

INSTALLATION & OPERATION MANUAL

DISTRIBUTION TRANSFORMERS

CAST RESIN TRANSFORMER up to 4 MVA



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PARTNERSHIP

SAFETY

DURABILITY

Contents

1.0 General	5
1.1 Information Concerning this Manual	5
1.2 Safety Information Symbols	5
1.3 Transportation	6
1.3.1 Lifting the Transformer	6
1.3.2 Moving the Transformer	7
1.4 Storage of Transformers	8
1.5 Cleaning	8
2.0 Installation & Connections	10
2.1 Installation Examples	10
2.1.1 Installation with Enclosure	10
2.1.2 Installation without Enclosure	11
2.2 LV Connections	12
2.3 HV Connections	13
2.4 Tightening Torque for Electrical and Mechanical Connections	13
2.5 Positioning	14
2.6 Ventilation	15
2.7 Temperature Monitoring Systems	17
2.8 Earth Connections	18
2.9 Safety Instructions	19
3.0 Putting Into Service	20
3.1 Condition for Correct Operation of the Transformer	21
3.2 Tappings for Voltage Regulation	21
3.3 Energizing	21
4.0 Rating Plate	23
5.0 Maintenance	24
5.1 Suggested Maintenance and Control Activities	25
5.2 Suggested Maintenance for Specific Installations	25
5.3 Troubleshooting Guide	26
6.0 Components	28
7.0 Standards	30
Notes	31

GENERAL



1

1. General

1.1 Information Concerning this Manual

This manual contains important information on transformer equipment, handling, operation etc. Full compliance with the safety and service instructions given herein are important conditions for safe and smooth operations. Additionally, all applicable local safety and accident prevention instructions and regulations should be taken into consideration in conjunction with this manual.

All persons involved with the installation and/or use of this equipment must read, understand and follow the instructions of this manual before installing, starting any work, and/or operation of this equipment. This equipment must be properly installed before it is used. If instructions are not followed, the manufacturer will not be held responsible for any problems or equipment malfunction. Failure to follow installation and/or operating instructions voids the warranty.

This manual is an integral element of the product. It must be stored close at hand and must be available to all personnel at all times. In an attempt to make things clearer and easier to understand, pictures contained in this manual may have been magnified, or they may not show exactly what you see on your specific equipment.

The documentation accompanying this equipment may contain further instructions, manuals etc. by OEMs of components integrated with this equipment. Be sure to comply with this information (especially safety and security information), in addition to all the information contained herein.

1.2 Safety Information Symbols

This manual uses symbols to highlight information concerning health, safety and security. Such information always starts with an eye-catching title like “Danger”, “Warning” or “Caution”, indicating the degree to which life, limb or property are at risk.

Such information must be absolutely complied with. Use common sense and caution to avoid accidents and damage to persons and property.



DANGER

Indicates a dangerous situation that is imminent and direct and will cause the death of people or severe injuries unless properly avoided.



WARNING!

Indicates a situation that may become dangerous and cause death or severe injuries unless properly avoided.



CAUTION!

Indicates a situation that may become critical and cause damage to property unless properly avoided.



NOTE

Highlights tips, tricks and useful information to help you operate your equipment trouble-free and efficiently.



Danger to life caused by electric voltage!

Indicates life-threatening situations caused by hazardous voltages. There is a danger of serious injury or death if the safety notes are not complied with.

The work to be performed must only be carried out by qualified electricians.



CAUTION!

Important information. Failure to comply may lead to material damage due to incorrect current and/or voltage.

1.3 Transportation

Secure the transformers properly during transport using the holes in the upper clamps.

At destination, it is highly recommended to examine the transformer thoroughly to verify if any damage has occurred during transport (LV bars, HV connections, broken insulators, cracks in the HV windings, dirt or humidity, damaged protective enclosure, foreign objects between the windings, etc.).

Any non-conformity must be recorded on the delivery note and notified to the shipper or to **alfanar Electrical Systems (AES)** by fax or by registered mail within 3 days of receipt of the transformer.

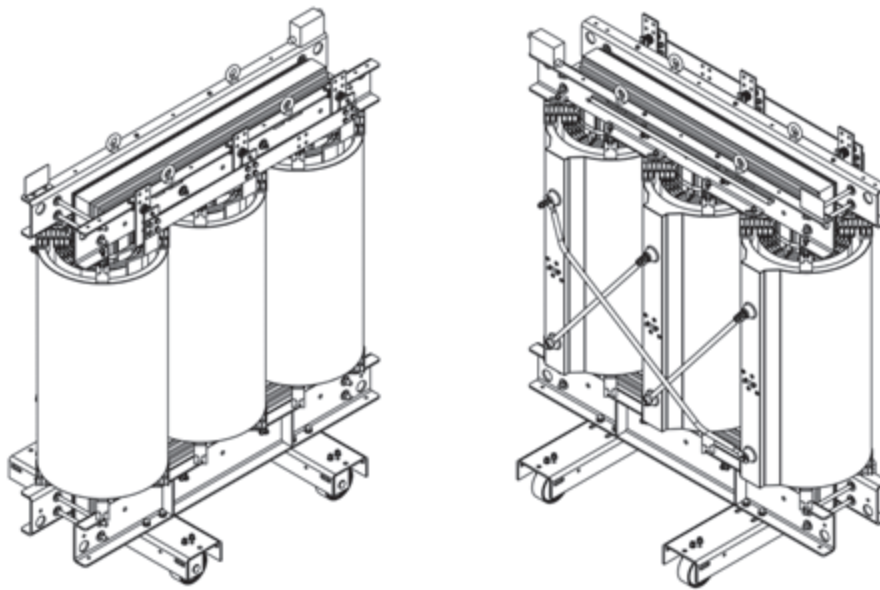


Figure 1.1 Sensitive components of CRT

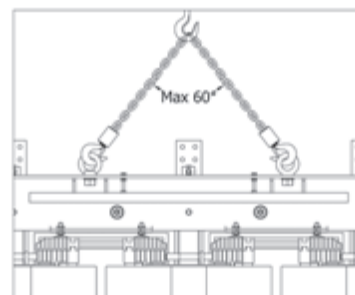
1.3.1 Lifting the Transformer

Lifting by means of slings or a lifting beam

The unit must be handled with 4 lifting rings located on the transformer.

Handling using a forklift truck

Forks must only lift the chassis from within the inverted channel sections, with idler rollers removed.



This unit must be handled with 4 lifting rings located on transformer

Figure 1.2 Lifting and moving of transformer

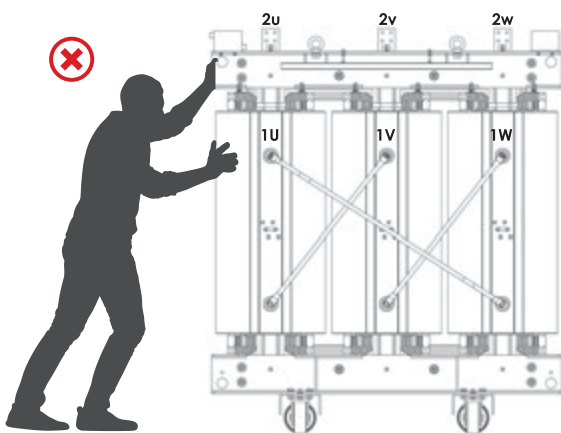
1.3.2 Moving the Transformer

Move the transformer, whether alone or enclosed in an integral sheet metal enclosure, by leverage against lower clamps or by means of its towing holes only.

The unit can move in two directions only, depending on how the rollers are oriented. The rollers are only to be used over short distances i.e. maximum 10 meters.



Do not move the transformer by pushing the HV casted windings!



- The unit can move in two directions only depending on how the rollers are oriented.
- Maximal displacement distance with the rollers: around 10 mt.

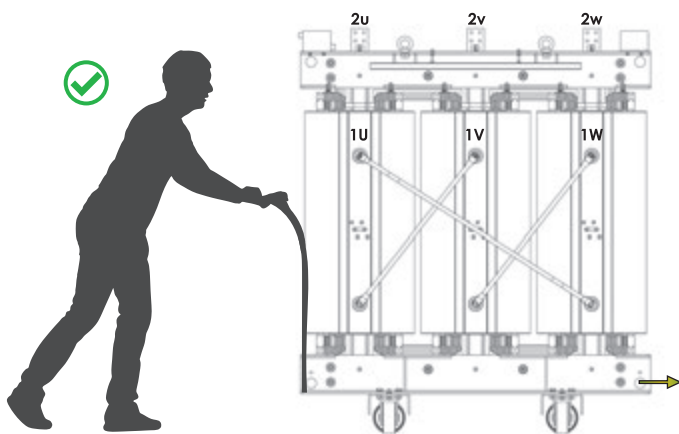


Figure 1.3 Pushing the transformer

1.4 Storage of Transformers

If not installed immediately, the transformer should be protected against water, dust and humidity. Moreover, the PVC protection sheet should not be removed when in storage. Storage temperature should not be lower than -25°C .



Figure 1.4 Storing the transformer

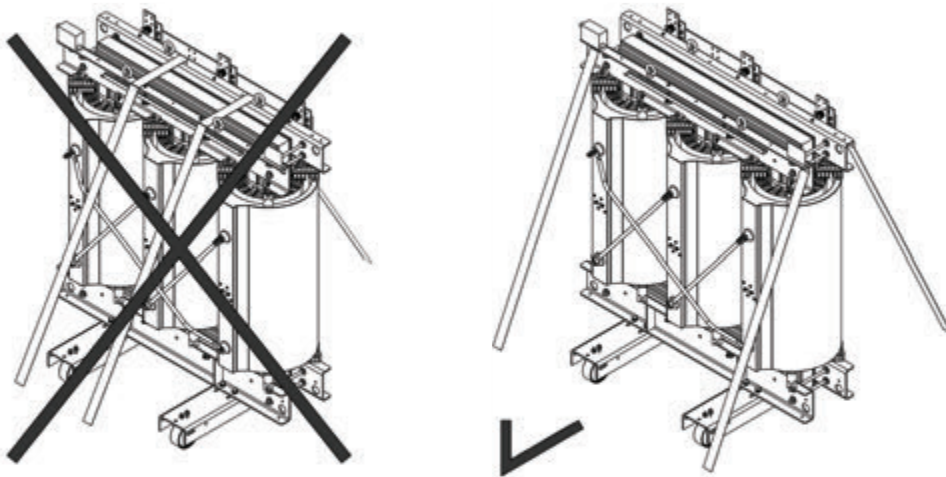


Figure 1.5 Proper storage of the transformer

1.5 Cleaning

If the transformer has been stored for a long period, clean it thoroughly. Clean the HV and LV windings from dust deposits, dirt and condensation. Use a vacuum cleaner to avoid dispersion of dirt and dust on the transformer.

If the transformer has been installed in a high pollution / powder environment, clean it with compressed air when the dusty accumulation on the top winding is more than 5 mm. If the transformer is in operation, use the self-air flow cooling provided to clean it thoroughly.

INSTALLATION & CONNECTIONS

A technical line drawing of a mechanical assembly, possibly a door or panel mechanism, showing various components like hinges, bolts, and structural beams. The drawing is rendered in a light gray color against a dark gray background. A large, bold white number '2' is positioned in the bottom left corner of the page.

2

2.0 Installation & Connections

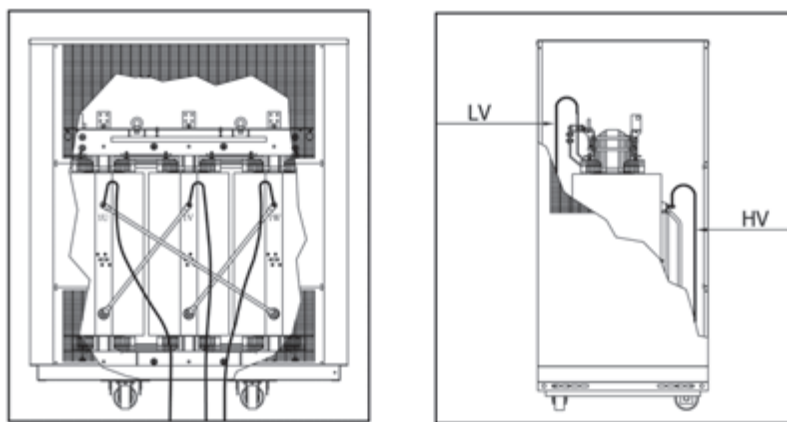
The dry type cast resin transformers from **alfanar Electrical Systems (AES)** are for indoor installations, in clean and dry environments, without risk of water intrusion, to a maximum ambient temperature of 50°C.

During installation refer to the safety rules for your country. If there is any risk due to the presence of inflammable or explosive substances, apply and follow your national directives.

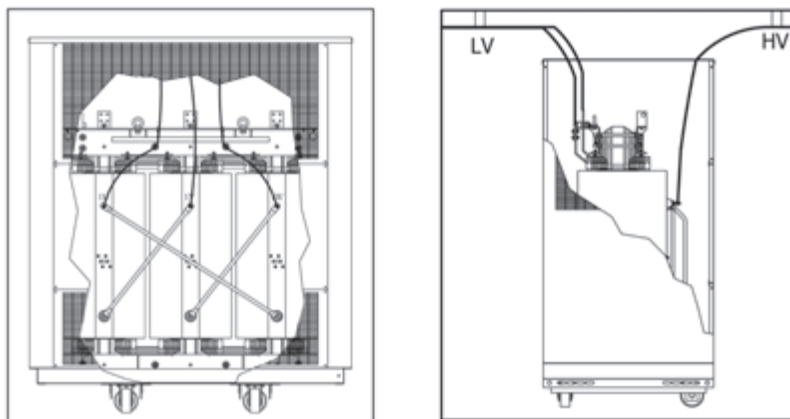
2.1 Installation Examples

2.1.1 Installation with Enclosure

The transformer with metal enclosure can be designed to be suitable for receiving the cables either from bottom or top entries as per the site requirements as shown in the below figures.



Bottom cables entry



Top cables entry

Figure 2.1 Installation with enclosure

Cable entry plates for low voltage side will be manufactured from non ferrous material. Proper cable glands and lugs must be used to prevent any electrical and mechanical stress on the high voltage and low voltage terminals of the transformer.



NOTE: in some countries the Terminal Identification shall be: Primary: 1A, 1B, 1C; instead respectively: 1U, 1V, 1W. Secondary: 2a, 2b, 2c, 2n instead respectively: 2u, 2v, 2w, 2n. Tertiary: 3a, 3b, 3c, 3n; instead respectively: 3u, 3v, 3w, 3n.

2.1.2 Installation without Enclosure

The high voltage terminal of the transformer side is suitable for both bottom and top connection as per the below diagram. The cable can be connected to the transformer after layout in the bottom cable tray or from the top cable tray as per the site requirements.

The low voltage terminals of transformer side is suitable for both top and bottom cable termination. If the busbar connection is used on the top side, the connection of the busbar to the LV terminals must be a soft connection to avoid mechanical impact on the low-voltage winding.

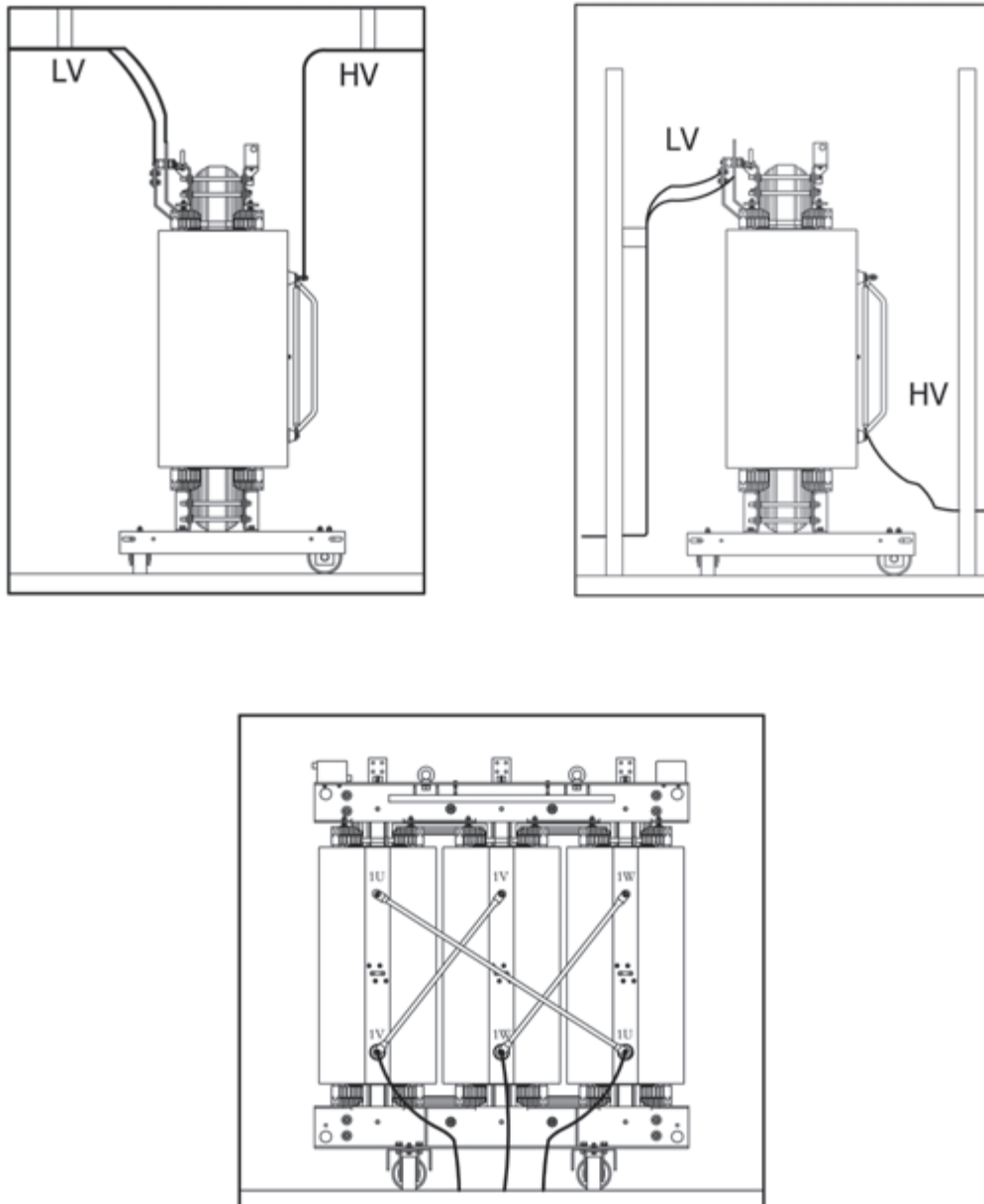


Figure 2.2 Installation without enclosure



Distance between cables and transformer active parts to be maintained based on electrical clearance as per table in Figure 2.6.

HV and LV cables must always be supported to avoid mechanical stress on the transformer terminals.

2.2 LV Connections

Usually, the LV connections in the upper part of the transformer are aluminium. The cable connection should be done with tinned-copper cable terminals. Connect one or two cables per hole as shown in the following figure.

The connection should also be directly made using aluminium or tinned copper busbar with the same hole configuration as shown in the following diagram.

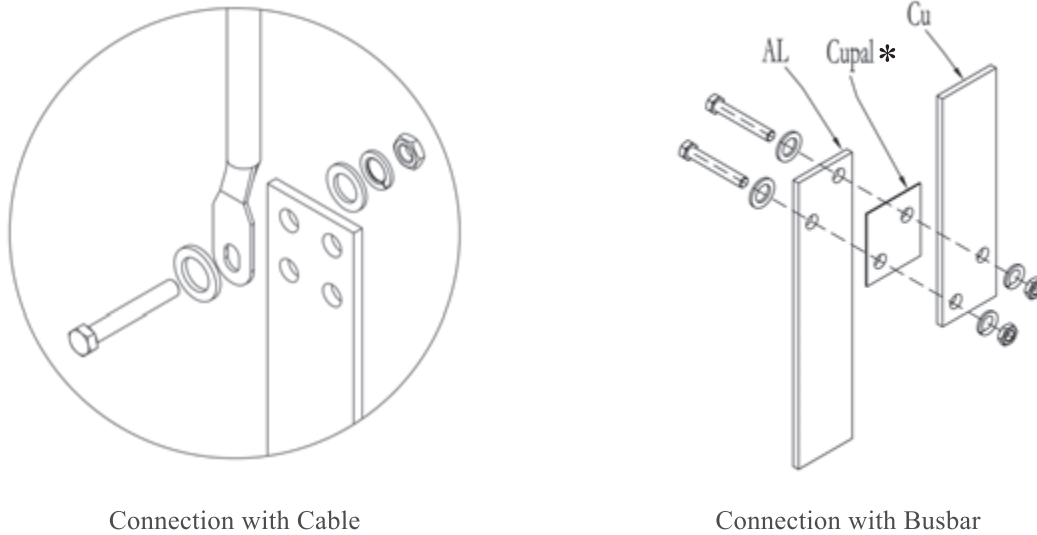
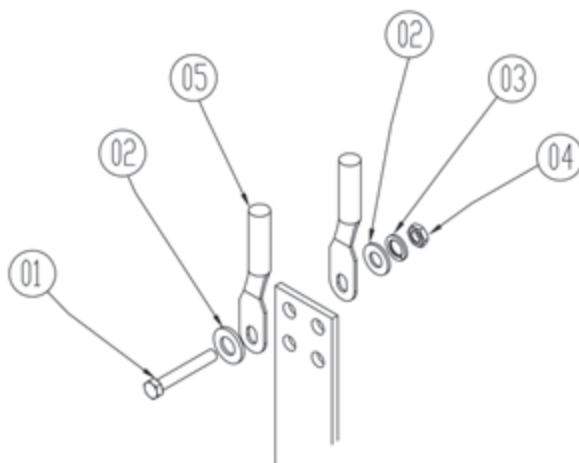


Figure 2.3 LV connections

(*) When connecting the LV Aluminum Terminal bars to copper bars, causing a direct connection between copper and aluminum, it is necessary to use CUPAL (Bimetallic) intermediate plates.



Connection Details by Cables	
1	Steel Bolt
2	Steel Flat extra-large washer
3	Spring washer
4	Nut
5	LV Cable

Figure 2.4 LV connection details by cables

2.3 HV Connections

HV connections are part of the HV winding and are usually brass bolts directly connected to both ends of the winding in order to:

- enable the connection with HV cables both from the top or from the bottom.
- enable the connection of the phases and the HV supply.
- avoid galvanic coupling between different materials in the connection.



Figure 2.5 HV connections



Do not replace the brass bolts with a different material bolts; it could alter the connection and may cause trouble.

2.4 Tightening Torque for Electrical and Mechanical Connections

Block and/or tighten both the electric and mechanical connections in accordance with the following values:

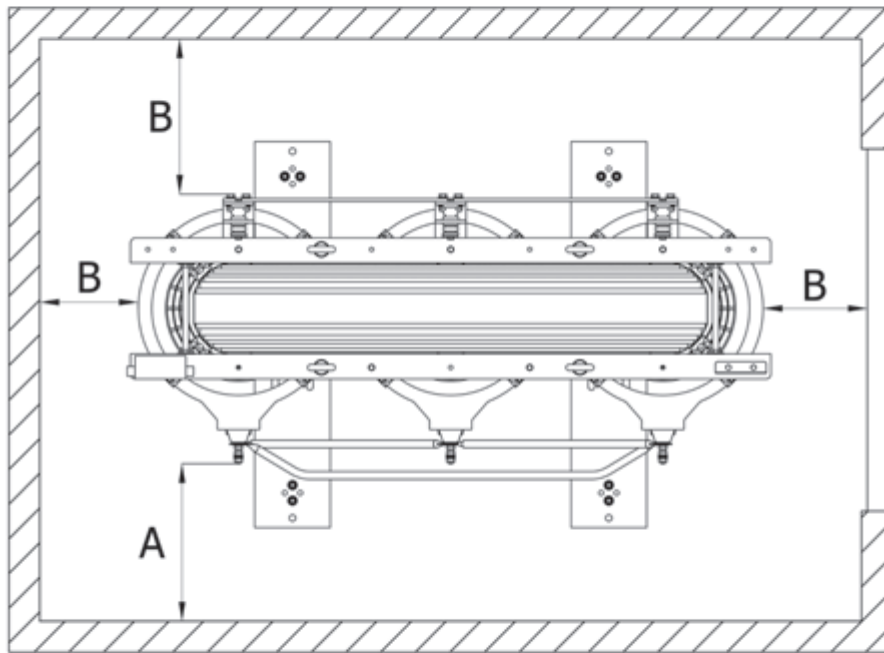
Bolt	Electrical Connections [Nm]		Mechanical Connections [Nm]	Tightening Instrument [mm]
	Brass	Steel		
M 6	5 - 10	10 - 15	20	10
M 8	10 - 15	30 - 40	35	13
M 10	20 - 30	50 - 60	45	17
M 12	40 - 50	60 - 70	60	19
M 14	60 - 70	90 - 100	100	22
M 16	80 - 90	120 - 130	150	24
M 18	-	-	200	27
M 20	-	-	270	30
M 22	-	-	360	32
M 24	-	-	460	36

Table 2.1 Mechanical and electrical connection torque

2.5 Positioning

Cast resin transformers do not assure contact insulation. It is absolutely forbidden to touch the cast HV coils while the transformer is energized. Resin is functional insulation only. Therefore, the transformer must always be installed in a metal enclosure, inside a cage or in a room with doors restricting personnel access to only when the transformer is de-energized.

Inside this electrical enclosure the transformer must be positioned to comply with minimal insulation distance from the walls. Distances are related to the voltage class shown on the rating plate.



KV	A (mm)	B (mm)
12	125	60
17.5	170	80
24	225	120
36	320	200

Figure 2.6 CRT positioning

2.6 Ventilation

As air should flow on cooling surfaces, inlet and exhaust vents should be correctly dimensioned ($3.4 - 4.0 \text{ m}^3$ fresh air per minute, for every kW of losses). Should the air flow be inadequate, the transformer would experience anomalous heating, which could cause the thermal protection system to trip.

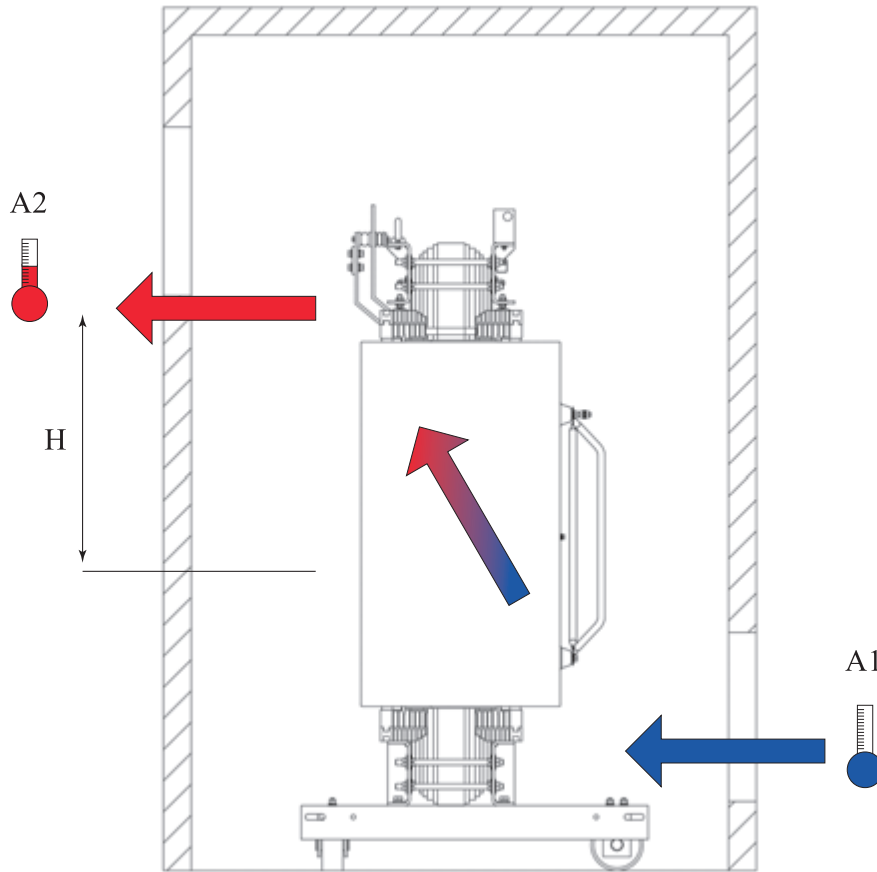


Figure 2.7 Air flow for the transformer

Transformers without rollers should be positioned high enough off the ground to allow cooling air to enter from beneath.



If the room does not allow sufficient natural air exchange, it is necessary to install an air exhaust/circulation system to ensure enough air to cool the transformer.

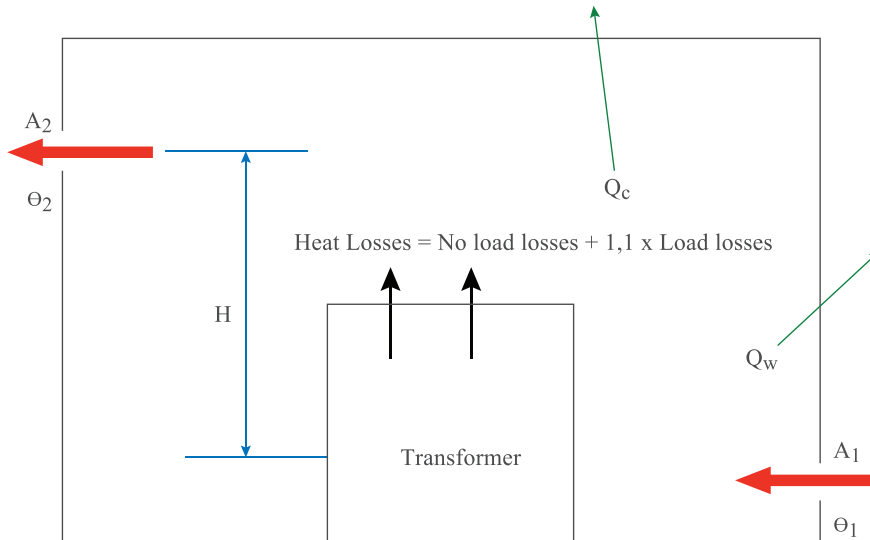
To approximately evaluate the performance of the natural ventilation, and verify the section of the windows and positioning height, it is necessary to take following calculation which has been made according to IEC 60076-11 into consideration:

The room is cooled by naturally air circulation therefore

$$Q_{AF}=0 \quad Q_c=Q_w=0$$

Q_{AF} is the heat dissipation by forced air circulation (kW)

Q_c , Q_w are losses dissipated respectively through ceiling and the walls (kW)



A_1 : Air inlet effective cross section (m²)

A_2 : Air outlet effective cross section (m²)

θ_1, θ_2 : Air temperature of inlet and outlet (°C)

H : Difference in height between mid-outlet surface and mid height of transformer (m)

Data for the calculation of ventilation: $\Delta\theta_a = \theta_2 - \theta_1 = 15K$

$\Delta\theta_a$ is the temperature rise (K):

Note: Value K is indicated above is common value from the experience of the manufacturers “As per IEC 6007611- -Annex C, clause C.2

$$HL = NLL + 1.1 \times LL \text{ (kW)}$$

NLL transformer no load losses

LL transformer load losses

HL transformer heat losses in the room/enclosure

Output

$$A_1 = \frac{HL}{0.1 \sqrt{H \cdot \Delta\theta_a^3}} \quad (\text{m}^2)$$

$$A_2 = A_1 \times 1.1 \quad (\text{m}^2)$$

2.7 Temperature Monitoring Systems

The transformers produced by **alfanar Electrical Systems (AES)** are equipped with PT100 temperature sensors.

Please study the connection drawings and consider the amount and function of the output contacts and terminals that you can find in the technical documentation supplied by the manufacturer of the monitoring device. Connections “4” is dedicated to the core sensor when it is present, otherwise it may be used as a spare.

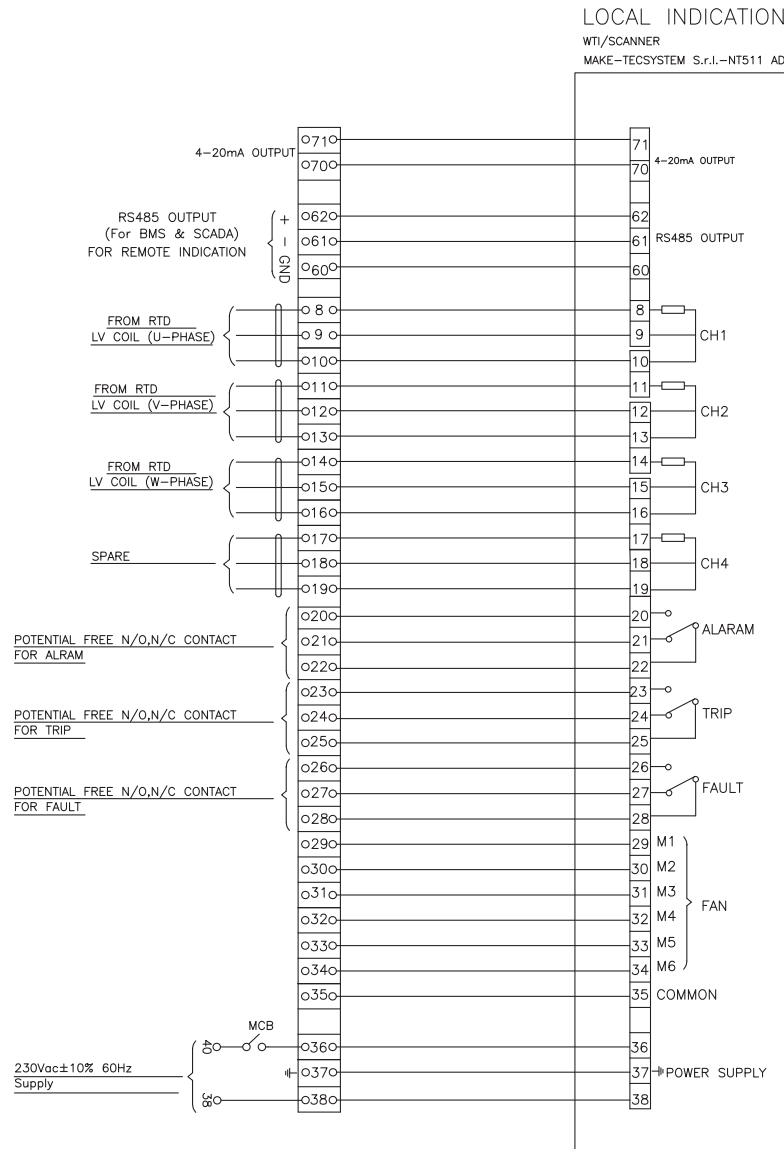


Figure 2.8 Recommended connections for PT100

These are the recommended settings when the transformer is equipped with a temperature monitor device:

- Class H transformers alarm 165°C trip 175°C
- Class F transformers alarm 140°C trip 150°C
- Class B transformers alarm 115°C trip 125°C

When Transformer (F- Class) is equipped with a ventilation fan kit, supplied by the manufacturer, the setting temperature for FAN ON and OFF on the Temperature monitoring device shall be:

FAN ON 110°C FAN OFF 90 - 100°C

Other values may be required in case of specific exercising conditions.

2.8 Earth Connections

Earth cable $\oplus \geq 16 \text{ mm}^2$ or in any case according to the fault current calculation.

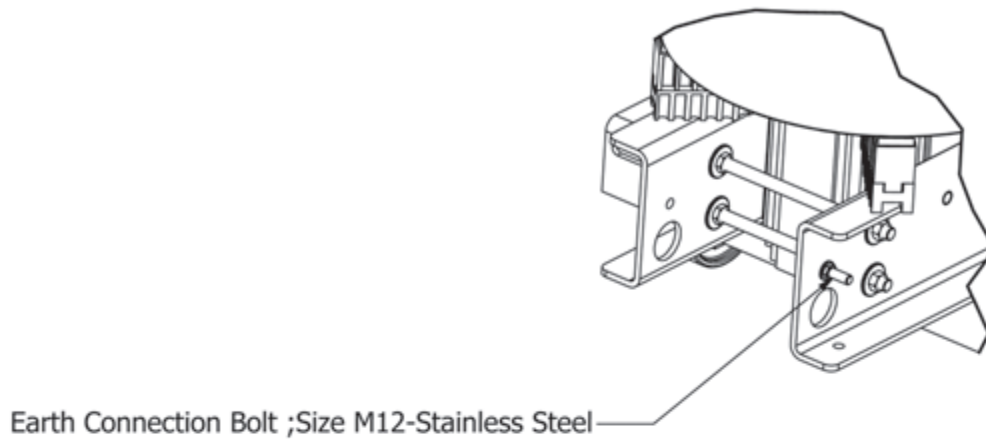


Figure 2.9 Earth connections for transformers

- Verify that the LV and HV windings have not been displaced during transport and that the compression bolts are centered on the compression blocks.
- Check the connections of both HV and LV for torque and electrical continuity.
- Check the connections of the auxiliary circuits for electrical continuity, and correctness interface with temperature protective relay.
- Check the earth connections and earth shields connections where applicable.

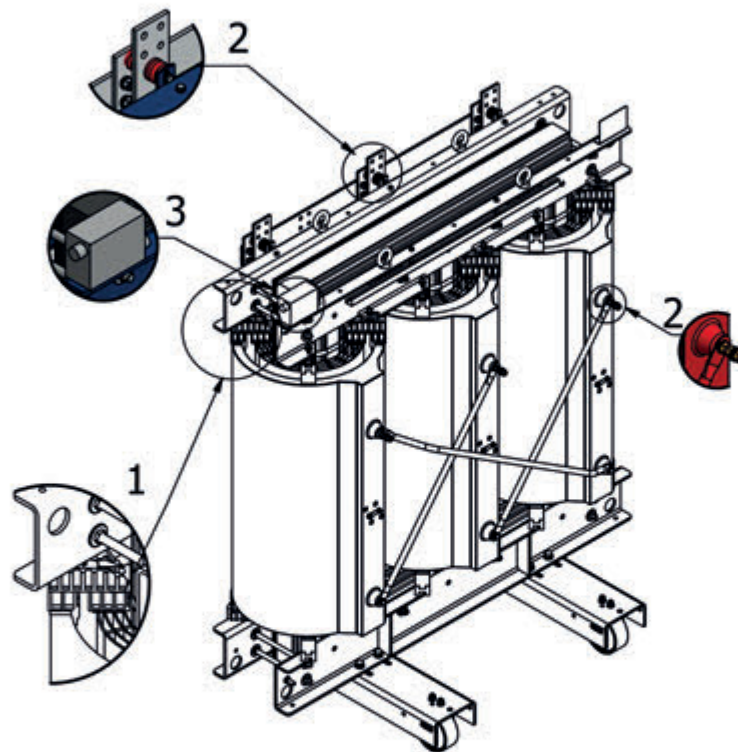


Figure 2.10 Checking of important connections

2.9 Safety Instructions

DANGER

- Correct operation of alfanar transformer requires that handling, installation, operation and maintenance are to be carried out exclusively by qualified personnel.
- The system must be de-energized prior to installation and maintenance operations to avoid exposing personnel to the risk of electrical shock.
- The purpose of this instruction manual is to familiarize qualified personnel with alfanar products construction, installation and maintenance as well as potential risks.

Personnel must be:

- Qualified to work near live equipment.
- Trained with respect to all applicable safety practices.

Failure to observe these instructions could result in severe bodily injury, death or damage to the transformer.

Check the transformer nameplate, located on the front side, for conformity with the delivery note.



Danger to life caused by electric voltage!

Indicates life-threatening situations caused by hazardous voltages. There is a danger of serious injury or death if the safety notes are not complied with.
The work to be performed must only be carried out by qualified electricians.



Don't Touch Sign

Do not access the transformer's operation area or remove the protection devices when the transformer is under voltage.

Unless otherwise, specified, inspection and maintenance should only be performed on transformers to which power has been switched off, disconnected and electrically isolated to avoid accidental contact with energized parts. Follow all manufacturer warnings and instructions.

PUTTING INTO SERVICE

A detailed technical line drawing of a mechanical assembly, possibly a suspension or steering component. The drawing shows a complex arrangement of metal parts, including a central vertical beam, two diagonal arms, and various mounting brackets and bolts. The drawing is rendered in a light gray color against a dark gray background.

3

3.0 Putting Into Service

3.1 Condition for Correct Operation of the Transformer

- Observe all the instructions of this manual.
- Operate the transformer according to the data on the rating plate.
- Connect to earth using the correct terminals.
- Protect the transformer against chemical agents, pollution, atmospheric pollution, sun radiation, vegetation and animals that could influence the normal operating conditions.
- Protect the transformer against mechanical damage during installation and operation.

3.2 Tappings for Voltage Regulation

The tolerances of the electrical supply system can be compensated with the regulation taps on the HV side, to maintain the correct output voltage on the LV side.

Standard transformers are equipped with following tappings: +5%, +2,5%, 0%, -2,5%, -5%. The setting diagram of the regulation tappings for transformers with one or dual primary voltages are shown on the rating plate.

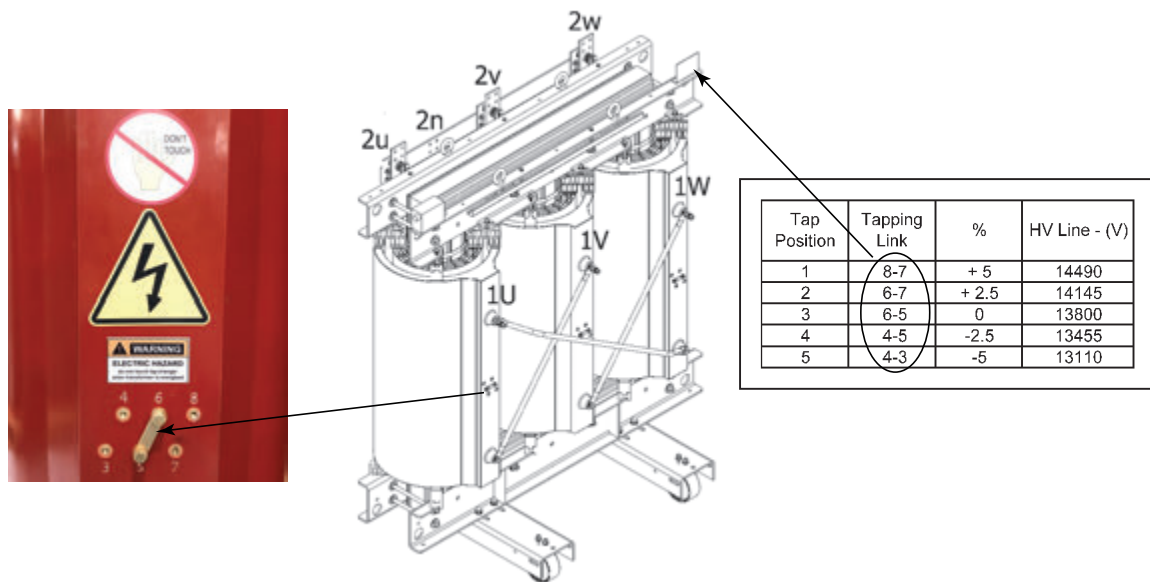


Figure 3.1 Tapping details



It is important to regulate the taps on all three HV coils and to regulate them equally to avoid circular currents, which would cause irreversible damages to the transformer.

3.3 Energizing

After checking the installation and ensuring that no object/tool has been left on the transformer, it is possible to close the circuit breaker on the HV side. After energizing the transformer from the HV side, close the LV circuit breaker, applying the load on the transformer.



In case the transformer is exposed to over-voltages, (due to atmospheric events, or to the operation of circuit breakers) appropriate surge arrestors set for the insulation level are necessary.

RATING PLATE

A technical line drawing of a door rating plate assembly. The drawing shows a cross-section of a door frame with a rating plate mounted on it. The plate is secured with several screws. Two long, thin rods are attached to the plate, extending diagonally across the door. The drawing is rendered in a light gray color on a white background.


4

4.0 Rating Plate

The following data is available on the rating plate:

- | | | | |
|----|--------------------------------------|----|--|
| 1 | Year of manufacture | 15 | Impedance “%” |
| 2 | AES serial No. | 16 | Altitude |
| 3 | Owner serial No. for IEC transformer | 17 | Seismic class |
| 4 | Sap code No. | 18 | Type of cooling |
| 5 | Sales order No. | 19 | Maximum ambient temperature |
| 6 | Rating (kVA) | 20 | Maximum winding heating K |
| 7 | Specification “IEC 60076” | 21 | Thermal class of insulation |
| 8 | Frequency “Hz” | 22 | Mass without enclosure “kg” |
| 9 | High voltage volts @ No-Load “Volts” | 23 | Mass with enclosure “kg” |
| 10 | Low voltage volts @ No-Load “Volts” | 24 | Insulation level lightning impulse “LI” kV |
| 11 | Line high voltage current Amp. | 25 | Climate class |
| 12 | Line low voltage current Amp. | 26 | Environmental class |
| 13 | No. of phases | 27 | Fire behavior class |
| 14 | Vector group | 28 | Purchase order No. |

Rating Plate alfanar Specification In Accordance With IEC 60076-11



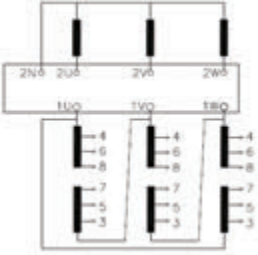

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CAST RESIN TRANSFORMER 3-PHASE

YEAR OF MFG	<input type="text"/>	OWNER SERIAL NO.	<input type="text"/>
AES SERIAL NO.	<input type="text"/>	SAP CODE NO.	<input type="text"/>
SPECIFICATION	IEC 60076-11-2018	SALES ORDER NO.	<input type="text"/>

RATED POWER (kVA)	AN	<input type="text"/>	IMPEDANCE	%	<input type="text"/>
RATED POWER (kVA)	AF	<input type="text"/>	TYPE OF COOLING		<input type="text"/>
FREQUENCY	Hz	<input type="text"/>	MAX AMBIENT TEMP.	C	<input type="text"/>
VOLTS AT NO LOAD	HV	<input type="text"/>	MAX. WINDINGS TEMP. RISE	K	<input type="text"/>
	LV	<input type="text"/>	INSULATION CLASS		<input type="text"/>
CURRENT (A) - HV	AN	<input type="text"/>	SEISMIC CLASS		<input type="text"/>
	LV	<input type="text"/>	ALTITUDE		<input type="text"/>
PHASES		<input type="text"/>	MASS WITHOUT ENCLOSURE	kg	<input type="text"/>
VECTOR GROUP		<input type="text"/>	MASS WITH ENCLOSURE	kg	<input type="text"/>
WINDING MATERIAL (HV/LV)		<input type="text"/>	CLIMATIC CLASS		<input type="text"/>
INSULATION	kV	HV: /	ENVIROMENTAL CLASS		<input type="text"/>
LEVEL (LI/AC)	kV	LV: /	FIRE BEHAVIOUR CLASS		<input type="text"/>
ENCLOSURE IP CLASS		<input type="text"/>			<input type="text"/>

PURCHASE ORDER NO.

Tap Position	Tapping Link	%	HV Line - (V)
1	8-7	+ 5	
2	6-7	+ 2.5	
3	6-5	0	
4	4-5	-2.5	
5	4-3	-5	

WARNING

1. Off Circuit Tap changer , de-energized before changing taps
2. Please refer O & M manual for operating transformer

MADE IN K.S.A

MAINTENANCE

A detailed technical line drawing of a mechanical assembly, possibly a door or panel mechanism. The drawing shows a top-down view of a rectangular frame with various components, including hinges, bolts, and internal structural elements. The drawing is rendered in a light gray color against a dark gray background.

5

5.0 Maintenance

In normal operational conditions, cast resin transformers from **alfanar Electrical Systems (AES)** do not need specific maintenance.

5.1 Suggested Maintenance and Control Activities

POS.	CONTROL ACTIVITY	PERFORM EVERY	INSTRUMENT TO BE USED	RESULT
9.1.1	Function of the temperature sensors. PT 100	Yearly / in case of need	Tester	Electrical continuity
9.1.2	Monitoring device	Monthly / after exceptional events	-	Functional check according to manufacturer's instructions
9.1.3	Cleaning of dust, dirt possible foreign materials on the windings	Every 6 months / when the transformer is de- energized	Clean, dry compressed air press, max 3 bar. Dry wiping rags	The ventilation gaps between the windings must be completely clean and open.
9.1.4	Moisture on the windings	After a period out of use with no applied voltage	Oven / method of heating in short circuit	Drying at 80°C
9.1.5	Tightening of the bolts for delta/star (HV / LV)	Yearly / when needed	Torque wrench	Tightening torque according to paragraph 2.4
9.1.6	Insulation between windings and earth	After a period out of use with no applied voltage	Mega-ohmeter (Megger) with voltage more than 1000 V	LV against earth: min 5 MOhm HV against earth: min 20 MOhm HV against LV: min 20 MOhm Should the value be lower contact alfanar
9.1.7	Correct matching core LV winding, HV winding	After moving, shock or a short circuit	Steel tape rule or similar	Geometric matching of the windings
9.1.8	Correct position / tightening if the winding clamping devices.	Monthly / after exceptional events	Torque wrench	Tightening torque between 20 and 40 Nm.

Table 5.1 Correct maintenance of cast resin transformer

5.2 Suggested Maintenance for Specific Installations

In abnormal operational conditions, like installation in a high pollution environment, with or without filters for inlet cooling air, cast resin transformers from **alfanar electrical systems (AES)** do not need specific maintenance, but only periodically cleaning according to the following table:

POS.	CONTROL ACTIVITY	PERFORM EVERY	INSTRUMENT TO BE USED	RESULT
9.2.1	Functionality of forced circulation fans if present	Monthly / after exceptional events	-	Functional check according to manufacturer's instructions
9.2.2	Inlet cooling air filter located in the access door or in the bottom ventilation window	Monthly/in case of registered temperature by PT100 sensor increasing more than 15 °C comparing usual values	Clean, dry compressed air press, max 3 bar. Dry wiping rags	Clean filter if obstructed with dust or powder
9.2.3	Cleaning of dust, dirt possible foreign materials on the windings	Every 6 months / when the transformer is de- energized	Clean, dry compressed air press, max 3 bar. Dry wiping rags	The ventilation gaps between the windings must be completely clean and open.

Table 5.2 Additional maintenance of transformer in particular applications

5.3 Troubleshooting Guide

POS.	PROBLEM	POSSIBLE REASON	POSSIBLE REASON
9.3.1	General overheating	The load is unevenly distributed.	Check the position of the connection on the tapings. Set the tapings according to the supply voltage.
9.3.2	General overheating	High ambient temperature.	Check the ventilation grills are not closed / dirty. Restart the ventilation air flow.
9.3.3	Overheating in the core	Parasitic currents in the core due to damage in the magnetic steel or lack of insulation for the tie rods	Restore insulation of the tie rods using insulated tubes and washers.
9.3.4	Overheating in the core	Primary voltage too high	Check the position of the regulation taps, and adjust them so that the tension of the secondary winding without load, is lower or equal to the value on the rating plate (on + or ++)
9.3.5	Noise	Primary voltage too high	
9.3.6	Noise	Rigid connection with the busbar. Rigid connection with the floor.	Insert flexible connections between transformer and busbar. Insert anti-vibration pads under the rollers
9.3.7	Tripping of the temperature monitoring device. Tripping of alarm.	- Defect in the monitoring device or temperature sensor. - Current load higher than the nominal value on the rating plate. - Ventilation air flow stopped.	- Replace the faulty piece. - Reduce the load to the rated current or install the air circulation system. - See points 2.6 and 2.7. - Check, clean and tighten all contacts of the sensor.

Table 5.3 Troubleshooting guide

COMPONENTS

A technical line drawing of a mechanical assembly, possibly a door or panel mechanism. The drawing shows various components including a top rail, a vertical panel, and a diagonal linkage. A circular component is highlighted with a white glow, and a large white number '6' is positioned in the bottom left corner.

6

6.0 Components

alfanar offers an optimized design for a full range of Cast Resin Transformers made in KSA. For each one of the CRT sizes included in this catalogue, the following list of components are available:

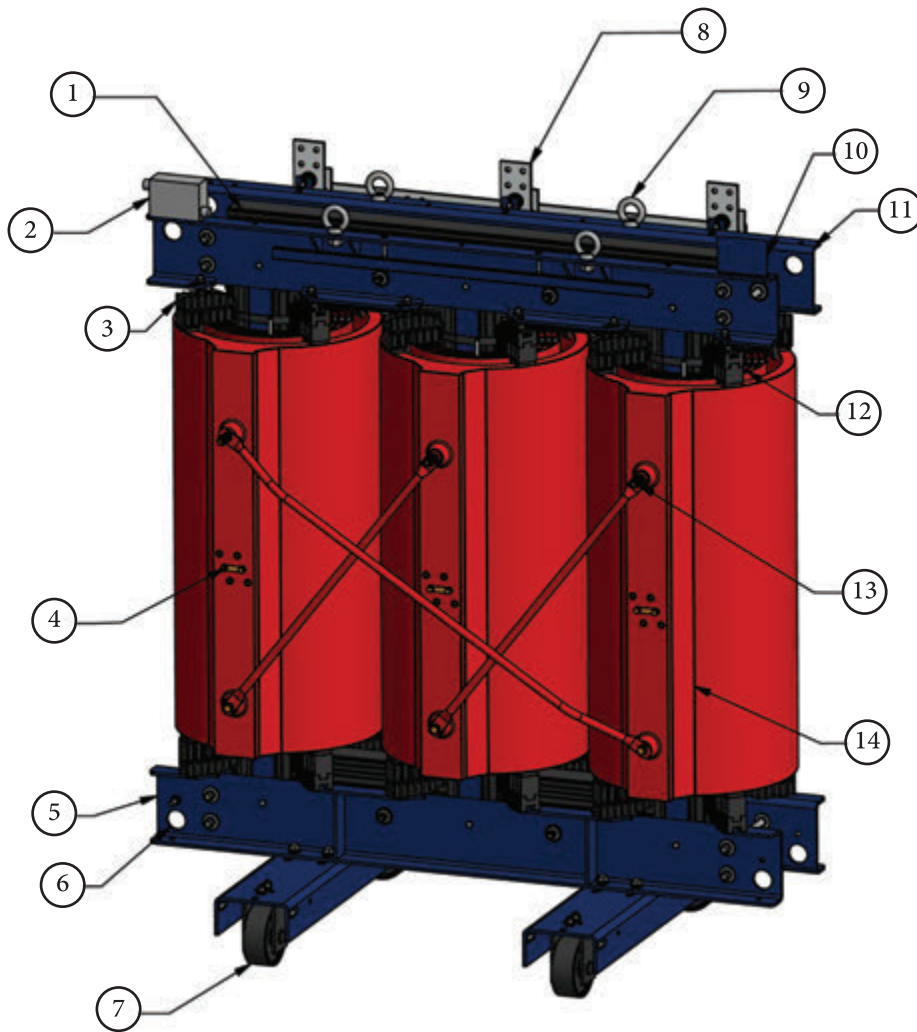


Figure 6.1 Cast resin transformer components

1	Magnetic Core	8	LV Connection
2	PT 100 Box	9	Lifting Eyes
3	Winding Support	10	Name Plate
4	HV Tapping	11	Core Clamp
5	Core Clamp	12	LV Coil
6	Pulling Hole	13	HV Connection
7	Scrolling Wheel	14	HV Coil

STANDARDS

A detailed technical line drawing of a mechanical assembly, possibly a suspension system or a structural frame. The drawing shows various components including beams, bolts, nuts, and brackets. The perspective is from a slightly elevated angle, looking down at the structure. The drawing is rendered in a light gray color against a dark gray background.

7

7.0 Standards

alfanar cest resin transformer is fully complies with the following IEC standards used under general operation conditions for indoor installation;

IEC	60076-11	Power transformers – Part 11 Dry – type transformers.
	60076-1	Power transformers – Part 1 General amendment.
	60076-2	Power transformers – Part 2 Temperature rise for liquid immersed transformer.
	60076-3	Power transformers – Part 3 Insulation levels dielectric test and external clearances in air.
	60076-5	Power transformers – Part 5 Ability to withstand short circuit.
	60076-10	Power transformers – Part 10 Determination of sound levels.
	60076-12	Loading guide for dry-type power transformers.
	60085	Thermal evaluations and classifications of electrical insulations.
	60270	High-voltage techniques – Partial discharge measurement.
	60529	Degree of protection provided by enclosures (IP code).



Notes

A series of horizontal dashed lines for taking notes.



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