ELETTROMECCANICA COLOMBO

CAST RESIN TRANSFORMERS
INSTRUCTION MANUAL

INSTALLATION , OPERATION, MAINTENANCE

Issue 03/2007

SUMMARY

NOTE: data contained herein may differ in small details from the transformer delivered.

We reserve the right to make alterations without notice.

A) INSTALLATION

1.0 INTRODUCTION

This manual defines the conditions for utilisation ,putting into service, maintenance and safety rules compliance for cast resin transformers according to IEC 726 standards, in order to avoid wrong manoeuvres and misuse.

1.1 Parts identification

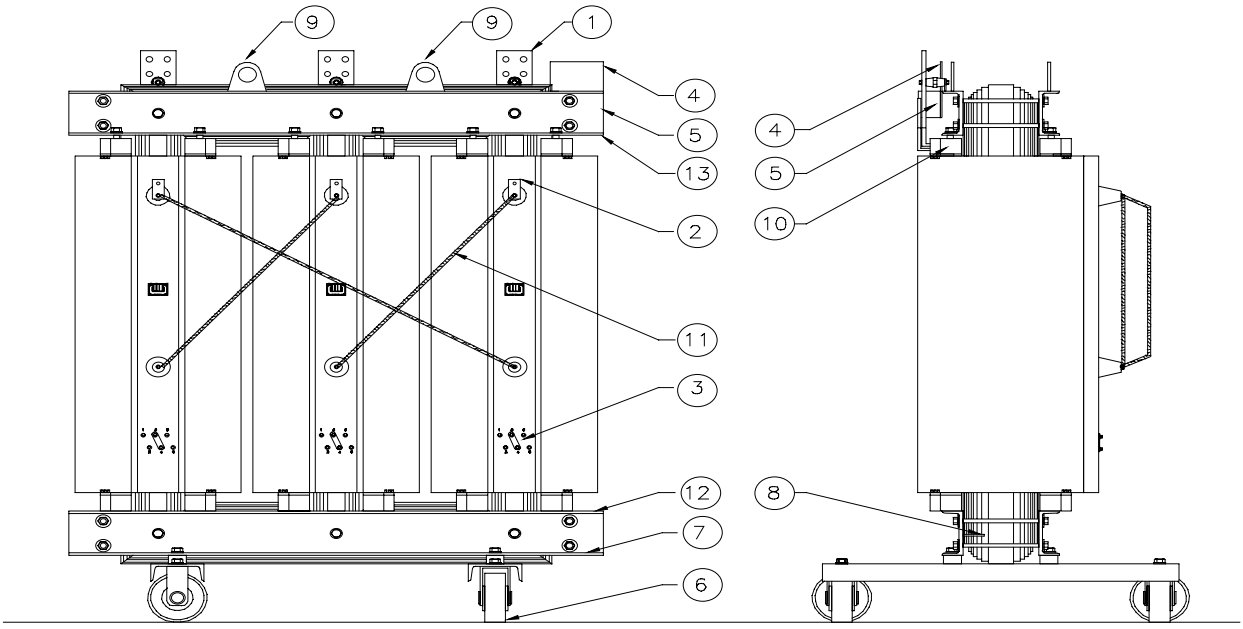


Fig. 1

N°	Description
1	LV terminals
2	HV terminals
3	Plates for tapping
4	Name plate
5	Auxiliary box
6	Bidirectional wheels
7	Pulling holes
8	Earthing terminal
9	Lifting lugs
10	Coil supports
11	Connecting bar
12	Lower clamps
13	Upper clamps

2.0 TRANSPORT

In order to avoid damages during transportation, the transformers must be accurately fixed with ropes or belts, utilising the hooks located on the transformer.

The transformer MUST NOT BE transported with the wheels assembled.

3.0 ACCEPTANCE

At the receiving, before unloading the transformer, it must be made an accurate check in order to verify possible damages occurred during the transportation..
If the inspection points out damages or faulty handling, it is necessary to do as follows:

a) notice on the transport documents that the shipping has been received damaged or incomplete, specifying date and signing
b) if the transformer has moved on the transportation, issue a short relation on the fixing conditions
c) ask for a verification on site from carrier's insurance surveyor
d) fill a formal reservation and damage covering request to the carrier
e) communicate by letter anticipating by fax to our company the damage occurred.

4.0 HANDLING

4.1 Lifting

Lifting must be made utilising the four lifting hooks on the upper clamp(fig 2) remembering to use ropes adequate to the mass to be lifted(see the mass on the nameplate) and enough long so that the maximum angle shot of the ropes do not exceed 60°.

NEVER use fork lift for lifting from the bottom (fig 3) because the magnetic core, which sticks out from the lower clamps, makes unstable the transformer, causing it to fall down. Furthermore, even if the transformer will not fall down, the magnetic core risk to be definitively damaged.

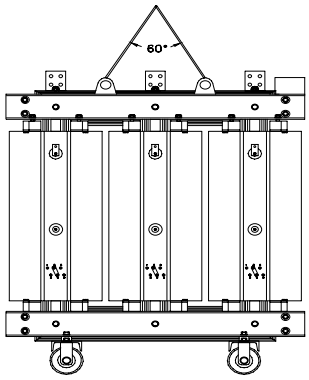


Fig. 2

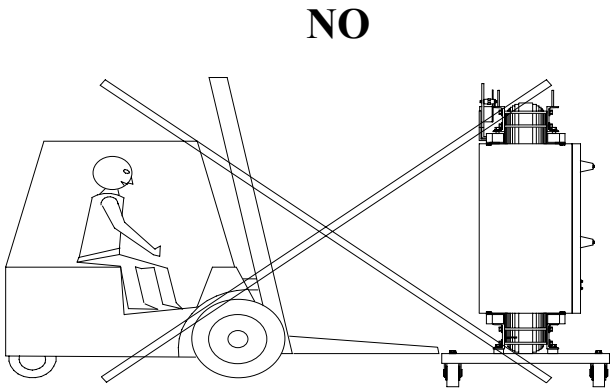


Fig. 3

4.2 Translation

The translation of the transformer must be made by using ropes apt for the mass to be moved; the ropes must be hooked to the holes in the bottom channels (fig 4); translation can also be done manually utilising a lever as shown in fig. 5

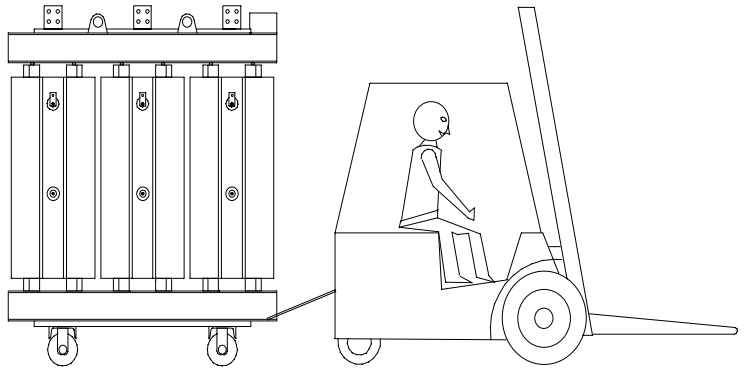


Fig. 4

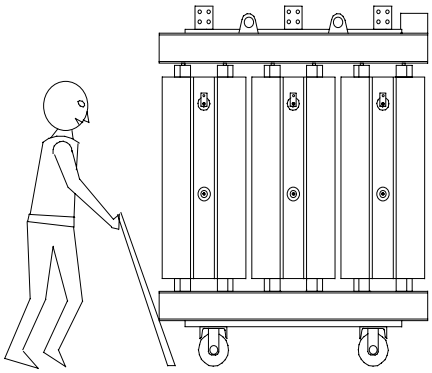


Fig. 5

DO NOT make manual or mechanical translations pushing directly the resin coils. (fig. 6 e 7)

NO

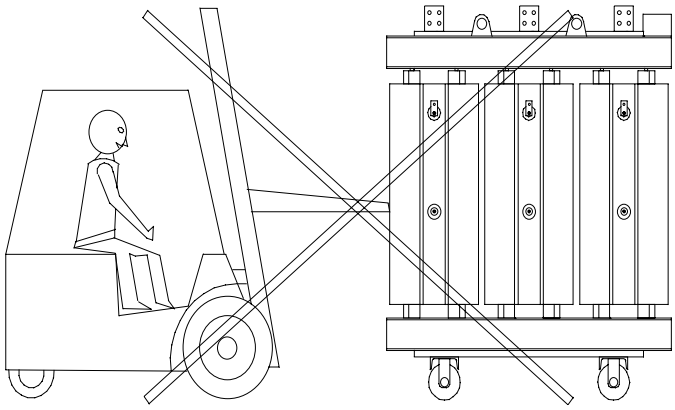


Fig. 6

NO

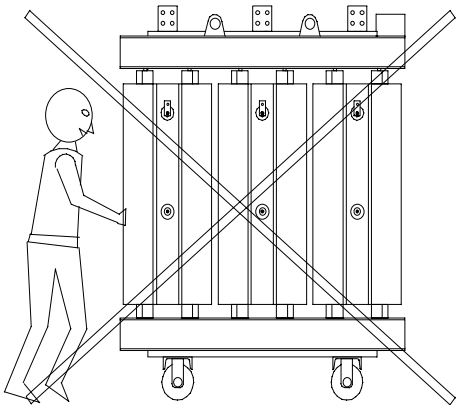


Fig. 7

5.0 STORAGE

If the transformer is not used immediately, it must be stored in a covered and dry site, with temperature no lower than 20 °C and the protecting plastic wrap must be kept up to the utilisation moment. If the protection has been damaged during the transport or discharge operations, it must be restored in order to avoid dust and moisture accumulation .

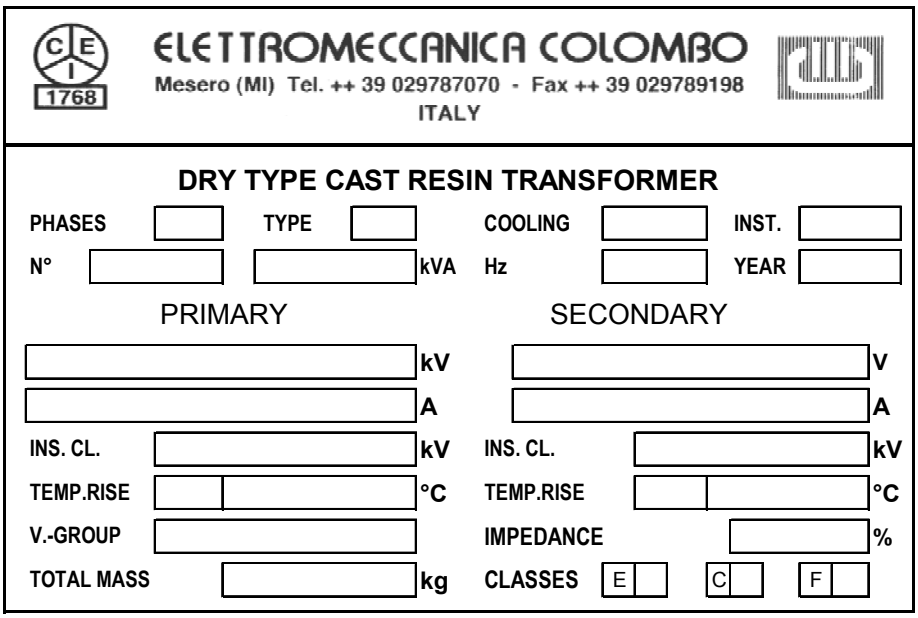
B) OPERATION

6.0 TECHNICAL BASIC DATA

Cast resin transformers, as they are built, are designed exclusively for inside installation, by having a protection degree IP00: hey must be installed in dry ambient, without possibility of water fall –leakage.
They can be installed outdoor inside a box, protecting form water, with a minimum protection degree IP 23.
During the installation, the safety rules and the existing laws concerning accidents at work must be observed
If not otherwise stated, the maximum height above sea level must not exceed 1000 mt .

6.1 Name Plate

The transformers must be used as per data reported on name plate.
See the name plate on the transformer upper channel.



6.2 Minimum insulation distance

The resin surface does not protect against direct or accidental contacts.

It is absolutely forbidden to touch the resin coil when the transformer is energised.

For this reason, the installation must always be inside a barrier or a box , where the access is allowed only by means of interlocked doors opening only when the transformer is not connected to the net..
The transformer inside the box must be located in order to respect the minimum permissible insulation distances against the walls.
These distances depend upon the maximum voltage Um of the transformer and are listed in fig 8 .

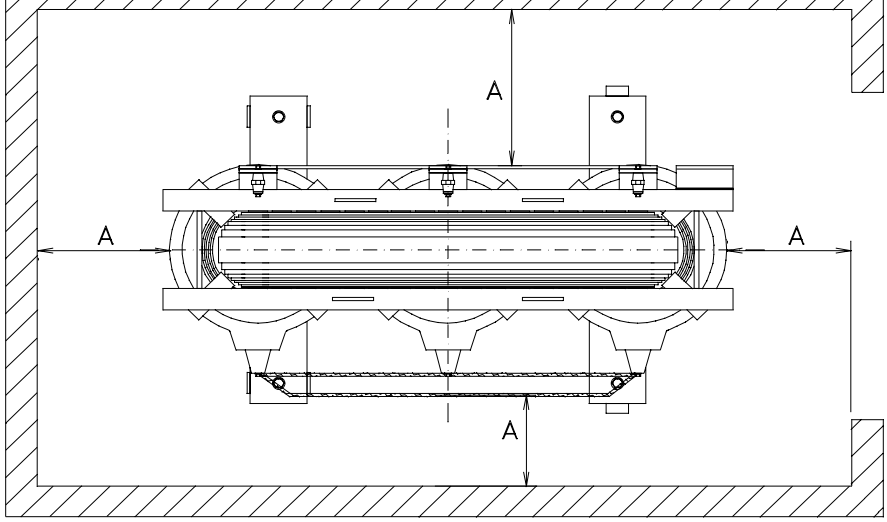


Fig. 8

Um (kV)	12	17,5	24	36
A mm	110	170	225	330

6.3 Ambient temperature and operating temperature

Ambient temperature must not exceed maximum 40°C and minimum –5°C.
IEC standards indicate that the temperature must not exceed the average daily value of 30°C and the yearly average value of 20°C.
The working temperature of the transformer varies in relation to the insulation classes as indicated in the following table.

Insulation class	Temperature range
B	- 5°C ÷ +120°C
F	-5°C ÷ +140°C
H	-5°C ÷ +165°C

6.4 Dissipation of heat produced from transformer

6.4.1 Natural Cooling

In order to prevent overheating, which may cause working problem, it is necessary that the thermal energy produced from the transformer is adequately dissipated. This problem is particularly important when the transformers are installed in places or boxes of reduced dimension.
In these cases it must be provided an adequate air flow, with grated louvers at the bottom for intaking fresh air and at the top for exhausting warm air (fig. 9).

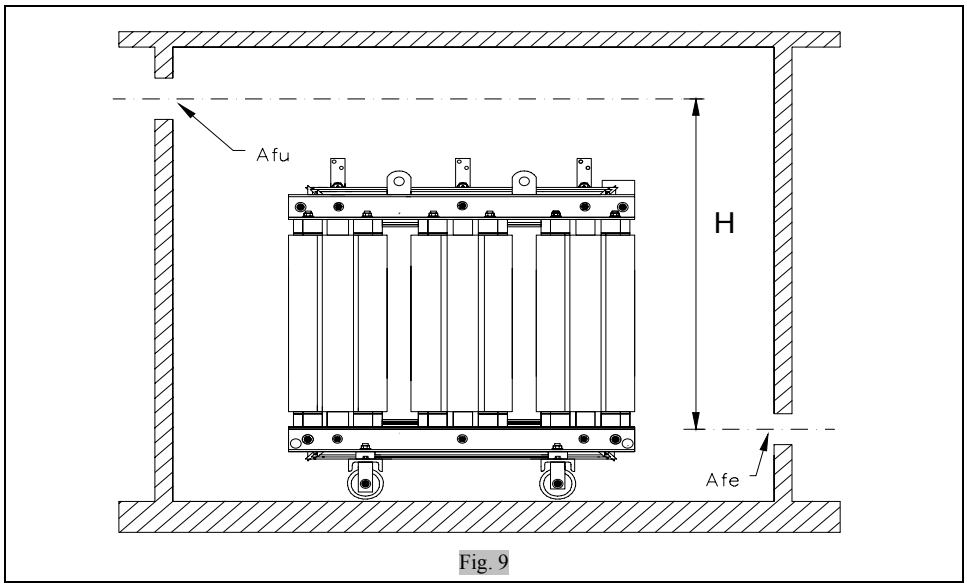


Fig. 9

The formula used to calculate the exhaust of the heat generated from the transformer losses P (kW), takes into consideration the total area of the openings Af and the distance H from the openings.(for conversion ,1KW= 0,86 Kcalories)

Afe = P x 0,188 / √ H
Afu= 1,10 x Afe
Afu= Area of upper louver in m² (excluded the grate surface);
Afe= Area of lower louver in m² (excluded the grate surface)
P = Transformer total loss in KW;
H = Central line distance of the upper and lower louver in mt.

6.4.2 Forced ventilation

When the room dimensions of the room do not allow an adequate exhaust of the heat, or in case of frequent overloads or average temperature higher than 20°C, it is necessary to provide a forced ventilation by means of a fan. This can be operated by an ambient thermostat .
In this case the flow suggested in m³/s at 20°C is equal to 0,05 P (P= total losses in kW).

6.5 Overvoltages

Two types of overvoltages can occurr in the transforming rooms:

a) atmospherical:

these are originated in the distribution net from direct lighting or from static charges; they are frequent during storms: the effect are as much bigger as the aerial net is longer .
Particular production clever devices guarantee the correct working of the transformer, independently from the repeated presence of overtensions in the net, provided that these do not exceed the values foreseen from the coordination of the insulation related to the net itself. .

b) manoeuvre:

these are caused by the openings and closing of the primary net switch, by sudden switch-off of big load and or by capacitors batteries, either for service reasons and for tripping of the relevant protection.

These overvoltages can have dimensions similar to the atmospherical ,but lasting some hundreds µs.
Any MV cable has a considerable capacity/meter, and as a consequence when a cable of a certain length feeds a transformer off load, the small primary current involved produces an increase of the voltage at the extremities.
Furthermore, if the cable feeding is perturbed from an overvoltage, this is drastically amplified along the cable, so to the transformer can be reached by a voltage much higher than the maximum allowable. As a consequence, it is necessary to protect the cable terminations against overvoltages .

6.6 Connections

In figures 10 and 11 are illustrated some examples of connection of cables or bars MV and LV with incoming line from upside and downside .
In all the cases, the cables-bars must be rigidly fixed in order to avoid dangerous mechanical solicitations to the insulators-terminals.

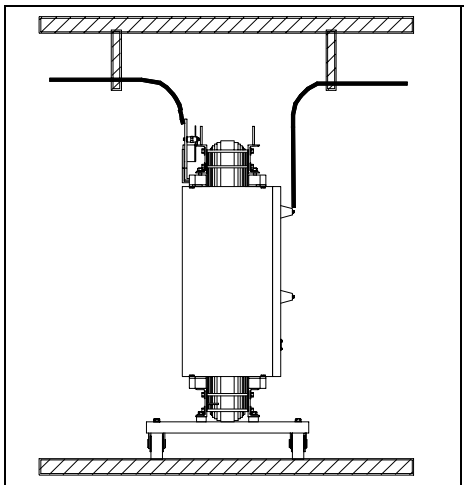


Fig. 10

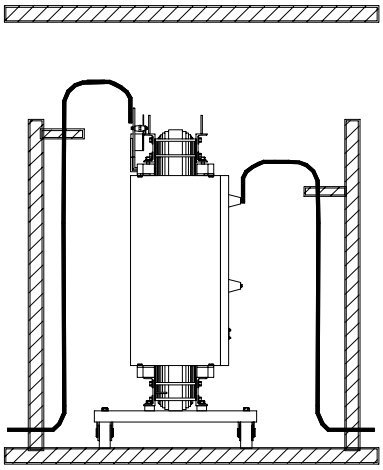


Fig. 11

LV cables must no be laid upon resin coils. It is advisable to keep the minimum insulation distance (see point 6.1) also for cables.

7.0 PUTTING INTO SERVICE

7.1 Preliminary controls

Before feeding the transformer, make the following checks :

a) Cleaning:

After having detached the protecting plastic wrap, take away dust depots which could have been originated from the long stocking period, with low pressure compressed air.
Control that cooling channels between MV and LV are not closed, and eventually clear with compressed air Do not introduce any object between MV and LV .

b) Earth connection

Make sure that the transformer earthing plate (located in the internal side of the lower channel) is connected with a conductor apt to sustain default currents in case of discharge against the magnetic core, accordingly to IEC norms.

c) Connections:

Make sure that the windings have not been moved .
Verify the tightening of the bolts MV and LV.

When temperature control devices are installed (thermometer, temperature monitoring units, fan control units etc..) verify that the intervention level of the alarms are settled (see point 7.3) and make sure that these units are perfectly working.

d) Tightening control:

Check tightenings, either electrical and mechanical, as per value indicated in the table.

Screw	Electrical connections (Mn)		Mechanical connections (Nm)
	Iron	Brass	
M6	15 - 20	10 - 15	35
M8	40 - 50	15 - 20	60
M10	60 - 70	30 - 40	85
M12	70 - 80	50 - 60	95
M14	100 - 120	70 - 80	150
M16	130 - 140	90 - 100	230
M18	/	/	320
M20	/	/	450
M22	/	/	600
M24	/	/	750

e) Tap changer:

Do not make regulations when the transformer is energised.

The voltage supplied form the net can fluctuate; these fluctuations can be balanced by means of the tap changer, using the tapping plates in order to have constant the voltage to LV terminals .
When MV voltage decreases, for instance from 15000 down to 14625 V (- 2,5%), LV voltage decreases in the same percentage, changing from 400 to 390 V (off load voltages).
To bring LV voltage to desired level (400V) it is necessary to set the tapping plates on position "-" (terminals 2 – 3 fig. 12).
If the voltage increases, the balance is made moving the tapping plates to positions "+" or "++"

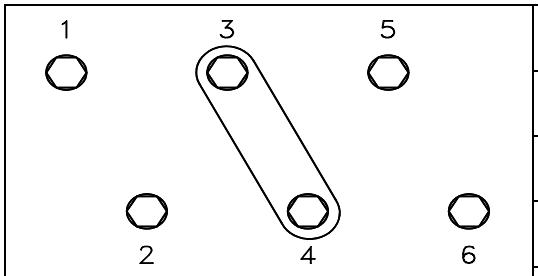


Fig. 12

1 - 2	- -
2 – 3	-
3 – 4	0
4 – 5	+
5 – 6	+ +

The tapping used must be the same for all the MV coils, in order to avoid circulating current which can damage irreparably the transformer.

When the transformer is having two tapping boards for each phase (fig. 13), it is compulsory that te tapping plates be on the same position on all six boards in order to avoid circulating currents.

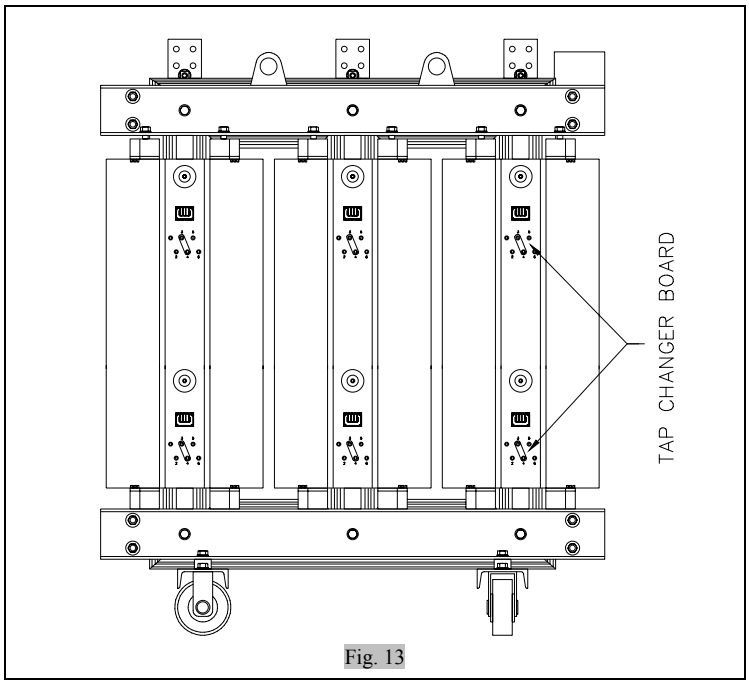


Fig. 13

f) Transformers with two MV tensions :

For the transformers having two primary voltages (ex. 15000 – 20000 V), the voltage tapping varies according to the required voltages; as a consequence it is necessary to refer to the connecting scheme reported in the test report and annexed.

g) Parallel connected transformers:

If the transformer must work parallel with others transformers, the following conditions must be respected

- same vector group
- same short circuit voltage (in %);
- same turn ratio in all tapping positions
- ratio between rating power of the transformers must not be higher than ½ (one transformer cannot have rating power higher than two times the other).

h) Insulation level:

Control insulation level between the windings and against mass with a megaohmeter (Megger type) having voltage 5000 V.

The values to be found are the following:

- MV → mass = 250 MΩ;
- LV → mass = 50 MΩ;
- MV → LV = 200 MΩ.

7.2 Temperature control

Resin transformers are supplied as standard with 3 thermistors PT100, one per each LV winding and upon request one also for the magnetic core.
In order to control the temperature, is necessary to connect the thermistors to the monitoring unit.
The connection to the monitoring unit are made in the auxiliary box, according to the reported schemes (fig 14 for N° 3 PT100 and fig. 15 for N° 4 PT100).

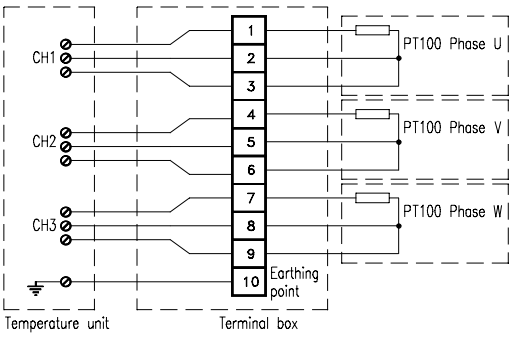


Fig. 14

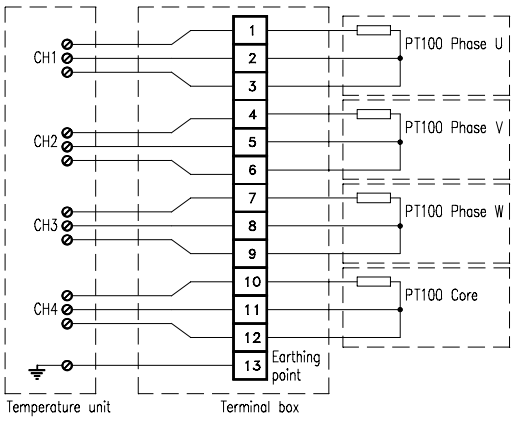


Fig. 15

The connection of the terminals from the auxiliary box to the monitoring unit must be done utilising cables with screen, size 3x1,5 mm² (one for each thermistor).

According to the insulation class of the transformer, the temperature monitoring unit must be settled as reported in the following table.

Insulation class	Temperature setting		
	Fan insertion	Alarm	Trip
Class B	+ 90° C	+ 110° C	+ 120° C
Class F	+ 110° C	+ 130° C	+ 140° C
Class H	+ 130° C	+ 150° C	+ 165° C

NOTE: IT IS POSSIBLY TO AVOID THAT THE TEMPERATURE UNIT ARE CONNECTED WHEN MAKING THE COMMISSIONING –ENERGISING STEPS.

7.3 Overloads

Our transformers are designed and built in order to work at nominal power with a normal ambient temperature as defined in IEC standards (see point 6.2).
The working life of the transformer depends from the lasting of its insulation; the speed of deterioration of the insulation increases at the increase of the working temperature, which in its turn depends upon the load cycle to which the transformer undergoes.
Notwithstanding that ,some overlaods are permitted without compromising the expected life of the transformer, at the conditions that they are compensated with normal load lower than the nominal power.
The overload current anyhow cannot be higher than 1,5 times the value of the nominal current.
The value and the duration of the overload are determined by the initial load conditions, by the ambient temperature and by the time constant of the transformer.
In the following tables are listed some typical overloads; for different situations and clarifications please contact our Technical Dept.

Overloads permitted without exceeding temperatures allowed from standards IEC, ambient temp. **40°C**

Former load at running conditions as a percentage of nominal power	Permitted overload (in minutes) as a percentage of nominal power				
%	10%	20%	30%	40%	50%
50	150	75	50	25	12
75	100	50	25	12	6
90	50	25	12	6	3

Overloads permitted related to ambient temperature

Former load at running conditions as a percentage of nominal power	Ambient Temperature	Continuous overload admitted as a percentage of nominal power	Power reduction as percentage of nominal power
%	°C	%	%
100	0	30	-
100	10	25	-
100	20	26	-
100	30	8	-
100	35	4	-
100	40	0	0
100	45	-	6
100	50	-	15

7.4 Feeding

After making all the preliminary controls as indicated in the previous chapters, it is possible to give voltage to the transformer, feeding it off load. This insertion causes an inrush current which varies from 8 to 12 times the nominal current.

This transient period has a duration of few seconds; the intervention time of the circuit protection on primary side must be delayed in order to avoid unuseful tripping during these current peaks.

After positive off load connecting, the load can be applied to the transformer on LV side.

It is to avoid repeating of starting-closing manoeuvres.

C) MAINTENANCE

8.0 CONTROLS-FREQUENCY

Resin transformers need a reduced maintenance.

It is necessary to carry out periodically some checks, which frequency depends on ambient and working conditions :in clean spaces, dry and with regular and uniform working cycles, time intervals are reported in the table; in dusty, humid ambient, or when high and frequent load variations happen, as well as temperature, the checks must be done with a frequency reduced to the half of the one indicated below.

	Intervention frequency	
Control	3 months after starting	Every 12 months
Thermistor efficiency	X	X
Cleaning of dust, dirty, moist		X
Tightening of bolts and nuts MV/LV	X	X
Tightening clamps of auxiliary box	X	X
Check of temperature monitoring unit	X	X
Control of coil supports	X	X
Tightening of bolts of coil supports	X	X

In case of atmospherical discharges, accidental short circuits on LV side and anyhow whenever working anomalies are occurring, check insulation level (see point 7.1 /e).

9.0 ASSISTANCE

ELETTROMECCANICA COLOMBO provides a continuos post sale assistance to his customers for whatever problem concerning the running and the utilisation of his transformers.
For any need please contact our Commercial Dept indicating the serial number and the data of the transformer reported on the name plate.

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