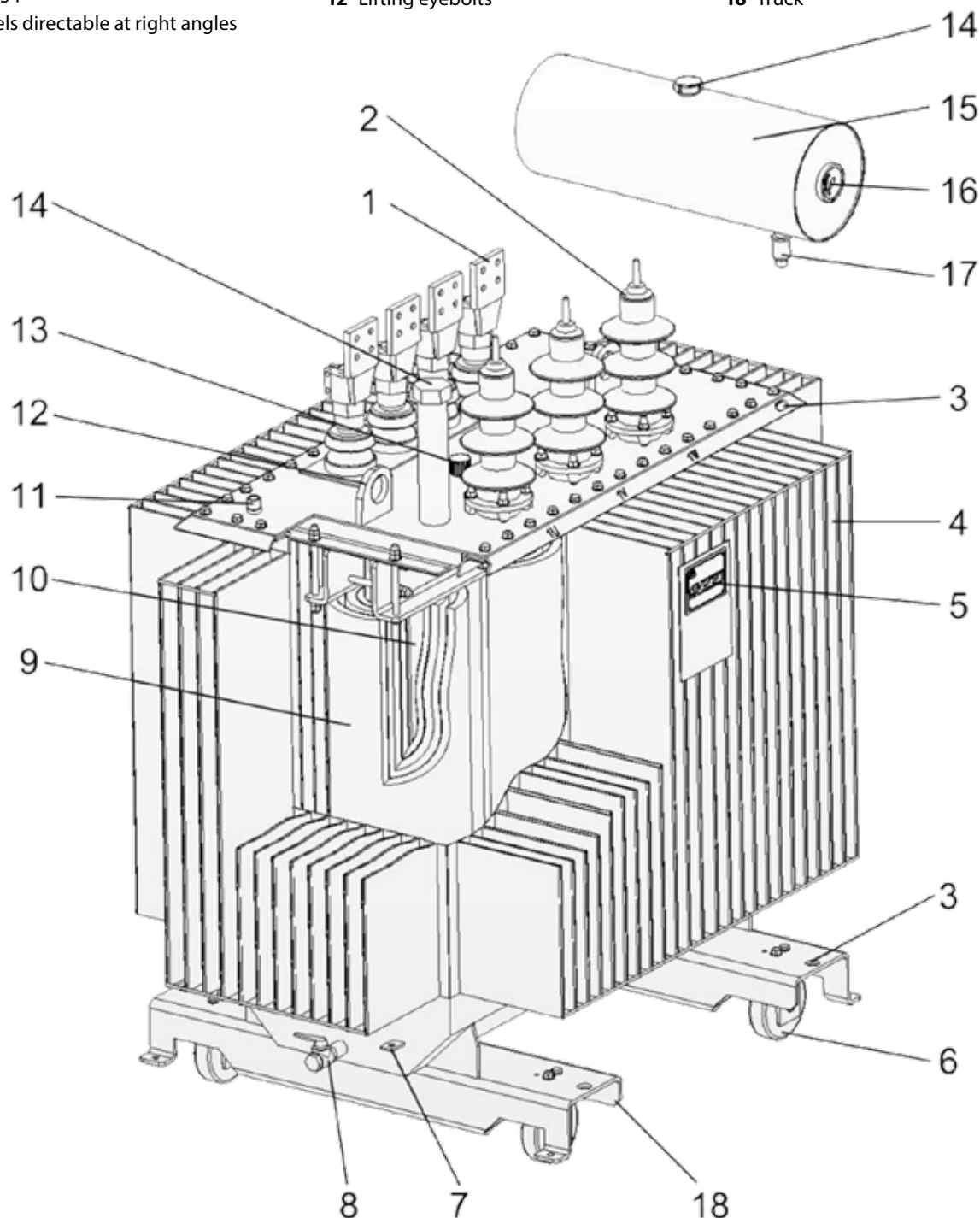
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Oil immersed transformer

- | | | |
|--|-----------------------|--|
| 1 Low Voltage bushings | 7 Earthing terminals | 13 Off-load Tap Changer |
| 2 Medium Voltage bushings | 8 Drain valve | 14 Filling cap / Safety valve |
| 3 Movement eyebolts | 9 Windings | 15 Conservator (if not hermetic) |
| 4 Cooling fins or radiators for heat dissipation | 10 Magnetic core | 16 Oil level indicator (if not hermetic) |
| 5 Rating plate | 11 Thermometer pocket | 17 Silica gel connection (if not hermetic) |
| 6 Wheels directable at right angles | 12 Lifting eyebolts | 18 Truck |

fig 1



Accessories upon Request

- Thermometer with two electric contacts
- Buchholz relay
- DGPT2, DMCR or RIS (if hermetic)
- Antiburst valve
- Elastimold connections
- LV Busbars
- Filter press connections
- Others (see the manufacturer)

I - INTRODUCTION

1.1. INTRODUCTION

The oil immersed transformer is a machine that does not need many installations or 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.

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.

There are two different types of oil immersed transformers:

- hermetically sealed
- free breathing with conservator

1.2. REFERENCE NORMS

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

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 truck in a safe 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).

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(15)



Use cables or fixed structures to fix the transformer well to the means of transport.

In case provided, the wheels should be removed from the transformer during transport.

2.2. LIFTING AND DISPLACEMENT OF THE TRANSFORMERS

Each transformer has:

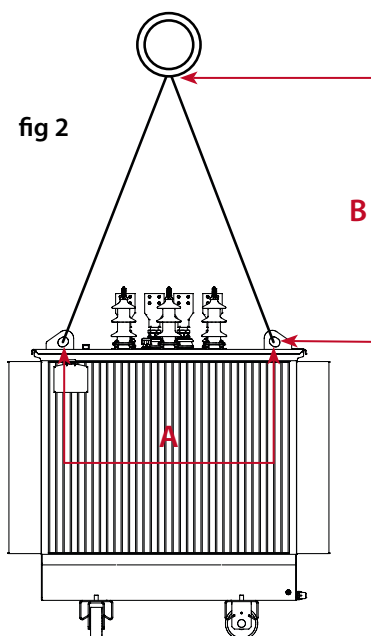
- 4 wheels or slides for moving
- hitches
- 2 (or 4) eyebolts for lifting

Small movements can be made with a suitable hydraulic jack, placing them against the cross members of the towing dolly or on dedicated supports, if provided. **IT IS FORBIDDEN** to lever the tank, 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°.

A suitable length of strap must be used during unloading operations Fig 2B.

Figure 1, clearly illustrates how the height of item B must be larger than the length of item A.



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 tank or the accessories to push and/or pull the transformer.

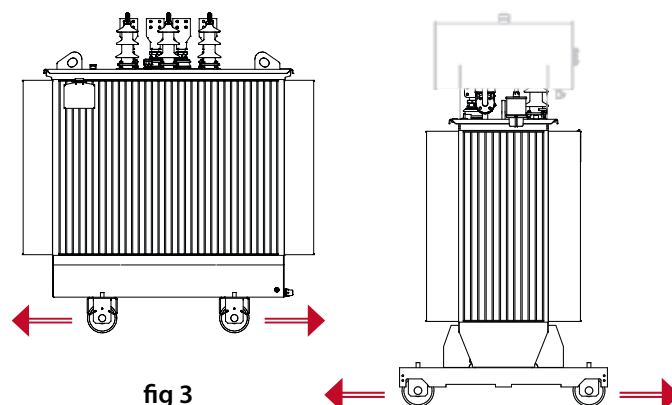


Figure 4 below shows exactly how to use the forklift truck without damaging the transformer.

Before setting up, check that the transformer has not been damaged during transport or storage.

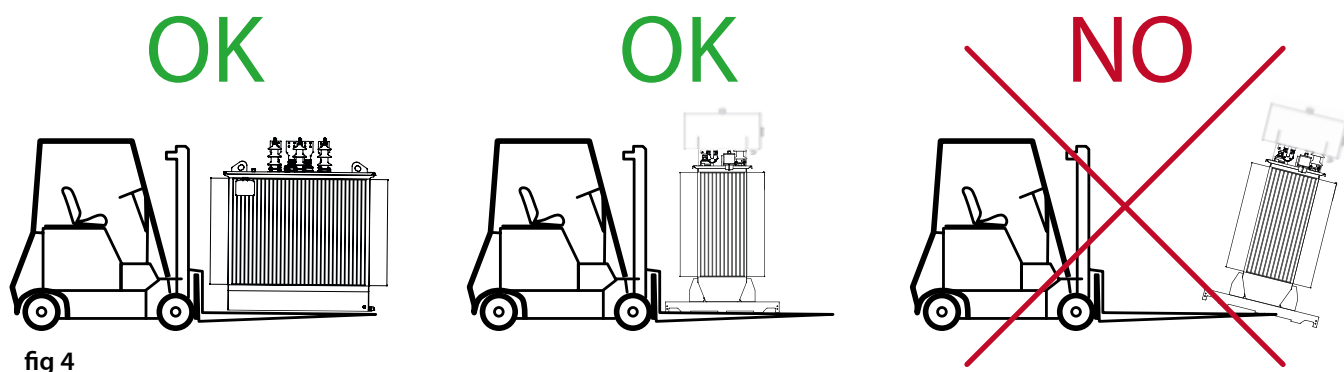


fig 4



Before lifting the transformer make sure that the forklift is correctly inserted under the complete length of the transformer. If not correctly made, the balance of transformer can not be guaranteed.

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 oil leaks
- there are no surface signs
- all accessories are present
- the tank or the dissipation elements (fins or radiators) have not been damaged or deformed
- etc ...



If you find any damages or other problems, make a note of the carrier's name and describe the problem on the consignment note and notify the dealer (Unitrafo Electric AB) immediately! If this is not done, the carrier does not take responsibility for any damage. The damage must also be photo-documented. Contact your dealer (Unitrafo Electric AB) for further instructions.

STORING

If the transformer is not used immediately, it can be stored for short periods, even outdoors. If storing over long periods, place the transformer in a closed, clean area with a temperature of between -25°C and 40°C. If the transformer is not hermetically sealed, the conservator (fig 1 > 14) must be mounted. The conservator 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 m³/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 annual maximum temperature 20°C
- Average highest temperature in the warmest month 30°C
- Highest temperature on occasional occasions 40°C.

If the temperature exceeds any of the specified maximum temperatures, inform Unitrafo immediately.

Where applicable, the transformer may be manufactured for other temperatures than those mentioned above. In that case, this is stated in our specification that belongs to your order.

2.5 POSITIONING THE TRANSFORMER

The transformer is usually equipped with truck 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: MV, LV 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 do not stress the insulators for no reason.

On the LV side, it is important to make sure that the bushing contact surface is clean and treated for a good contact before connecting the busbars or cables.

Each transformer has 2 pins or plates for earthing on its si-

des, 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 mm². If power circuits are being used (fans, TA, etc.) check the absorption and then the capacity of the connections.

Table 1 – Insulation voltage & distance

Max insulation voltage	Insulation Voltage (KV)	Nominal voltage at atmospheric impulses PEAK VALUE (KV)	Insulation distance (mm)
<1,1 kV	3	-	-
3,6 kV	10	20	60
		40	
7,2 kV	20	60	90
		75	120
12 kV	28	75	120
		95	160
		110	200
		125	220
17,5 kV	38	125	220
		145	270
24 kV	50	150	280
		170	320
		200	380
36 kV	70	250	480
52 kV	95		

2.7 MECHANICAL FASTENINGS

The tightening torques for the nuts and bolts are given below in table 2.

Table 2							
Nuts and bolts	Bushing type	Tightening Torque (Nm) [*]					
		Metal connections on flags [A]	Fixing bolts [B]	Tightening bolts [C]	DGPT2	RIS	DMCR
M 6		4 Nm	4 Nm				
M 8		8 Nm	8 Nm		13 Nm	8 Nm	6 Nm
M 10		15 Nm	15 Nm				
M 12	250 A	30 Nm	30 Nm	13 Nm			
M 14		40 Nm	40 Nm				
M 16		50 Nm	70 Nm				
M 20	630 A	80 Nm	130 Nm	30 Nm			
M 24		100 Nm	160 Nm				
M 30	1250 A			60 Nm			
M 42	2000 A			100 Nm			
M 48	3150 A			145 Nm			
M 55	4000 A			155 Nm			

* With torque wrench calibrated in kg, divide the values by 10.

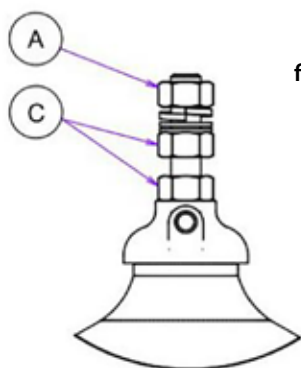
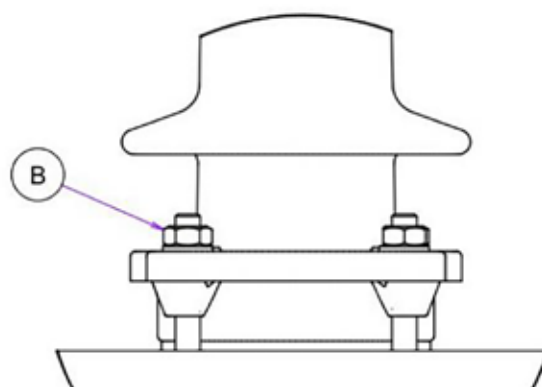


fig 5



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

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

2.8 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 difference between the power of the transformers may not exceed three times (3x) - 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.

Unitrafo cannot be held responsible for any damage caused by incorrect transformer connection.

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.



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

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 medium 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 medium 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.
- Check the insulation between the windings and to ground using a Megger-type megameter;
- Make sure that the transformer is connected to ground in the foreseen points;
- In case the transformer is working in parallel service with other units, the correspondence of phases must be checked by the use of a voltmeter (Remember that, for the choice of voltmeter, in case of parallel error the voltage can be the double of the phase voltage and remember that nominal features shall be the same or compatible. Otherwise, it will be impossible to make the parallel connection.)

3.3 WORKING TEMPERATURE

The oil immersed transformer is made with class A insulating material that stands up to a maximum working temperature of 110°C. We recommend the working temperatures given here.

Insulation material class	Alarm Temperature	Release Temperature
A	100°C	110°C

3.4 GENERAL INDICATIONS FOR THE MAIN ACCESSORIES

DIAL THERMOMETER

This instrument shows the temperature of the oil at the hot-test point. The thermometer has a bulb sensor that should be inserted in a sump and fixed with a ring nut. To meas-

re 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.

VOLTAGE OFF CIRCUIT TAP CHANGER

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

The positions are normally marked with progressive numbers where the highest number corresponds to the highest voltage 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.

Tapping occurs at the primary and acts as indicated:

- Tap Changer towards + the LV lowers;
- Tap Changer towards - the LV rises.

The modification must be made exclusively when the transformer is Off-Circuit, and without current.

To change the position of the Tap Changer:

- lift the knob or the grey pin inside the red handle (fig. 6B)
- turn the knob or the handle to the required position, then set the knob or the pin back to the original position.

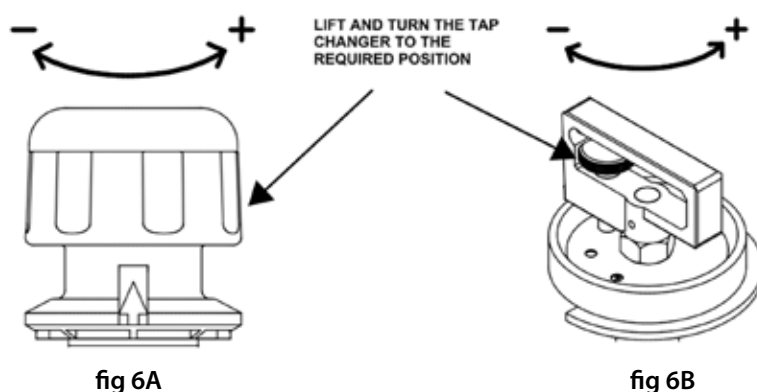


fig 6A

fig 6B



Do not move the Tap Changer towards “-” if the mains voltage is greater than the nominal voltage. This variation increases the noise and the core losses.

PRIMARY VOLTAGE EXCHANGE SELECTOR

If the transformer has more than one primary voltage (for example: 11-22 kV), the voltage can be changed using the selector on the lid, positioned close to the handle for regulating the voltage. In these cases, it is important to carefully read the information on the connection plate. The voltage can be changed following the instructions given for voltage regulation.

As soon as the new connection is made – whether a doubt exists – check through the test below:

- 1 Feed the medium voltage with the low voltage available on site.
- 2 With a manual tester (high precision is not required since the measure to perform is only a few volts) measure the line voltage on the low voltage side.
- 3 Calculate the ratio among the voltages and compare it with the required transformer ratio.

It is obviously well advised to avoid performing test feeding the low voltage side.

SPARK GAPS

These are electrical protections for the transformer and work like surge arresters. For them to work correctly, the dis-

tances according to the insulation class of the transformer (see Table 1 - p.7) must be guaranteed.

SAFETY VALVE

It is a valve usually installed on the lid or at the top of the filling tube. This valve is set at the maximum tank pressure and in case of a higher pressure it will release oil in the quantity needed to avoid the tank to explode. If the valve goes

off, disconnect the transformer and immediately contact our Technical Office. This type of valve can be provided with one electrical contact.

PRESSURE RELAY

It is a pressure sensor which thresholds are set by the manufacturer. In case of an anomalous pressure in the tank, the relay gives an Alarm Signal (first threshold) or Trip Signal

(second threshold). It is highly recommended NOT to change the pre-set thresholds.

3.5 TRANSFORMERS WITH CONSERVATOR

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 po-

sitioned 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.

DEHYDRATING BREATHER

These are salts inside a unit mounted on the conservator. The salts hold air humidity in non-airtight tanks. For a correct working of the unit, make sure that the salts are of the colour indicated on the label. If the salts are not of the

colour on the label it must be oven-dried at approx. 120-150°C until it returns to its original colour or it needs to be replaced. Some models are provided with a small beaker to be filled with oil before commissioning the unit.

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.

3.6 HERMETICALLY SEALED TRANSFORMERS

DGPT2, DMCR OR RIS2

This instrument fully checks the transformer temperature and operation and has electric contacts that signal externally. To work correctly, make sure that the transparent tube of the DMCR, DGPT2 or RIS2 is completely filled with oil. If not, please inform our Technical Department.

on the transformer. Opening any valve or tap causes the loss of transformer airtightness which annuls the guarantee. If one of these taps or valves has been opened by mistake, you must consult our Technical Department.

Important note: Do **NOT** open the breather unit valve on the DMCR, DGPT2 or RIS devices, or any other airtight tap

There is a pressure sensor set by the factory at 0,3 bar (maximum value 0,4 bar). In case of an anomalous pressure in the tank, the relay gives a Trip Signal.

OIL LEVEL GAUGE

it is a device with a floating system installed on the transformer lid. Depending on the model, there is a visual indication of the oil level inside the tank. The oil level of the hermeti-

cally sealed transformers should never drop. In such case, there is an oil leakage or the unit is no longer hermetically sealed.

3.7 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. It is advisable to contact a specialized company, on the contrary if you want to proceed independently you must proceed as follows:

- 1 Extract the oil from the valve in the lower part of the tank.
- 2 Remove the protection lid and the sealing tap.
- 3 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.
- 4 Close the oil in a clean, airtight container.

Send the sample to an analysis centre (it is preferable to contact the centre before collection, as they can usually send you the appropriate containers and instructions). Test results should be compared with the table below:

Breakdown Voltage [kV]		
Good	Fair	Poor
> 40	30-40	< 30

NOTE: The data shown in the table are those suggested by current standards, we advise in the case of a new stored transformer that the value is greater than 50 kV, otherwise contact our technical office.

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 in table 3 below.

4.3 SPECIAL MAINTENANCE

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

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Table 3 - Routine maintenance		
Operation	How often	Description
Oil level check	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.
Silica gel salt check	Every 6 months	Check the colour indicated on the label, if the colour differs, oven-dry the salts at 120-150°C or change them. Make sure that the transparent capsule (if provided) under the silica gel is at the correct level.
Insulator cleaning	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.
Accessory check	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. Note: if the oil thermometer is not fitted by the manufacturer, half fill the pocket well with oil.
Oil rigidity	Hermetically sealed Every 2-3 years Free breathing- Every year	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/2,5mm. If it does not, have the oil treated by specialist technicians.

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.

Table 4 - Troubleshooting		
Problem	Causes	Solution
Oil thermostat activates	Incorrect thresholds set	Check the settings
	Excess load	Limit the load
	Strained current	Measure the strain and filter the current
	High room temperature	Ventilate the area
Buchholz relay activates	Residue air in the relay	Bleed the relay several times. Check the oil level. If the problem persists, contact our Technical Department
Excessive noise	Supply voltage too high	Regulate the tap changer (fig 1 > 13)
	Rigid connections	Check the distortion
	Presence of voltage harmonics	Insert flexible cables
	Mechanical resonance	Insert anti-vibrators
Protections activate at starting	Insertion current	Increase switch delay
Oil leaking from the bushings	Wrong tightening torques	Regulate the tightening torques (see Table 2 – page 8)
	The connections to the bushings are too stiff	Extend the connections and/or use flexible connections

V – CONCLUSIONS

5.1 GUARANTEE

Unitrafo transformers are guaranteed against all production defects for a period of two years from the final inspection date. Any extensions to the guarantee shall be negotiated

separately. The guarantee only covers repairs and replacements on faulty transformers and this does not extend the original guarantee.

5.2 CONCLUSION

Unitrafo thanks you for the purchase of our transformer and by using the information in this manual you can handle the transformer in a correct way for the best functionality.

Our offices are available for you and the information you may need further.

