UNITRAFO

POWER QUALITY - SAFE ENVIRONMENT

Cast Resin Transformers

Manual for Installation, Operation & Maintenance

GBE

GET THE BEST OF ENERGY

RINA QUACER ISO 9002 CISQ

MTR_SVE_17 rev.01

Index

Overview image 3

I – Introduction
1.1. Preface 4
1.2. Reference standards 4

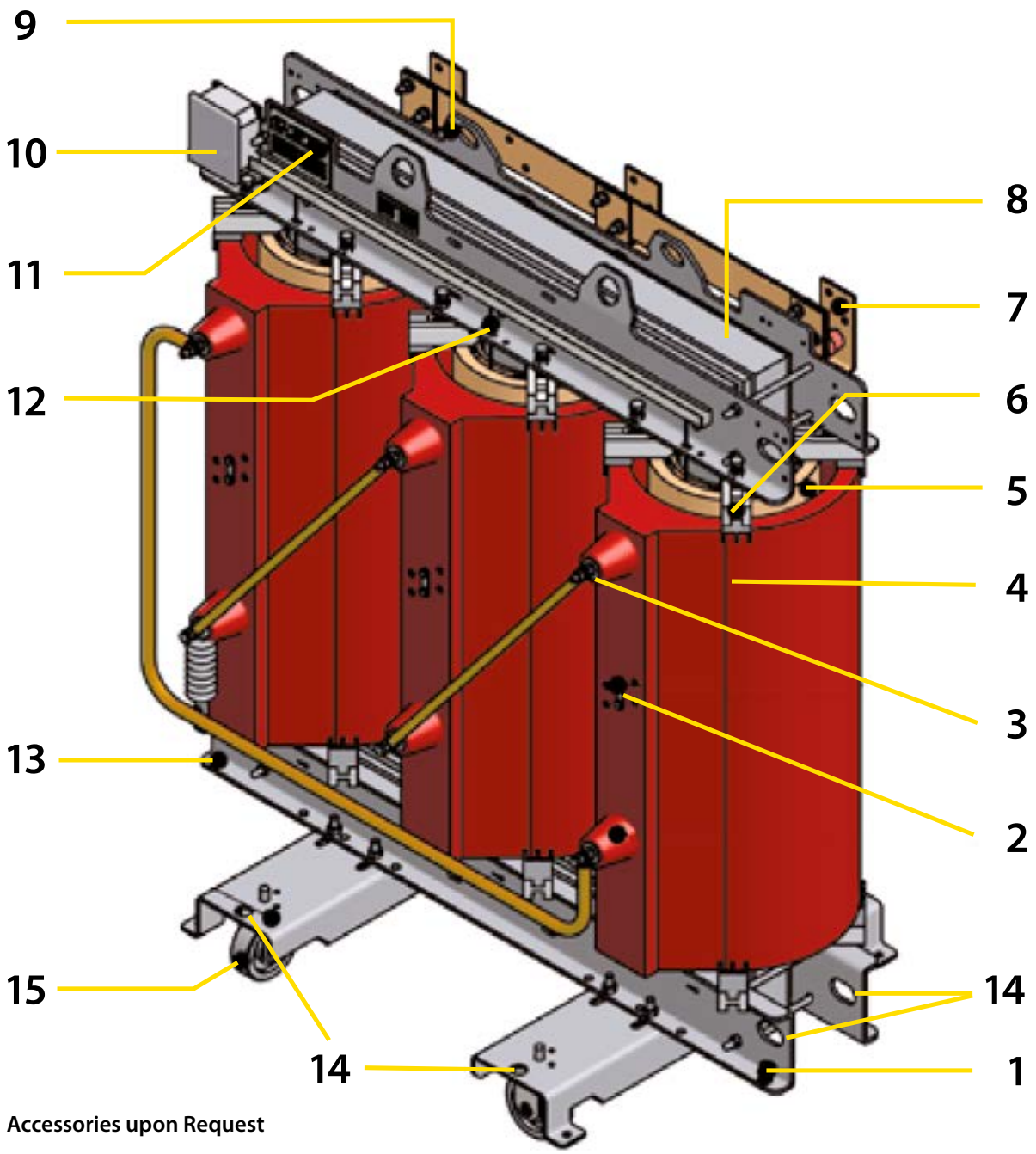
II – Installation
2.1. Packing and transport 5
2.2. Lifting and displacement of the transformers 5-6
2.3. Information about protection devices 6
2.4. Overload and working conditions 9
2.5. Working temperatures 9
2.6. Insulation distances 10
2.7. Security distance 10
2.8. Protection against overvoltage and over-current . . . 10
2.9. Mechanical fastenings and electrical connections . . . 11
2.10. Installation advice for heat dissipation 11

III – Commisioning
3.1. General Information 12
3.2. Unloading inspections 12
3.3. Visual inspections 12
3.4. Check before commissioning 13

IV – Operation and Maintenance
4.1. General information 14
4.2. Voltage change operation 14
4.3. Voltage tapping operation 14-15
4.4. Periodical checkings 15
4.5. Warranty 15

Cast resin transformer

1 Earthing Terminal
2 Primary Voltage Regulating Tapping
3 High Voltage Output Insulator
4 High Voltage Winding
5 Low Voltage Winding
6 Windings Pressure Plugs
7 Low Voltage Output Terminals
8 Magnetic Core
9 Lifting Eyebolts
10 Centralization Auxiliary Box
11 Data Plate
12 Thermal Sensor
13 Lamination Holder
14 Eyebolts for Horizontal Movement
15 Orthogonal Revolving Wheels



Accessories upon Request

- Bushing for Connector Plugs
- Connector Plugs
- Protection Enclosure
- Auxiliary Fans for Forced Ventilation
- Antivibration Pads
- Thermometer with Changeover Contacts

MTR_ENG_17 rev.01 ✗ 2023-09

I - INTRODUCTION

1.1. PREFACE

This manual intends to supply all the explanations needed in order to assure a correct use of our electric transformers as well as the maintenance and control of operations. Modern environmental necessities and the consequent legal requirements which prohibit the use of poly-chlorodiphenyl dielectric fluids such as Askarel or Pyrochlor have given rise to the development of products that are not only noninflammable but also have dielectric strength properties enough to support working voltages of 20 to 30 kV.
Epoxy resin in combination with other components guarantee not only “non-flammability-features”, but also special physical and technical characteristics that enable to design units that are smaller than standard oil-insulated ones with the same features.

Dry type transformers have demonstrated considerably improved resistance to transient overloads, network short circuits and impulsive voltages. They behave extremely well in damp environments and have a very low average noise level. These features of non-flammability, limited size, etc., give a reduction of the plant's general costs and therefore make this kind of transformer competitive and advantageous compared to traditional solutions.

1.2. REFERENCE STANDARDS

- **IEC 60076** **Power transformers**
- **IEC 61378** **Converter transformers**
- **IEC 50588-1** **Medium Power Transformers 50 Hz, with highest voltage for equipment not exceeding 36kV.**

II - INSTALLATION

2.1. PACKING AND TRANSPORT

Packing must be done properly in order to assure a safe transportation without damages.
According to the products dimensions, different types of packing can be used. Wooden pallets are used for small transformers in order to facilitate the loading and unloading, while for big transformers polystyrene or cardboard are used to avoid any possible damages due to external agents.

However sturdily manufactured, cast resin and dry type transformers cannot withstand violent shocks or excessive tugging of the lifting eyebolts. The transformers are covered on the outside with a shrinking polyethylene film which protects them from rain, dust or excessive dampness.

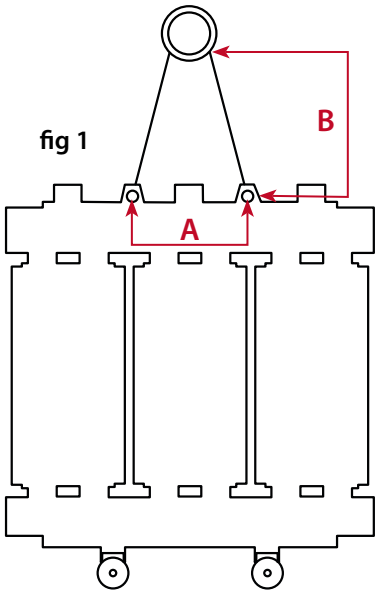
It is well advised to grant a good fastening on the means of transport by belts or fixed frames. The transformers must be handled with care and stored in a dry location.

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

2.2. LIFTING AND DISPLACEMENT OF THE TRANSFORMERS

The transformers loading, also in case of Exworks sales, is always made by the factory. The end client shall arrange and take care about the offloading.
A suitable length of strap must be used during unloading operations (B).
Figure 1, hereunder, clearly illustrates how the height of item B must be larger than the length of item A.

fig 1



The transformers are usually equipped with 90° revolving sliding wheels as illustrated in the figure 2.
Special eye-bolts are provided near the wheels for moving the transformer.

fig 2

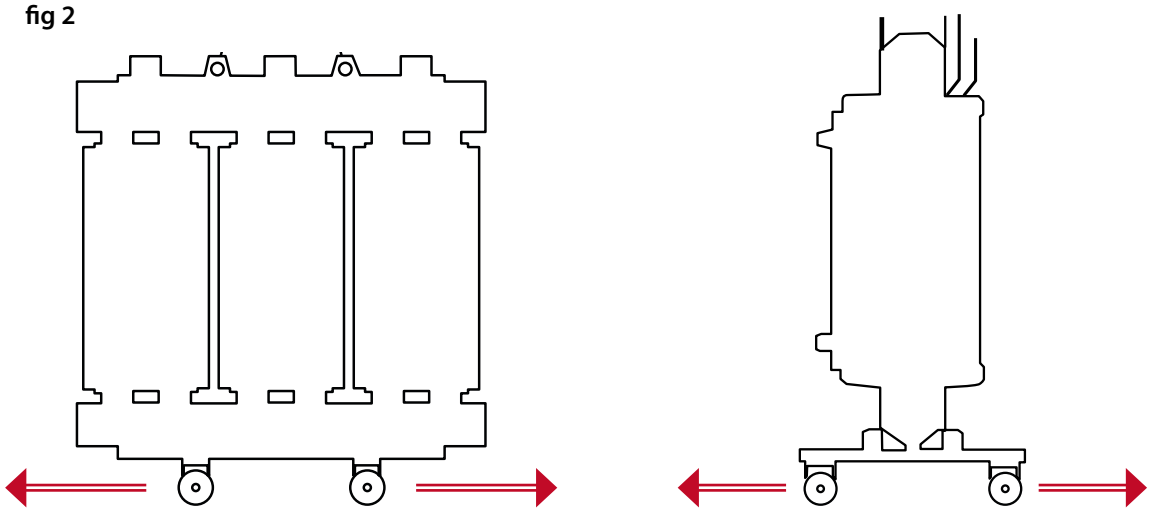


Figure 3 below shows exactly how to use the forklift truck without damaging the transformer.

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

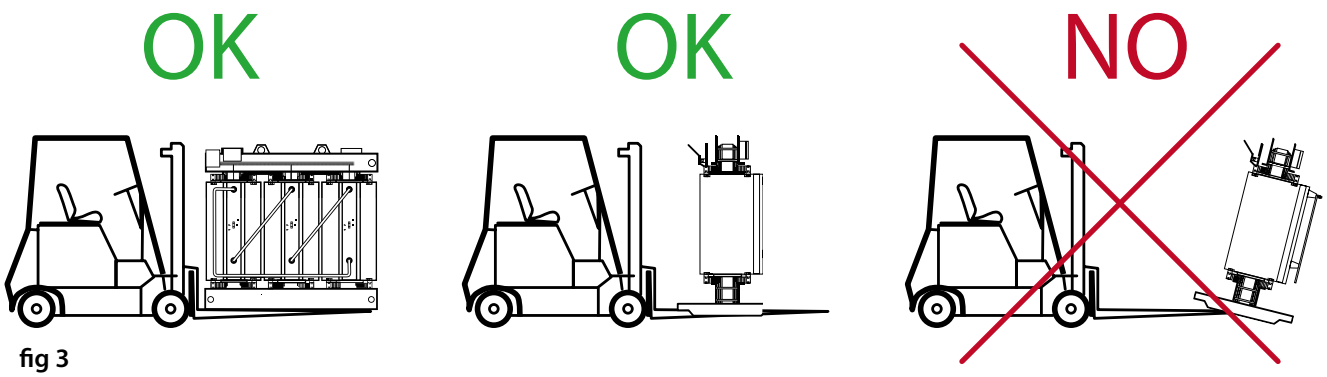


fig 3

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. INFORMATION ABOUT PROTECTION DEVICES

The temperature control is performed according to the below diagram. Three different types of control devices can be supplied as options, allowing visual and acoustic inspection and the possibility for the device to trip.
For normal application the tripping temperature for the alarm is in accordance to applicable STANDARDS and specifically indicated in this manual.

The devices illustrated are:

- Dial thermometer with two contacts
- Electronic device with thermal contacts or PTC
- Electronic device with PT100 sensors control

THERMOMETER WITH ELECTRICAL CONTACTS
This is the easiest way to monitor, control and measure the temperature of cast resin transformers. The thermometer can be supplied with electrical contacts normally opened or closed as per wiring diagram figure 4 & 5. For recommended settings for alarm and trip see chapter 2.5. Max load 2,5A – 250V. This thermometer is extremely reliable.

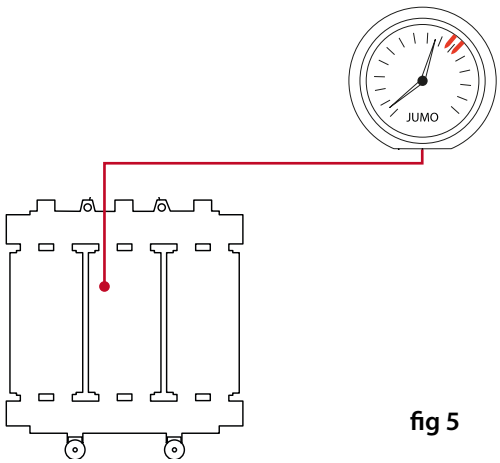
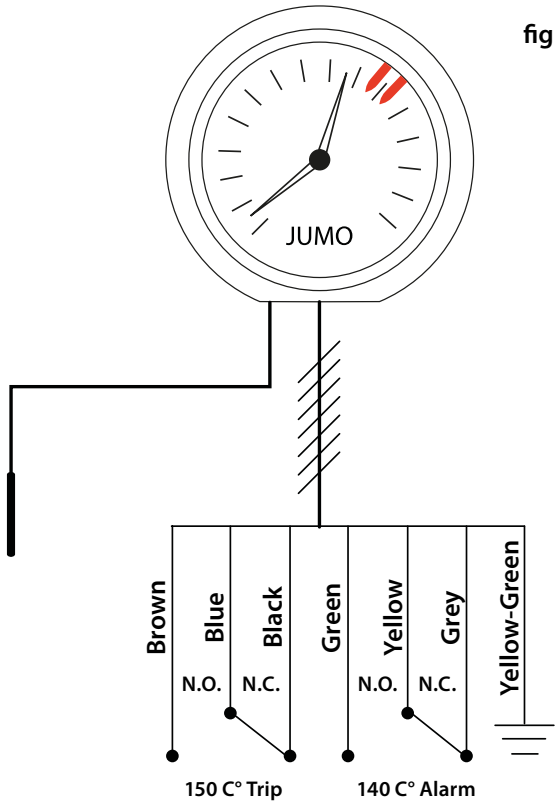


fig 5

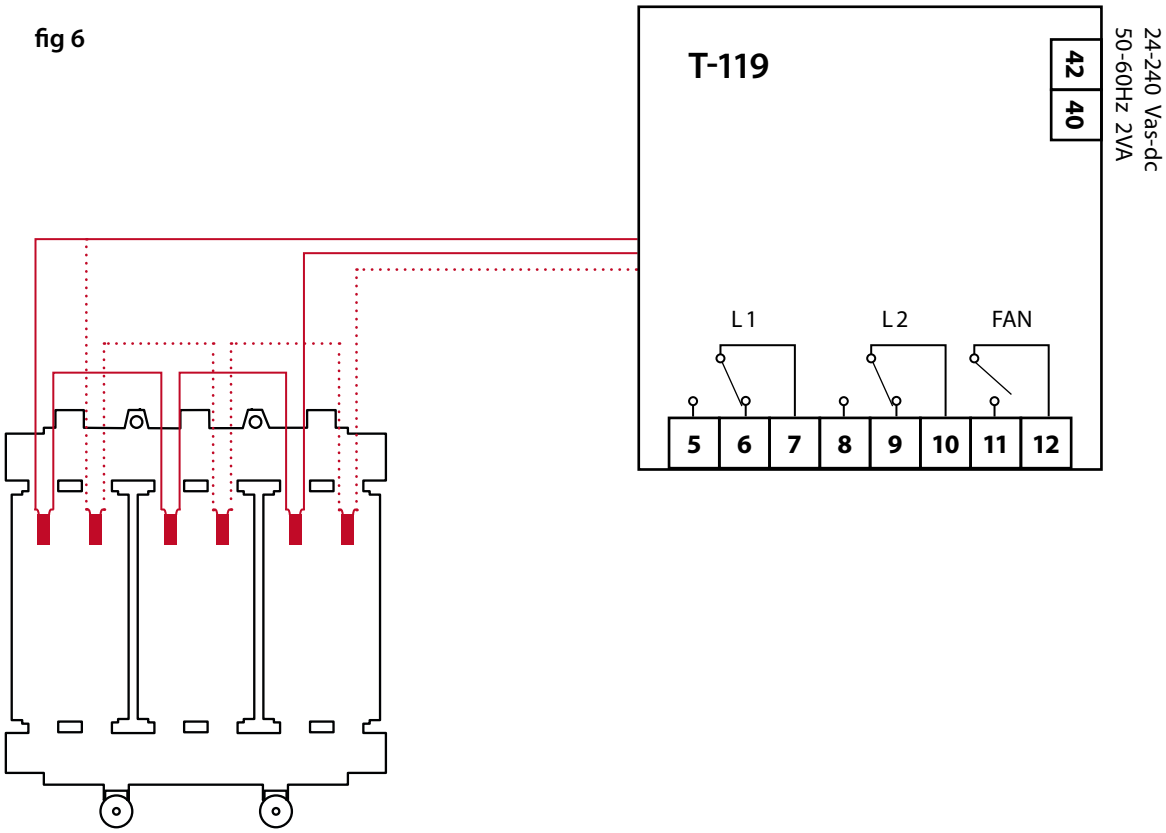
fig 4



ELECTRONIC DEVICE FOR THERMAL CONTACTS OR PTC

The electronic device for thermal contacts allows the visualization of the temperature of the central phase and control of the temperatures of the windings at the same time, by means of 3+3 thermal contacts, normally opened or closed and set for alarm and for trip intervention. Electronic device for temperature control for PTC-sensors figure 6.

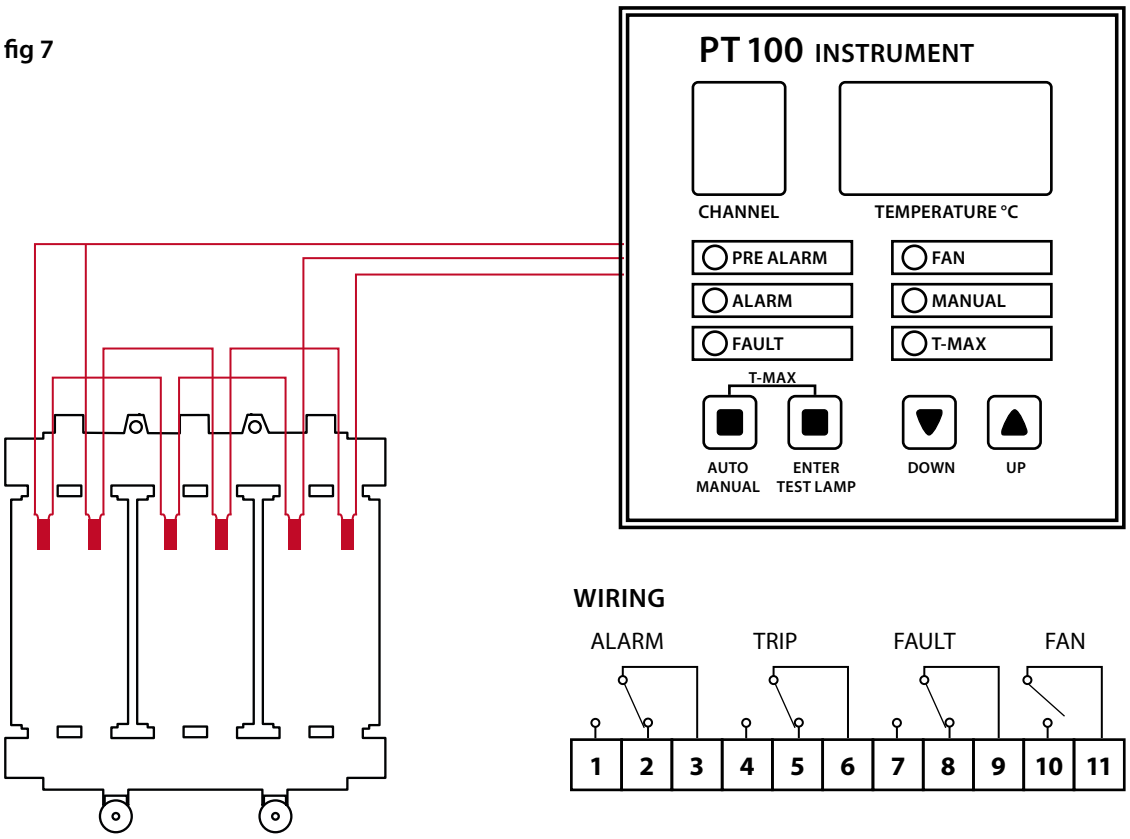
fig 6



ELECTRONIC DEVICE FOR PT100

This device has the function to control the temperature of all three phases and, if required, of the core. The electronic control of temperature is obtained by means of PT100 sensors (100 Ohm at 0°C). The electronic device shows the highest temperature of the transformer. The operator can also check the temperature of all three phases. The functions warning and trip are obtained by means of electrical output contacts -Opening/Closing- according to the diagram figure 7. Operation temperatures can be chosen by the operator, but normally we set 140°C for warning and 150°C for trip. On the electronic device there is also one output contact for signal of sensor's faults and for start of possible cooling fans (5A – 250V) (available as option).

fig 7



2.4. OVERLOAD AND WORKING CONDITIONS

During special working conditions or special applications for which a temporary power increase is required, it is good to be familiar with all the essential features of the cast resin transformer.

The cast resin transformer has a great thermal inertia and can withstand considerable overloads for short time.
Below (figure 8) is indicated the state of the overloads in function of the time in minutes or hours.

Overload capacity and time according to the overload, the pre-load and an ambient temperature of 20 °C

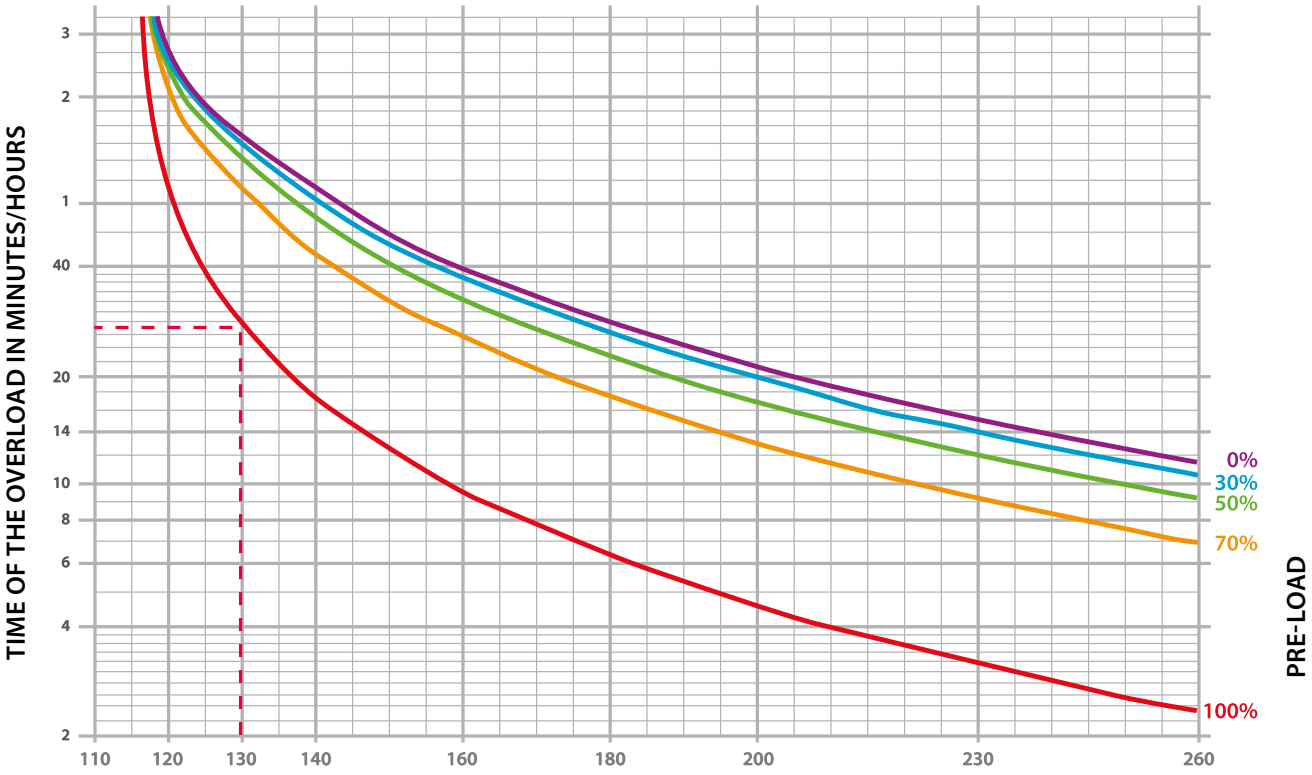


fig 8

2.5 WORKING TEMPERATURES

The working temperature of the transformers are changing according to the insulation class and the climatic class as per applicable standards and are indicated in table 1.

Table 1

Insulation class	Service range C1 class	Service range C2 class
B	from - 5 to 120 °C	from -25 to 120 °C
F	from - 5 to 155 °C	from -25 to 155 °C
H	from - 5 to 180 °C	from -25 to 180 °C

According to IEC60076, the transformer must be installed in an environment where the following temperatures are not exceeded:

- Lowest temperature -25 °C
- Average annual maximum temperature 20 °C
- Average highest temperature in the warmest month 30 °C
- Highest temperature on single occasions 40 °C.

If the temperature exceeds any of those specified temperatures above, inform Unitrafo urgently.
Where applicable, the transformer may be manufactured for temperatures other than mentioned above. In that case it is stated in our specification that belongs to your order.

Each transformer can be equipped with thermal contacts. Some devices have a sensor for each winding and a sensor in the core. For temperature control and supervision, the provided temperature sensors shall be connected to the temperature device. The device normally has two levels for temperature settings. We recommend the settings in table 2 for alarm and trip.

Table 2

Insulation class	Alarm	Trip
B	120°C	130°C
F	140°C	150°C
H	160°C	170°C

2.6. INSULATION DISTANCES

It is an absolute necessity to observe a minimum distance between the live parts of the transformer, the surrounding metal masses and other elements of the device during working, according to applicable standards.

Table 3 below shows the minimum insulation distances to respect.

Table 3 – Insulation distance & Security distance

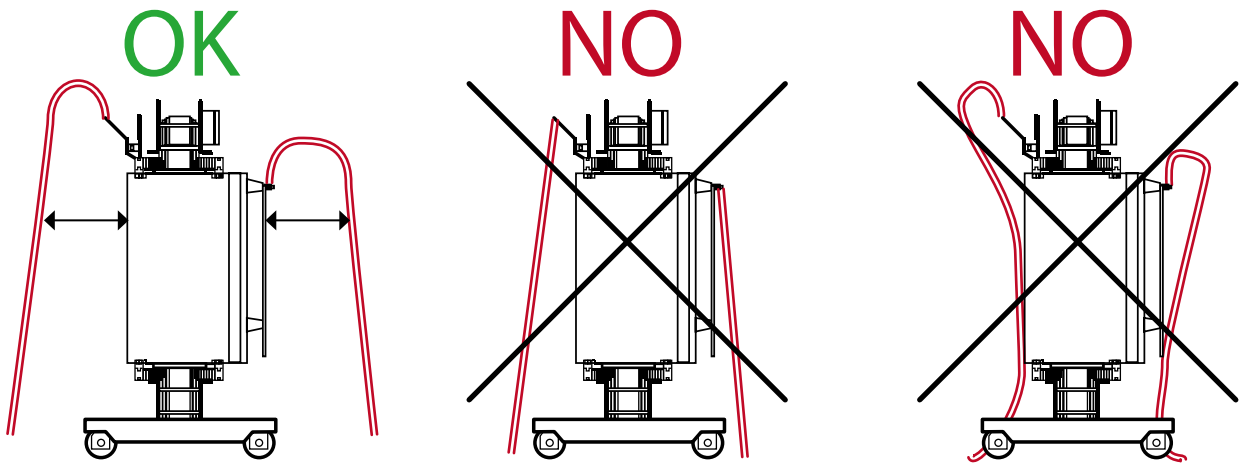
Max insulation voltage	Insulation level according to SS-EN (IEC) 60076, list 2 (kV)	Minimum allowed insulation distance (mm)	Security distance (mm)
3,6 kV	10 / 40	60	150
7,2 kV	20 / 60	90	150
12 kV	28 / 75	120	150
17,5 kV	38 / 95	160	200
24 kV	50 / 125	220	280
36 kV	70 / 170	360	400

2.7. SECURITY DISTANCE

The transformer must be set up and installed in such a way as to avoid involuntary contact between persons and live parts (NOTE! also cast resin parts) and to allow discharge of the heat produced by the transformer and that the highest temperature of the windings can be kept below the values given in section 2.5 above.

To protect people from involuntary contact, the distances specified above (Table 3) must be respected in accordance with applicable standards.

INSTRUCTION FOR CABLE CONNECTION **fig 9**



Observe the minimum permissible insulation distance between insulated cables and transformer according to the sign mounted on the transformer's upper yoke beam.

2.8. PROTECTION AGAINST OVERVOLTAGE AND OVER-CURRENT

OVERVOLTAGE

If there is any risk that the transformer could be exposed to overvoltage (e.g. lightning impulse, switching impulse or any other reason) it is necessary to provide it with surge arresters suitable for the required insulation level. In particular, the most potentially dangerous over voltage condition is when a transformer is overhead line connected. This situation has to be avoided by the use of these surge arresters.

OVER-CURRENT

The transformer needs to be equipped with protection devices against the thermal and dynamic effects of over-currents due to short circuits. The transformer should be protected with breakers equipped with fuses adapted for possible overloads on site.

2.9. MECHANICAL FASTENINGS AND ELECTRICAL CONNECTIONS

All the external wirings – on the Low voltage side, on the High voltage side and on the earthing points – must be properly performed and insulation distances, cable sections and positions must be taken into consideration.

The locking and/or the gripping of electrical connections and of mechanical fastenings shall be carried out according to the diagram below (table 5 och 6).

Table 5 – Tightening Torque (NM)'		
Bolts and screws	**Mechanical Connection**	**Electrical Connection**
M 6	10	/
M 8	23	23
M 10	50	40
M 12	85	50
M 14	130	80
M 16	205	125

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

For the bolts and screw-nuts auto-locked of the yoke pressure profiles, the torque has to be lower according to table 6 below

Table 6 – Tightening Torque (NM)'	
Bolts and screws	**Mechanical Connection**
M 8	8
M 10	9
M 12	11
M 14	17
M 16	21

* Applies to steel screws / bolts (type 8.8). Divide values by 10 for torque wrench calibrated in kg.

2.10. INSTALLATION ADVICE FOR HEAT DISSIPATION

To ensure the correct life of the transformer, the heat produced in the core and windings must be released to avoid exceeding the temperature limits.
If the air circulation is insufficient, the transformer overheats in an abnormal way, which in the worst case can cause the thermal protection to trip.

Ventilation becomes effective when the difference in height between the thermal axis of the transformer and the midpoint of the outlet the opening is large enough.

The cooling surfaces must be in contact with the circulating air through suitable intakes (approx 3,5-4 m^3/min. per kW losses).

The room where the transformer is installed must have correct ventilation. Air circulation shortage causes an abnormal overheat that in the most serious case can require the thermal protection relays intervention.

III - COMMISSIONING

3.1. GENERAL INFORMATION

The transformer will be delivered with wheels on the upper side of the truck or separately fastened or packed.

3.2. UNLOADING INSPECTIONS

Upon receipt of the transformer, the plastic must be removed in order to detect any transport damage. This must be done at reception regardless of when the transformer is to be installed. Inspect the transformer and check that all parts are included.

Before unloading the unit, it is extremely important to verify that the transformer has not been damaged during transport. (For example: bent low voltage bars, broken medium voltage bushings, weakened or lacerated connections in between medium voltage phases, coils not perfectly concentric with the core axis).

In the event of a complaint and other contact with Unitrafo, it facilitates communication if the following information about the transformer is stated in the correspondence:

- **Type**
- **Rating Power**
- **Serial Number**
- **Manufacturing Year**
- **Voltages**

This information is stated on the nameplate on the transformer and a photo of this can be attached to an email.

If you find damage 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.

3.3. VISUAL INSPECTIONS

Before energising the unit, it is necessary to verify that no material is blocked in the channels or in proximity of the active parts, as it could seriously damage the transformer.

It is possible that during operations of installation and connection, or during storage, bolts, nuts, washers or other material coming from the surrounding equipments, remain stopped in the winding channels.

It is well advised that after a storing or stoppage, to clean the MV and LV windings, to eliminate dust, condensation and dirt blowing dried compressed air or wiping them with a dry cloth.

3.4. CHECK BEFORE COMMISSIONING

Before energising the unit, an inspection should be carried out in order to guarantee a proper installation and connection of the transformer.

The following points must be carefully examined:

A Clean the HV- and LV-windings and the relevant channels from dust and from dirt by blowing dried compressed air and or wiping them with a dry cloth.

B Preheating of the transformer must be done if condensation has formed during storage or transport. This is most conveniently done with a hot air fan or similar.

C Check the exact functioning of the probes. It is enough to measure the probes resistance in the centralization auxiliary box. The obtained value converted to °C by using the special conversion schedule shall confirm the ambient temperature.

D Check the good tightening of HV and LV connections, as well as all the external connections and the tapping.

E Fix the transformaer to the flooring if designated fixing points/lugs are available.

F Check that the windings are concentric to the core axis. Check carefully that the cooling duct between the windings is symmetric. In case of extreme non-symmetries in the cooling ducts, contact the supplier.

G Inspect the insulation of the windings, among themselves and towards earth, with a megohmmeter type Megger with a voltage over 3 kV.

H Check that all connections are intended for the specific feeding voltage, see the data plate/wiring diagram on the transformer.

I Check all the transformer protection devices against eventual overvoltages.

J Check the positions of the connection bars on the primary voltage regulation tapping board. It must be the same on all three HV-windings and must correspond with the specified feeding and loading voltages. In case the voltage exceeds the one allowed, the no load losses and the noise will increase.

K Check the motors of the fans – if provided.

L Connect to ground the designated points of the transformer.

M After the assembly is carried out, verify the connections and the adjustments of the auxiliary box, see the manual provided with this unit – if foreseen.

N 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 mistake 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.)

O Check that all metal parts, such as frames, walls or channels, are placed at correct insulation distances from all the active parts, as indicated in this manual.

P It is strictly forbidden to place HV- and/or LV-voltage wiring, metal parts or any other things close to the windings. The windings are active parts. Wiring that is fitted too close to the windings or a Delta connection can cause serious damage to the transformer.

Q Check that bolts and nuts are securely tightened. This is important, especially if the transport has been characterized by several loading and unloading. – For exact mechanical tightening, see information included in this manual.

R Check carefully that the windings not have been damaged during transport.

S Check that the cooling duct of the high- and low voltage windings are free from packaging residues, such as nylon, paper, adhesive tape, cobwebs etc.

T Carefully check that the cooling duct between high and low voltage winding is symmetrical. If there are large asymmetries in the cooling ducts, contact your dealer (Unitrafo).

IV – OPERATION AND MAINTENANCE

4.1. GENERAL INFORMATION

A careful check of the unit during its operation can prevent defects and permit a longer life of the transformer.

The client shall:

- perform most of the controls mentioned above when suitable for the client's requirements
- document the results of these controls
- arrange a maintenance and intervention program for the transformer to analyse the unit performance in its whole life.

4.2. VOLTAGE CHANGE OPERATION

Pay special attention when a change of voltage is required in doble primary voltage transformers. Read carefully the indications on the transformer rating plate.

When performing this operation, it is advisable to carefully read the information on the rating plate and the wiring diagram on the transformer.

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

- *Feed the medium voltage with a suitable low voltage available on site.*
- *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.*
- *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.*

4.3. VOLTAGE TAPPING OPERATION

When it is necessary to adapt the tapping to the feeding voltage proceed according to the following directions:

1 Disconnect the unit on both medium and low voltage sides and connect it to ground.

2 Set the tapping plates in the most suitable position according to the feeding voltage required (as per figure 10) and tighten carefully with tightening torque according to position 2.9, table 5 on page 11.

3 Reconnect the transformer and remove the connection to ground.

4 Energize the transformer.

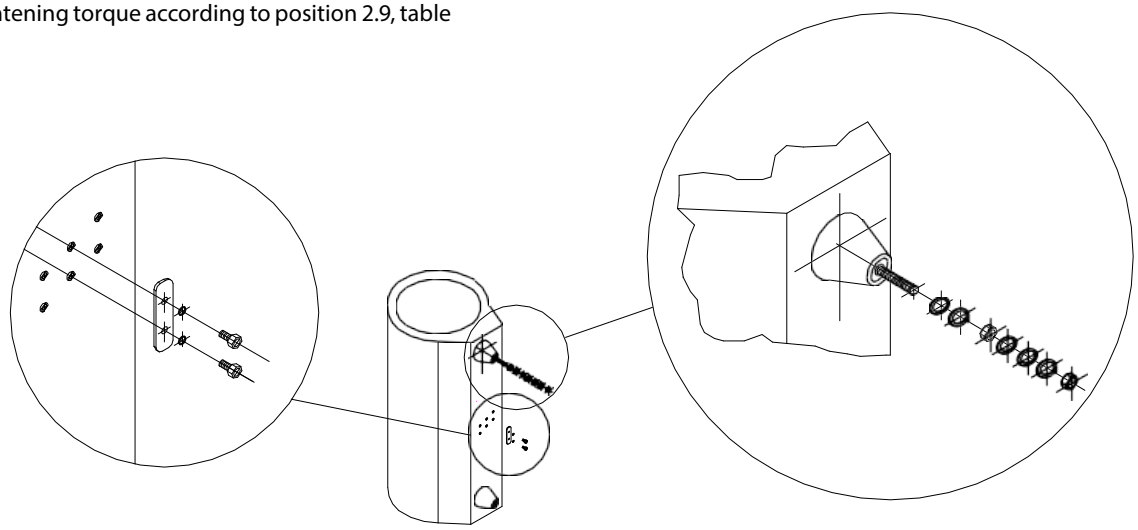
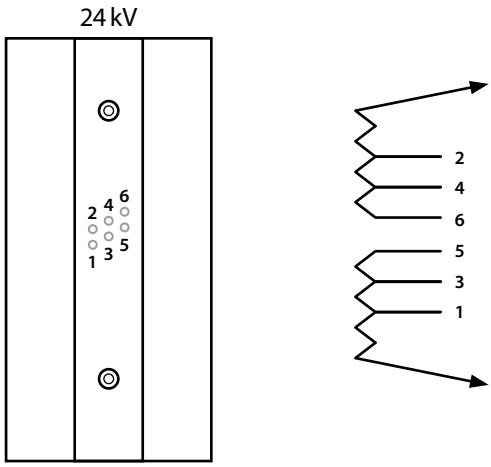


fig 10

MV WINDING TAPPING IN CASE OF SINGLE VOLTAGE

In order to obtain the secondary voltage variation, act on the primary winding adding or taking off turns. See figure 11 for standard tapping on our transformers.

The plate shown on the right is applied on the transformer to point out the proper position (+5% of the primary voltage correspond to a variation of -5% in the secondary voltage). The chosen positions must be identical in all three phases.



REGOLAZIONE*	
1 – 2	- 5%
2 – 3	- 2.5%
3 – 4	0
4 – 5	+ 2.5%
5 – 6	+ 5%

*SWITCHING

fig 11

MV WINDING TAPPING IN CASE OF DOUBLE VOLTAGE

In case of two primary voltages (e.g. 10-20 kV), two adjustment units are required.

The voltages variation is obtained by putting the windings in line or parallel as shown in fig. 12.

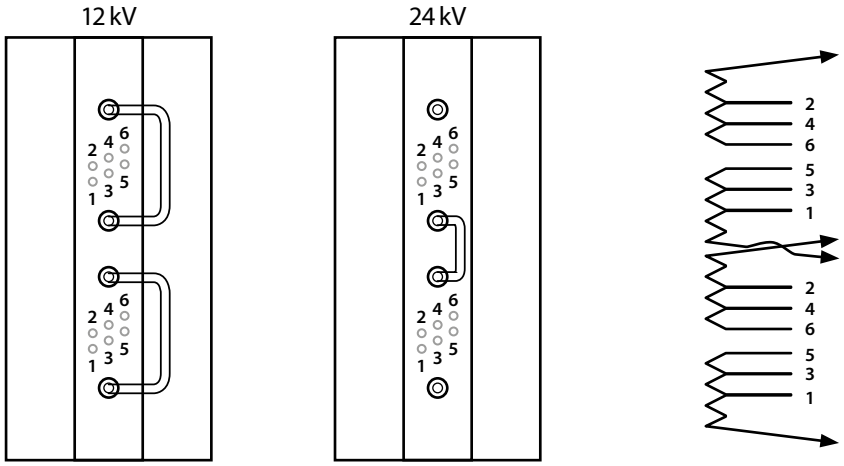


fig 12

4.4. PERIODICAL CHECKINGS

It is recommended to periodically check (every six months, based on the ambient installation or plant shutdown) that the both MV and LV windings are clean from dust and dirt. Clean the HV- and LV-windings and the relevant channels from dust and from dirt by blowing dried compressed air and or wiping them with a dry cloth.

To ensure a long life and durability of the transformer we advice you to make all the inspections that are mentioned in the previous chapter on a regular basis.

4.5. WARRANTY

All transformers are warranty covered for a time period starting from the dispatch date in accordance with the agreement and with GBE Sales Conditions. The warranty applies to Ex Works, Vicenza, Italy.

The warranty is limited to the unit replacement or reparation on Ex-Works basis, i.e. in our factory in Vicenza, Italy, transports excluded.
GBE S.p.A. decline any responsabilities for damages due to the unit breakdown.