

# HANDLING GUIDELINES FOR PHASE SHIFT AND SUT TRANSFORMERS





## 1. INTRODUCTION

We are pleased and proud to offer and deliver top-quality transformers, designed in accordance with the applicable standards of our customers.

The objective of this guide is to provide some general instructions regarding transformer receipt, handling, storage, mounting, installation and commissioning.

The information, recommendations, descriptions and safety notes contained herein are based on the guidelines, standards and experience of MAGNETRON S.A.S. with these types of transformers. This information does not include, nor does it cover in detail, all potential contingencies or unusual circumstances. Therefore, if you require additional information, please contact us.

## 2. RECEIVING

It is vitally important to conduct a thorough inspection upon receipt of your transformer in order to verify its condition upon arrival, since it may have suffered damage during shipment. All our transformers are carefully inspected and tested at our factory prior to shipment.

### Inspection recommendations

Check the information on the nameplate.

It should match data on the shipping documents.

- Serial No.
- Capacity
- Primary voltage rating
- Secondary voltage rating
- No. of phases
- Connection

Verify that the transformer is either mounted on a wooden or metallic platform isolating it from direct contact with the ground, or properly crated.

Verify that the transformer includes the cabinet opening key, that the doors can be opened and that the locking system operates properly.

Verify that the accessories such as valves, meters, LV and HV bushings and terminals, etc., are in good condition and that there are no oil leaks.

Verify that both the tank and the radiators are free of dents or scratches and that there are no oil leaks or stains.

Verify that the transformer nomenclature allows identification of the terminals and grounding points.

## 3. HANDLING

The transformers are provided with lifting hooks or lugs for handling with a crane. Wherever possible, try to use fiber slings rather than metallic chains or slings, in order to prevent damage to the anticorrosion coating. If you must use metallic chains or slings, make sure that the points of contact with the transformer are covered in order to avoid damage to the paint finish. Avoid hitting the tank or radiators with the slings, since doing so could damage the coated surfaces and result in tank deformation or leaks. Never lift the transformer by the lugs on the cover or on the cabinet.

The pallet or crate on which the transformer is shipped can be used for moving it with a forklift. Keeping the transformer on the pallet until it reaches

the installation site provides additional protection.

Do not allow the transformer to be dragged directly along the floor, since this could result in tank deformation or damage to painted surfaces, increasing the risk of corrosion.

If a crane or forklift is not available, rollers may be used to slide the transformer and maneuver it into position.

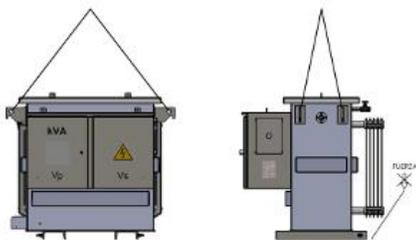


Figure 1. Lifting the transformer

**WARNING:** Under no circumstances try to use cabinet or radiators as leverage when attempting to slide or lift the transformer; the structure is not designed to withstand this kind of stress and may result in deformations or oil leaks.

#### 4. STORAGE

The transformer should be stored fully assembled, as if it were already energized at its final location, and should be kept as far as possible from the presence of water.

Transformers may not be stacked and must be stored on a firm, level foundation.

In the event that a transformer must be held in storage for a period in excess of one (1) year, it is recommended that the space above the oil be filled with dry air

or nitrogen at two (2) or three (3) psi; this will prevent moisture ingress. Periodic inspections should be made to ensure that the pressure is kept positive.

#### 5. MOUNTING

Transformers must be mounted on a flat level platform, strong enough to withstand the transformer's weight. The unit should not be tilted in any direction greater than 1.5°. A greater tilt may cause deviations in liquid levels, increasing the chance of a disruptive failure.

The transformer should be installed in a location with sufficient free space to allow opening of the doors of the transformer cabinet.

It is important to keep in mind that the transformers contain a flammable insulating liquid (mineral oil), and that transformer failure can cause fire or explosion. This risk should be considered when conducting the safety evaluation of the installation site.

#### 6. INSTALLATION

##### 6.1 Recommendations prior to installation

Make a visual inspection of the site where the transformer will be installed, checking dimensions, the level base, adequate ventilation.

Verify that the tap changer or changers are adequately fastened in the correct position.

**WARNING** These procedures may only be performed while the transformer is de-energized.



## 6.2 Testing

Prior to commissioning a transformer that has been stored for 4 months or more, the following basic tests should be performed.

### Transformation Ratio

Verify that the transformer input to output ratios are within the ranges listed in the protocols.

### Insulation resistance (Megger)

Taking transformer insulation resistance measurements is recommended in order to verify the condition of the insulation between live and dead parts.

For reference, the minimum in ohms value must be 1000 M $\Omega$  for 1.2 kV insulation class and 10000 M $\Omega$  for 5 up to 15 kV insulation class.

### Ohmic resistance

Measure the ohmic resistance between medium and low voltage phases. The result should be reasonably similar to that shown on the protocol and equal between phases.

For reference should be taken the value indicated in the test protocol. This value can be changed according to the rated kVA, voltage winding, tap changer position and temperature.

### Dielectric strength of the oil or other insulating liquid.

Take a sample of insulating liquid from the sampling valve provided for that purpose. The dielectric strength of insulating oil should be at least 30 kV,

measured with semi-spherical electrodes placed 25 mm apart.

## 6.3. Installation steps

**NOTE:** The equipment must be grounded in accordance with the applicable standards at the installation site.

**1. Grounding:** It is essential to make a solid, permanent, low impedance ground connection.

The transformer tank or chassis must also be connected to the grounding system.

The type of configuration of the grounding system will depend on the surface area, soil resistivity and the minimum resistance to be complied with.

**WARNING:** The transformer must be properly grounded before it is energized. Failure to connect it properly may result in serious personal injury or death.

**2. Low voltage connection:** To connect the low-voltage cables to the transformer proceed as follows:

Identify the connection line (conductor) and the diameter to be connected to the low-voltage terminals.

The conductor that will be used in low voltage must be long enough to prevent excessive tightness over the terminals when connecting the transformer; care must therefore be taken to ensure that the conductor is cut to the appropriate length.

Strip the precise amount of insulation from the cable and tin the tip of the cable prior to connecting it.



Wrap the low voltage terminals with self-fusing insulation tape in order to provide a dead front configuration, and prevent accidents to personnel operating the equipment.

Prior to energizing the transformer, take a Megger reading to ensure that none of the phases are grounded and that they are not short-circuited with one another.

**NOTE:** Loose or improper connections may cause the transformer to overheat and may result in electrical losses.

**NOTE:** When connecting the connectors to the paddles, avoid excessive strain that could result in damage to the insulator.

**3. Medium voltage connection:** To connect the medium voltage cable to the transformer proceed as follows:

Identify the color-coded phases in the network as well as in the high-voltage terminals.

Check to ensure that the insulators are tightly fastened and that their terminals are suitable for the conductor gauge to be used.

Connect the conductor without exerting pressure on the MV accessory.

**WARNING:** The length of the conductor must never exert stress on the accessories when connected to the transformer; care must therefore be taken to ensure that the conductor is cut to the appropriate length.

**NOTE:** Check to verify that all connections are tight. A loose connection can cause overheating, carbonizing the

affected part and may result in a connection fault or equipment failure.

**WARNING:** Verify that all grounding connections are securely fastened and that the ohmic grounding resistance complies with the respective regulatory requirement. This is critical to ensure people safety and proper equipment operation.

## 7. COMMISSIONING

Once the tests have been completed and the installation of the transformer has been verified, the transformer is put into operation. For this purpose it is important to take the following precautions and take the steps listed below.

1. Verify and ensure that the network is neither close to, nor influenced by, any external element that could
2. Prior to medium voltage installation and commissioning, make another measurement of the grounding resistance.
3. Energize the transformer.
4. After the transformer has been energized, take a secondary voltage reading to ensure that it is correct.
5. If the secondary voltage is not correct, it can be adjusted using the tap changer (where applicable). The tap changer operates at no load and the transformer must therefore be de-energized prior to making the change.

## 8. MAINTENANCE



In order to guarantee a long life for your transformer and to ensure optimal operation at all times, the transformer should be inspected periodically and provided with proper maintenance.

**WARNING:** The transformer must be de-energized before any maintenance is performed.

**NOTE:** All preventive and/or corrective maintenance activities must be carried out by duly qualified and trained personnel. It is important to follow all applicable safety measures.

### 8.1. Preventive Maintenance

Preventive maintenance can be defined as a set of regularly scheduled actions intended to anticipate potential damage and deterioration to components, parts, pieces, materials and other elements, resulting from normal use and/or expiration of their useful life. See Table 1.

Table 1. Frequency of preventive maintenance by accessory.

Pieces to be inspected	Frequency	Observation
Thermometers	Once a year	
Accessories with trip and/or alarm contacts	Once a year	Verify the operating condition of the contacts.
Winding insulation resistance	Once a year	Record data to ensure proper follow-up
Measurement at the LV terminals	Once a year	Record data to ensure proper follow-up
Dielectric strength of the oil	Once a year	
External accessories	Every 6 months	Physical condition
Paint	Once a year	Remove dust and other loose dirt
Transformation ratio	Once a year	

## 9. TIGHTENING TORQUES

The recommended tightening torques for threaded connections (joints) are shown in Table 2.

Table 2. Tightening torques

Accessory	Torque [Nm]
Tap changer	10.8
Medium-voltage bushing 	24.4
Low-voltage bushing 	31.2

- It begins to decompose at temperatures of 280°C or higher.
- Avoid excess heat and the presence of highly oxidizing agents.
- It may generate flammable and/or harmful gases.
- In the presence of air, there is a risk of self-ignition at temperatures above 270°C.

Considering the above, please keep in mind the following preventive measures before handling the oil:

Ensure availability of proper fire-extinguishing equipment: in this case use carbon dioxide (CO<sub>2</sub>) in the form of a dry chemical agent or foam. Water/mist sprinklers may be used. For safety reasons do not use water pressure jets, unless handled by authorized personnel. (Risk of combustion stains).

Use appropriate personal protective equipment, such as nitrile gloves, goggles and safety boots.

Ensure availability of oil storage and oil spill control equipment.

To prepare for the possibility of a spill during shipment, installation or repair of the transformer:

Transport the transformer in a vehicle equipped with oil spill control equipment. It is recommended that temporary storage drums be kept available; they must be labeled properly in the event of use.

Once a spill has occurred, prevent the oil from soaking into the ground or leaking into ditches, drainage or sewage systems, or water streams. To this end, use the elements in the spill handling kit,

## 10. ENVIRONMENTAL RECOMMENDATIONS

This transformer contains dielectric insulating oil.

According to the Material Safety Data Sheet (MSDS), some of the properties of the oil include the following:

- The oil is stable under normal conditions.



as recommended by the applicable environmental agency.

Try to confine the spill as much as possible, keeping it from spreading and collect it using any available absorbent material. If possible, use special chemical oil-absorbing powders and rags, otherwise use sand, soil or any other inert material.

Keep in mind that any residues generated as a result of the handling of oil or the control of spills or emergencies are classified as hazardous and must be disposed of in accordance with local

regulations. They must therefore be collected from the site and taken to an authorized location.

If necessary, contact your local safety authorities.

Personal precautions: Use adequate personal protective equipment. In the event of a major spill, perform the cleaning process wearing the proper protective clothing, such as gloves and boots. Remove the contaminated clothing as soon as possible.