

# Three-phase HV/LV transformers

oil filled

## Summary

• Introduction	2
• Maintenance and storage	2
• Transformer accessories	3
• Installation	4
• Commissioning	6
• Voltage change	8
• Maintenance	9
• HV and LV connections	10



**ELETRAFO** SRL  
**TRASFORMATORI ELETTRICI**



Installation, commissioning and  
maintenance manual

## 1. INTRODUCTION

The instructions in this manual apply to oil-immersed transformers of the following type :

- **Breather with conservator - Hermetically sealed**, with the following types:

- Maximum insulation class 36 kV
- Rated power from 25 to 8000 kVA

## 2. MAINTENANCE AND STORAGE

### 2.01 Transport and reception

Transformers are shipped from the factory ready for installation. To reduce the risk of damage during transportation, transformers must be secured with cables using the special hooks provided on the machine. The cables must be positioned so as not to damage the radiators. However, it is mandatory for the customer to inspect the condition of the transformer upon arrival at its destination to verify that it has not suffered any damage. If the appliance has actually been damaged or if the ordered accessories are missing, the customer must immediately contact the seller to request a return or replacement:

- We kindly ask you to make a reservation with the last carrier on the shipping document and confirm it by registered letter within 3 days. If any damage is found, please immediately inform the carrier and Eletrafo

### 2.02 Lifting

The lifting must be carried out using all the Lifting lugs located on the transformer cover. The chains used must be long enough so that they do not form an angle greater than 60° (fig. 1). Small movements can be made with forklift by applying suitable support plates under the case.

### Transport (fig. 2)

The transport of the transformer must be carried out on the frame. For this purpose, except for small powers or particular specifications, there are 30 mm diameter holes at the ends of the frame. The transport must be carried out only in two directions: along the axis of the frame and perpendicular to it

### Maintenance with forklift(fig. 2)

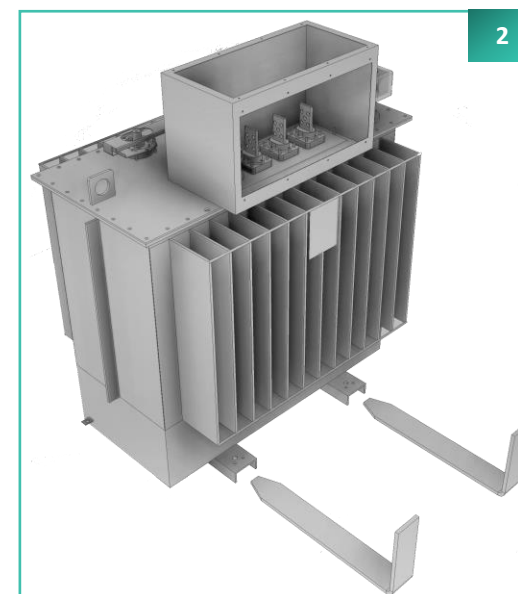
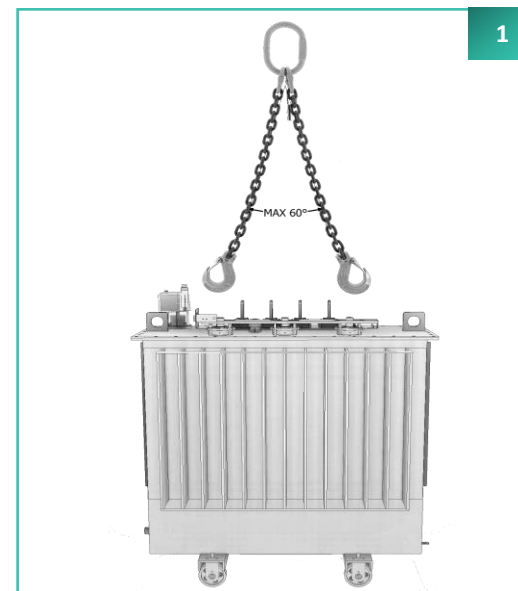
The load-bearing area of the forks must be the frame, inside the U-shaped bars. The sliding rollers are removed to prevent the forks from getting stuck or damaged during transport.

### 2.03 Movement

To move the transformer, use the traction hooks on the wheels or push it by supporting it on the bottom of the case (avoid forcing it on the radiators or insulators).

### 2.04 Storage

If the transformer is not installed immediately, it can be stored in covered and dry rooms.



### 3. TRANSFORMER ACCESSORIES

#### 3.01 Standard accessories

**High and low voltage bushing (fig. 3)** – They are normally located on the transformer cover. They allow connection to both copper and aluminum cables.

**No load tap changer (fig. 4)** – This switch allows you to adjust the primary voltage of the transformer in relation to the power grid. It should only be operated when the transformer is not connected to the power grid. The switch is numbered to indicate the position, has stops, and has a hole for a lock to prevent unauthorized operation.

**Rating plate (fig. 5)** – In accordance with CEI-IEC standards, electrical characteristics, weight and serial number are indicated..

**Oil drain device (fig. 6)** of the transformer.

**Earthing clamps (fig. 7)** – They allow the transformer to be connected to the plant's ground network. The clamps are made of stainless steel.

**Lifting lugs (fig. 8)** of the transformer is only the part that can be lift

**Carriage with wheels (fig. 9)** that can slide and rotate in two perpendicular directions.

**DGPT2 o DMCR3.0 (fig. 10)** – It is mounted only on Hermetically sealed transformers and offers complete appliance protection.

#### 3.02 Accessories on request

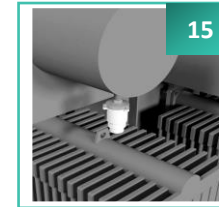
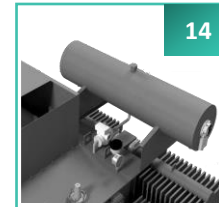
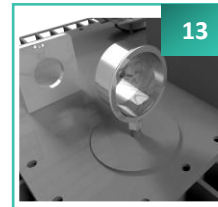
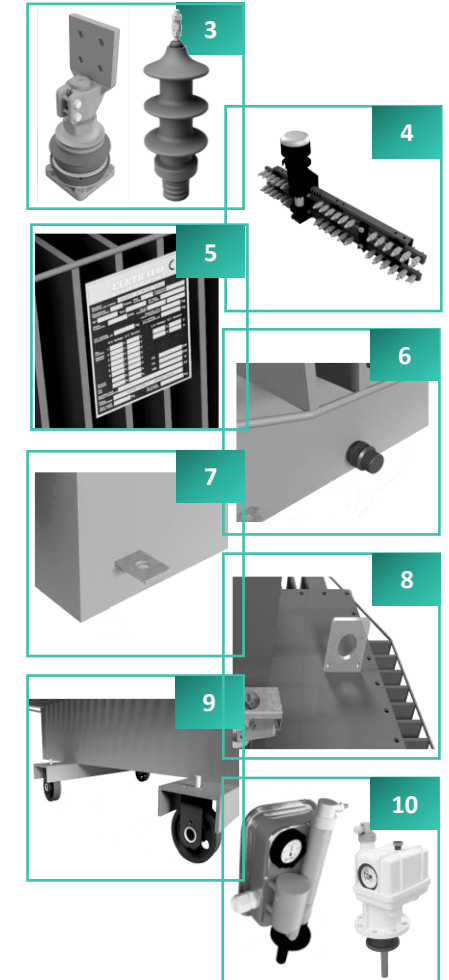
**Relè Buchholz (fig. 11)** – It is mounted only on the conservator version and serves to indicate any gas formation due to electrical discharges inside the transformer. It is supplied with NA – NA electrical contacts

**Thermometer pocket (fig. 12)** – Allows mounting of a thermometer for measuring oil temperature in the highest part of the case

**Dial thermometer (fig. 13)** – Used to measure the oil temperature in the highest part of the case. It is supplied with NA – NA electrical contacts.

**Conservator (fig. 14)** – It allows to absorb the variations of the oil volume due to the operating conditions. The conservator is equipped with a level indicator, a filling and aeration device and a drain plug

**Silica gel (fig. 15)** – It is mounted only on the conservator version and its function is to dry the moisture from the oil into the transformer. It is shipped not mounted on the device



## 4. INSTALLATION

The transformer must be installed at an altitude of no more than 1000 meters, unless a specific request is made at the time of order, as the rarefaction of the air compromises the good cooling of the coils.

In standard construction, unless a specific request is made at the time of order, the transformers are dimensioned according to IEC EN60076 for an ambient temperature:

**-Maximum: 40°C -Average daily: 30°C -Average annual: 20°C**

The ambient temperature inside the room, when the transformer is under voltage, must comply with these temperatures, with a minimum temperature of -25°C, unless a special request is made that requires a special calculation of the transformer.

### 4.01 Room size (Fig.16)

To ensure proper cooling of the transformer, it must be installed at a minimum distance of 200 mm from the walls, allowing for sufficient working space around it, and at least 1m away from other transformers. The room must have ventilation that provides an air exchange rate of at least 5-6 m<sup>3</sup>/min for every kW of equipment loss. To calculate the area Sc (in m<sup>2</sup>), use the following formula:

$$Sc = \frac{0,18p}{\sqrt{H}} \quad \text{et} \quad Sc' = 1,10 \times Sc$$

**P** = Sum of no-load losses and load losses of the transformer expressed in kW at 75°C, as well as losses emitted by any equipment present in the room.

**Sc** = Surface area of the fresh air inlet opening (minus any potential grille) expressed in m<sup>2</sup>.

**Sc'** = Surface area of the air outlet opening (minus any potential grille) expressed in m<sup>2</sup>.

**H** = Height between the two openings expressed in meters

This formula is valid for an average annual ambient temperature of 20°C and a maximum altitude of 1000 meters

### 4.02 Forced ventilation of the room

This is required in the case of a small or poorly ventilated room, or if the ambient temperature of the room is much higher than the external temperature, taking into account the temperatures that have been used to define the transformer. In the event of frequent overloads of the transformer, it can be used to evacuate the heat generated by the device, without, however, reducing the effects of such overloads on material degradation.

To avoid disrupting the natural circulation in the room, an air extractor to the outside will be installed in the upper part of the outlet opening; it can be controlled by a thermostat. Recommended flow rate (m<sup>3</sup>/s) at 20°C = 0.20 P, where P = total power losses to be removed, in kW, emitted by all installed equipment.

### 4.03 Fixing the transformer

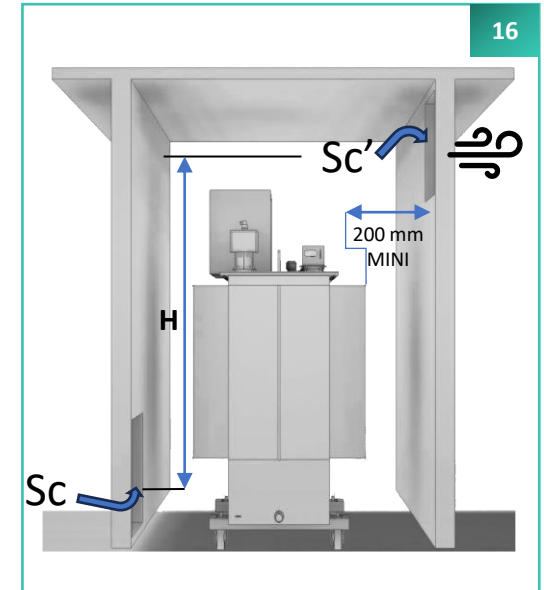
Lock the transformer equipped with wheels using clamps to prevent any movement.

### 4.04 Grounding

Securely connect the ground terminals to the ground network of the plant, in accordance with current regulations.

### 4.05 Network connections

To make connections to the High Voltage and Low Voltage cables, follow the phase indications marked on the bushings and ensure that the weight of the connection does not overload them.



#### 4.06 Auxiliary connections

If the transformer is equipped with the DGPT2 - DMCR protection device, Buchholz relay, and/or thermometer, connect it to the terminals of the central unit, or in its absence, directly to the protection devices. To verify the effectiveness of the device, follow the instructions provided with the device

#### 4.07

##### Installation of the silica gel

In case the silica gel has been shipped not mounted on the transformer, it is necessary to screw it instead of the female threaded cap located under the conservator.

#### 4.08 Checks before commissioning

##### Pre-energization procedures.

- No foreign objects on the equipment (filings, bolts, etc.)
- If the device is equipped with a DGPT2 protection block, verify that the large float is in the high position and that the vent is tightly closed (close by rotating clockwise). Consult the documentation provided with each device for testing.
- Proper maintenance of cables and conductors. No force on the transformer connection areas.
- Wiring for protection or ventilation aids
  - Insulation distances and cable maintenance,
  - Operation.
- Checking the tightening of connections
- Continuity of grounding. For maintenance personnel safety, the transformer's grounding must be connected.
- Ensure correct positioning of the switch handle to the selected position and its locking..
- Ventilation grilles not obstructed.
- In the case of parallel operation, check short-circuit voltage, phase concordance, and voltage ratio.

If all these checks are satisfactory, you can proceed to energize the transformer.



## 5. COMMISSIONING

### 5.01 Cleanliness

If the transformer has been stored for a long period of time, carry out the general cleaning of the appliance, in particular the insulators

### 5.02 Oil level

Any additions of oil must be carried out exclusively with oil having the same characteristics as the one used inside the transformer.

- **Hermetically sealed transformers:** In this type of machine, oil is not subject to evaporation, so usually no top-ups are required. These transformers are not equipped with an oil level indicator. The oil level can only be seen if the DGPT2 - DMCR device is installed. If oil top-up becomes necessary due to an anomaly, please refer to the transformer manufacturer's instructions.
- **Transformers with conservator:** The level indicator must display the ambient temperature. If it shows a lower value, it's necessary to add oil. To perform the top-up, the transformer needs to be at ambient temperature. Once confirmed, simply remove the top-up plug located on the conservator and pour oil up to the indicated level corresponding to the ambient temperature. If a Buchholz relay is installed on the machine, proceed with air discharge from it. Then, close the top-up plug  
**Note:** Due to the difficulty of finding suitable oil for top-ups on-site, and therefore the need to always ship it from Italy, Eletrafo has decided to ship transformers with the minimum level set at 60°C. To adjust the oil level to the correct position, in case the reading is higher than the ambient temperature, proceed with discharging excess oil. The drainage procedure involves removing the drain valve plug located at the bottom of the enclosure and turning the handle until the oil flows out. Allow the oil to drain to the level corresponding to the ambient temperature. Once the desired level is reached, close the valve and reattach the closure plug using Teflon.
- **Transformers with radiators equipped with valves:** Check the opening of the upper and lower valves, drain each radiator via the vent valve at the top.

### 5.03 Connections

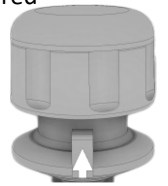
Check that connections to high and low voltage cables, ground connections and auxiliary connections are made correctly.

### 5.04 No load tap changer (fig. 17-18)

Verify that the No load tap changer is in the position corresponding to the voltage closest to that of the grid

#### ► Adjustment socket

Adjust the No load tap changer switch to the desired position:

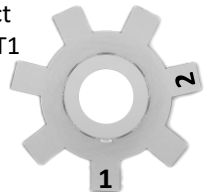


- Pos. 1 : Higher primary voltage
- Pos. 2 : Upper average primary voltage
- Pos. 3 : Rated primary voltage
- Pos. 4 : Lower average primary voltage
- Pos. 5 : Lower primary voltage

17

#### ► Double primary voltage

For devices with two primary voltages, select the desired position HT1 or HT2:



- Pos. 1 : HT1
- Pos. 2 : HT2

18

### 5.05 DGPT2 – DMCR (fig.19)

This device is a comprehensive transformer protection and has several functions:

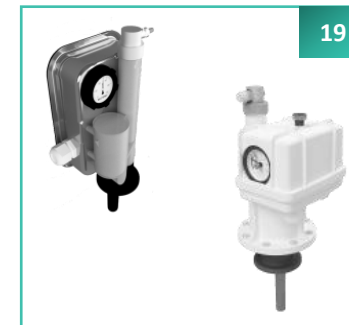
- The main role of DGPT2 - DCMR is to detect gas formation due to internal fault.

The operation is divided into two phases:

- The red float appears in the case of a slight decrease in level.
  - Electrical operation (disconnection) in the case of a significant level loss.
- 
- DGPT2 - DMCR also detects a decrease in dielectric level through an independent float.
  - DGPT2 - DMCR allows the visualization of oil temperature through a dial with a scale of 0/120°C, located on the front of the device.
- Additionally, two thermometers with switching contacts serve as alarm and disconnection functions. They can be adjusted from 30°C to 120°C.

**The maximum intervention temperature values can be set at 95°C for the alarm and 100°C for disconnection.**

- DGPT2 - DMCR indicates excessive pressure that has occurred inside the transformer. The pressure switch responsible for this function is factory-set (0.3 bar can be adjusted up to 0.45 bar).
- DGPT2 - DMCR is equipped at the top with a test socket and a special plug with a valve through which oil top-ups can be performed.



19

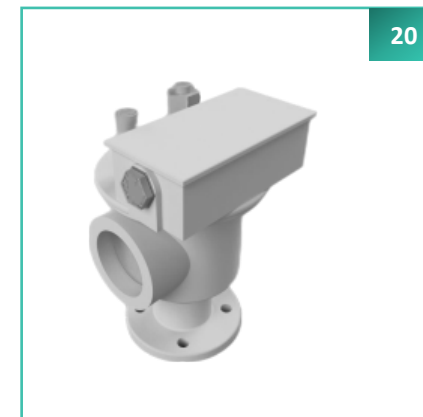
### 5.06 Relais Buchholz (fig.20) on request

To prevent unwarranted interventions, perform the following operations: - Drain the relay by operating the equipped valves.-Remove the wooden or plastic pin inside the push-button cap for mechanical testing.

If the relay indicates gas formation during the initial hours of operation, before considering an anomaly, repeat the drainage operation.

### 5.07 Thermometer (fig.21) on request

Check that the programmed temperature threshold for intervention is suitable for the desired operating conditions. **The maximum set values should be 95°C for the alarm and 100°C for disconnection.**



20

### 5.08 Silicagel on request

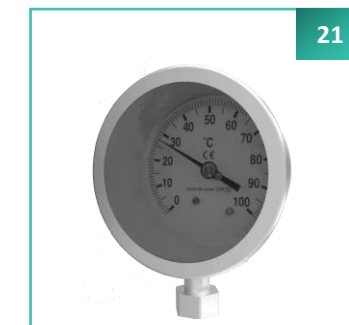
Regarding the silica gel, ensure that the air passage holes are not obstructed and check that the crystals are orange in color. If they appear white, it indicates saturation with moisture. In such a case, remove the silica gel and regenerate the crystals in an oven at 150°C until they return to an orange color.

### 5.09 Parallel operation

Ensure that the transformers have the following identical characteristics:

- Voltage ratio
- Short-circuit voltage
- Vector group.

Also, verify that the corresponding high and low voltage terminals of the transformer are connected to the same phase of the installation and that the switches are in the same position, corresponding to the same transformation ratio.



21

### 5.10 Insulation resistance control

- Before commissioning, it's necessary to perform an insulation test using a Megger to ensure that there are no winding points connected to ground.
- Insulation Check on HV side: Connect HV side to the Megger at 2500 V and LV side to ground.
- Insulation resistance value > 200 Mohm.
- Insulation Check on LV side: Connect LV side to the Megger at 1000 V and HV side to ground.
- Insulation resistance value > 200 kΩ.

### 5.11 Dielectric strength test of the oil.

Verify the dielectric strength of the transformer oil using a surge arrester, UNEL SAP 80, and the measured value must be above 40 kV.

### 5.12 Energization.

Following a comprehensive inspection of the installation, the HV (High Voltage) supply switch can be closed.

It is advisable to maintain the transformer at full rated voltage, but without a load (LV, or Low Voltage, switch open) for approximately 2 hours to facilitate the dissipation of any potential air bubbles within the protective devices.

After this duration and upon confirming the absence of air bubble indications in both the DGPT2 - DMCR and the Buchholz devices, load can be introduced by closing the LV switch.

## 6. VOLTAGE CHANGE

### 6.01 High voltage side

If the transformer is equipped with a no load tap changer, simply move the handle to the notch corresponding to the new voltage. **(WITHOUT VOLTAGE)**

### 6.02 Low voltage side

If the transformer has multiple voltages taps on the low-voltage side, modify the connections according to the diagram accompanying the transformer at the time of shipment



## 7. MAINTENANCE

The transformer is a machine that does not require specific care for monitoring and maintenance. However, to ensure smooth and safe operation, it is advisable to periodically perform a series of checks, the frequency of which will depend on the environmental and operating conditions.

In a clean and dry environment with regular operating conditions, monitoring can be limited, and checks can be conducted at larger intervals. In a dusty and humid environment or when significant temperature variations occur, checks must be more frequent, and continuous monitoring is recommended.

Below is a table with an example of a program under average operating conditions:

	Insulating liquid level*	Silicagel *	Cleaning of insulators	Checking DGPT2 - DMCR or Buchholz Relay	Location of surge arresters	Dielectric strength*	Filtration of the insulating liquid
Every week							
Every month							
Every three months	X	X	X	X			
Every year					X		
Every two years						X	
If the dielectric strength is low							X

**\* Control required only for transformers with conservator**

### 7.01 Oil level (unit with conservator)

If the indicator shows a significant decrease in level, add oil as indicated in section 5.02. It is important to note that during the initial operating period, the oil volume may experience a slight reduction. If the indicator does not show oil replenishments, check that the float is not obstructed or punctured.

### 7.02 Silicagel (units with conservator)

Proceed as indicated in paragraph 5.05.

### 7.03 Verification di DGPT2 - DMCR

To check the effectiveness of the device, proceed according to the instructions attached to the device.

### 7.04 Verification of the Buchholz relay (unit with conservator)

To check the effectiveness of the device, proceed according to the instructions attached to the device.

### 7.05 Dielectric strength (unit with conservator)

Have the dielectric strength checked by an equipped laboratory.

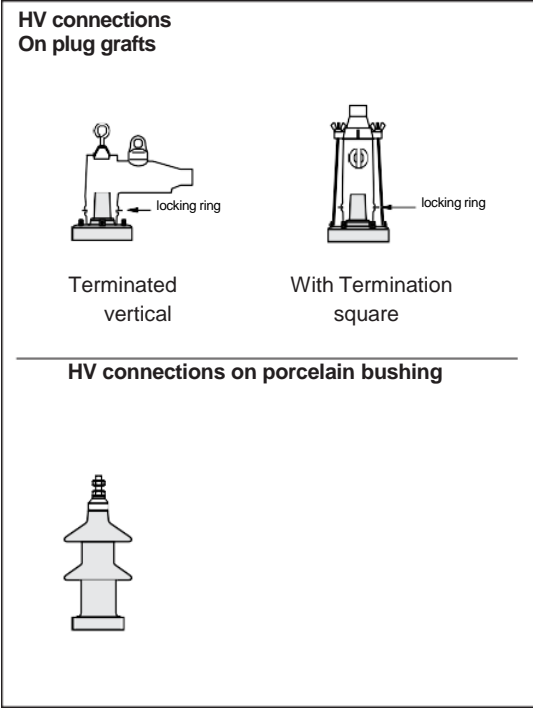
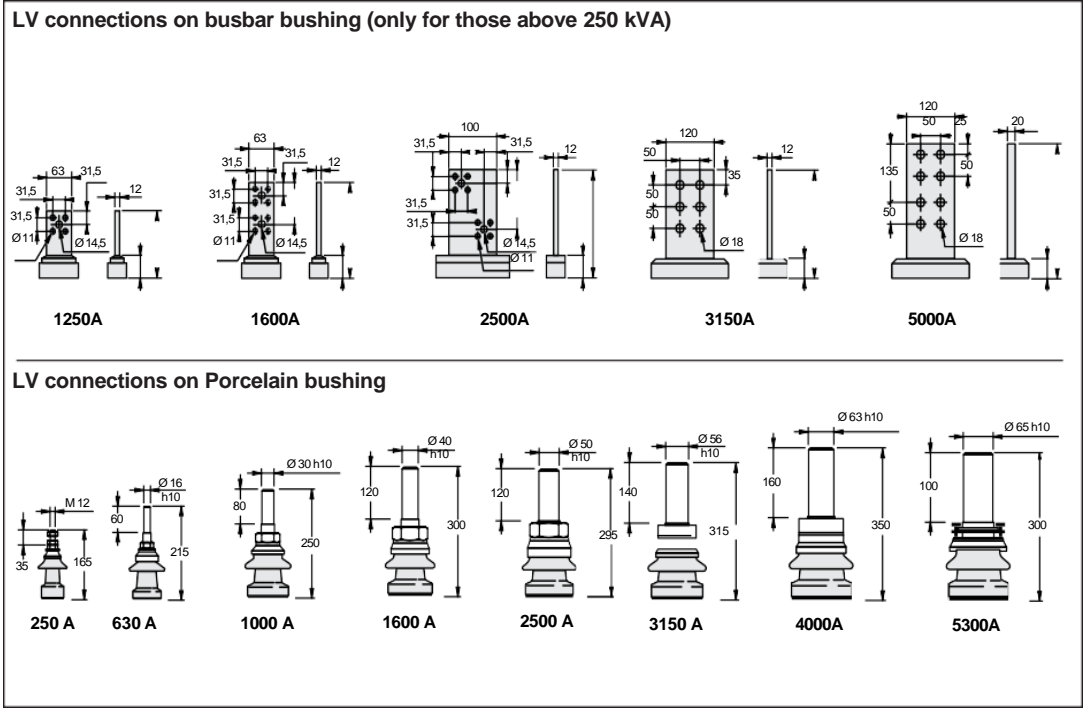
### 7.06 Oil filtration (unit with conservator)

It is recommended to carry out oil treatment to eliminate any deposits, even if the dielectric strength is low.

# 8. MV AND LV CONNECTIONS

## 8.01 Type of bushing

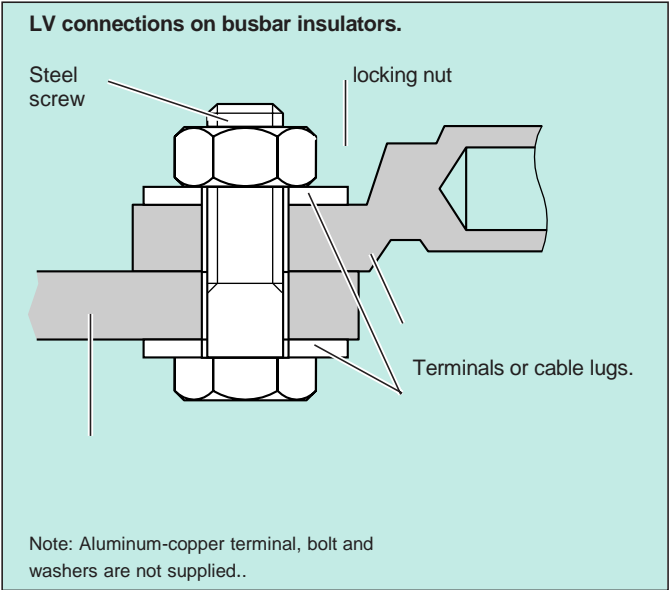
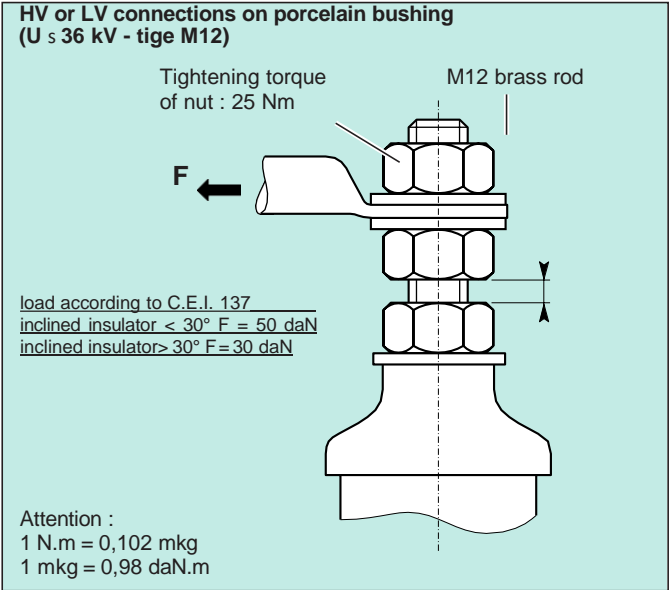
Transformers can be equipped with the following connections:



kVA	100	160	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
HV Busbar bushing	—	—	1250A	1250A	1250A	1250A	1250A	1250A	1600A	2500A	2500A	3150A	4000A	5000A
LV Porcelain bushing	250A	250A	630A	630A	630A	1250A	1250A	1250A	2000A	2000A	3150A	3150A	4000A	5000A

8.02 Assembly and tightening torque.

It is necessary to ensure that the penetrations are not subjected to forces due to cable or busbar connections; these efforts can lead to leaks in various seals  
The following assemblies and tightening torques will be respected:



8.03 Table of screw tightening torques

Screws	Steel class 6.8	Inox class A2-70 e A4-70	Inox class A2-80 e A4-80	Brass
M8	15,2	15,5	17,7	7,6
M10	30	30	35	15,1
M12	52	53	60	25
M14	83	85	97	41
M16	130	133	152	55

Tightening torque in N.m.

Tightening tolerance± 20%.

These values refer to assemblies made with flat washers; furthermore, the use of contact washers on the plates is recommended: these torques must then be increased by 35%. The steel and stainless steel screws are mounted lubricated.

8.04 Bushing crossbar

Screws	Tightening torque(Nm)	Bushing
M12	20	250A
M20	25	630A
M30	30	1000A
M42	55	2000A
M48	60	3150A
M55	75	4500A



**ELETRAFO** CE  
TRASFORMATORI ELETTRICI

Standard  
Conforme aux normes **EN 60076 - UE 548/2021 TIER 2**

Transformer  
Transformateur  Phases  Year  
Année  Frequency  
Fréquence

N°  Type  Oil Type  
Type huile

Power  
Puissance  KVA Group  
Couplage

H.V. winding  
Enroulements HT  Kg Magnetic core  
circuit magnétique  Kg

L.V. winding  
Enroulements BT  Kg

Tap Position Réglage Tension	H.V. Voltage	H.T. Tension	L.V. Voltage	B.T. Tension
1	<input type="text"/> V	<input type="text"/> V	<input type="text"/> V	<input type="text"/> V
2	<input type="text"/> V	<input type="text"/> V	<input type="text"/> V	<input type="text"/> V
3	<input type="text"/> V	<input type="text"/> V	<input type="text"/> A	<input type="text"/> A
4	<input type="text"/> V	<input type="text"/> V		
5	<input type="text"/> V	<input type="text"/> V		
6	<input type="text"/> V	<input type="text"/> V		

Current  
Courant  A  A P0  KW

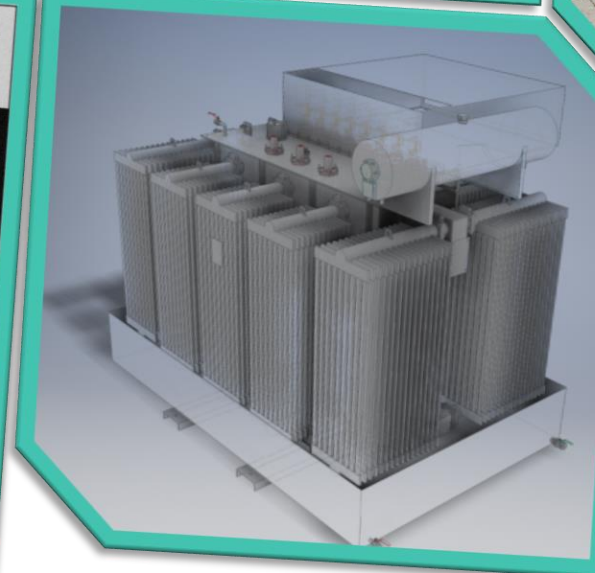
Vcc  
Ucc  %  % Pk  KW

Insulation level  
Niveau d'isolement  % PEI  %

Filling  
Remplissage  KV

Total weight  
Masse totale  Kg Oil weight  
Poids huile

**HERMETICALLY - HERMETIQUE**



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