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Operating Manual for Siemens Cast-resin Dry Type Distribution Transformer

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Catalogue

1. Scope of Application

This Manual applies to all cast-resin dry-type transformers of Siemens with three-phase and single-phase, including special purpose transformers such as: rectifier transformers and earthing transformers.

Cast-resin dry-type transformers are widely used indoors, especially in fire hazard areas and underground flooding areas. Generally, cast-resin transformers can be widely used in shopping malls, subway stations, sports grounds, auditorium, pumping stations and flooding areas. This product does not need oil leakage collection device and fire protection maintenance. It is economical and convenient to transfer. More and more dry-type transformers are applied to industrial fields, such as load center substation and feeder station.

2. Reference Standards

- IEC 60076-11 – Power transformers – Part 11: Dry-type transformers
- IEC 60076-1 – Power transformers – Part 1 General
- IEC 60076-2 – Power transformers – Part 2 Temperature rise
- IEC 60076-3 – Power transformers – Part 3 Insulation levels dielectric tests and external clearances in air
- IEC 60076-4 – Guide to the lightning impulse and switching impulse testing
- IEC 60076-5 – Power transformers – Part 5 SC test
- IEC 60076-10 – Power transformers – Part 10 Sound levels
- IEC 60529 – Degree of protection provided by enclosures (IP code)
- GB/T 1094.11 – 电力变压器 第11部分：干式变压器
- GB/T 1094.1 – 电力变压器 第1部分：总则
- GB/T 1094.2 – 电力变压器 第2部分：温升
- GB/T 1094.3 – 电力变压器 第3部分：绝缘水平、绝缘试验和外绝缘空气间隙
- GB/T-1094.4 – 电力变压器 第4部分：电力变压器和电抗器的雷电冲击和操作冲击试验导则
- GB/T 1094.5 – 电力变压器 第5部分：承受短路的能力
- GB/T 1094.10 – 电力变压器 第10部分：声级测定
- GB/T 4208 – 外壳防护等级（IP代码）

Specific reference standards shall be subject to the contract requirements.

3. Safety Guidelines

3.1 Equipment safety matters	
	Unload, position, transfer, instal or store the transformer on site in accordance with this Manual to prevent injury to persons or damage to the transformer body.
	Check the grounding condition of the transformer before power on to ensure that the grounding points of enclosure and the lower clamps are reliably grounded.
	Before power on, it is necessary to carefully check whether any foreign objects (such as washers, bolts, nuts, etc. left during installation) are left on the transformer core, low-voltage winding and outlet busbar.
	The transformer tapping shall be connected and tightened according to the tap indication on the nameplate, and the three-phase tap must be consistent.
	Insulation distance between secondary control communication line and transformer bus bar and high voltage cable should be maintained to prevent interference of control communication signal (e.g. RS 485 signal line).
	It is forbidden to adjust the tapping under power-on condition, and the tapping can be adjusted only after the transformer is powered off (power-off-padlock-power test-discharge-grounding).
	After the overhaul, dismantle the grounding wire, evacuate the personnel from the site, and energize the transformer after dismantling the warning sign.
	If the transformer is damaged or does not work for some unclear reason, please contact Siemens manufacturer.

3.2 Operator safety matters	
	When lifting the transformer vertically, it is strictly forbidden to stand below, and never enter the lifting work area of the crane and the operating radius of the vehicles and machine without permission.
	Before the transformer is put into operation, the staff should make clear safety precautions and emergency measures to deal with emergencies.

	Make sure that no operator performs commissioning or other operations on the transformer body before power on.
	At the moment of power on, the operator shall maintain an effective and safe distance from the transformer.
	When the transformer needs to be reparied d after tripping or power outage, it is strictly prohibited to repair the transformer itself immediately. Only after the transformer is grounded and discharged strictly by the professionals, can it be repaired.
	Operators are strictly forbidden to open the door panel of the transformer enclosure (if any) under the power-on condition to prevent the electric shock.
	Operators shall wear safety helmets, labor protection shoes, reflective clothes and other protective articles when operating on the site. Safety appliances, protective appliances, firefighting equipment and insulating gloves shall be provided on the site, and regular inspection and test shall be carried out.
	It is strictly forbidden for operators to smoke around the transformer.

3.3 Operator qualification

	Electrical operation personnel must undergo professional training and pass examinations, and electrical operation shall be carried out by personnel who holding an electrical operation certificate.
	In the handover test of transformer, the tester must have the certificate for performing the electrical work and the test equipment used must have the certificate of calibration.
	Electrical workers must be familiar with the knowledge of fire-fighting and first aid, be able to use fire-fighting appliances and equipment correctly, and be familiar with emergency rescue methods of electric shock..
	Operators working at height shall have the qualification certificate of working at high altitudes. Seatbelt should be fastened in a fixed position when operating at high altitudes.

Note:

The Safety Guidelines are not sufficient to cover all site safety conditions and all possible safety conditions. This section aims to help operators avoid safety accidents as much as possible during operation.

4. Product Structure

4.1 Transformer body

1 Low-voltage terminal
2 Insulator
3 Siemens logo
4 Nameplate
5 Lifting hole
6 Upper clamping
7 Insulating cylinder
8 Safety sign
9 High-voltage tapping
10 High-voltage winding
11 Earth terminal
12 Lower clamping
13 Wheels
14 Towing hole
15 High-voltage connection tube
16 High-voltage terminal

Remarks:
This picture is a standard legend and does not cover all types of transformers

4.2 Transformer enclosure

1 Enclosure lifting ring

2 Siemens Logo

3 Nameplate

4 Enclosure flank

5 Safety sign

6 Air inlet

7 Door panel

8 Door lock

9 Observation window

10 Position number plate

11 Temperature control system

12 Primary / Secondary side marking

13 Air outlet

14 Foundation

15 Enclosure earth terminal

4. Product Structure

Introduction to technical parameters:

1 Manufacturer

2 Siemens brand

3 National Standard GB1094.11-2007
International Standard IEC60076-11:2004

4 Transformer name

5 Type :
Take SCLB11-2500/10 as an example.

S – Three-phase
C – Cast-resin
L – Aluminum product
B – Foil winding
11 – Performance level code
2500 – Rated capacity
10 – Voltage level

6 Serial No.: Product No.

7 Rated voltage at high voltage side (2x±2.5%)

8 Rated voltage of low voltage side

9 Drawing No.: Product drawing No.

10 Frequency: Rated frequency

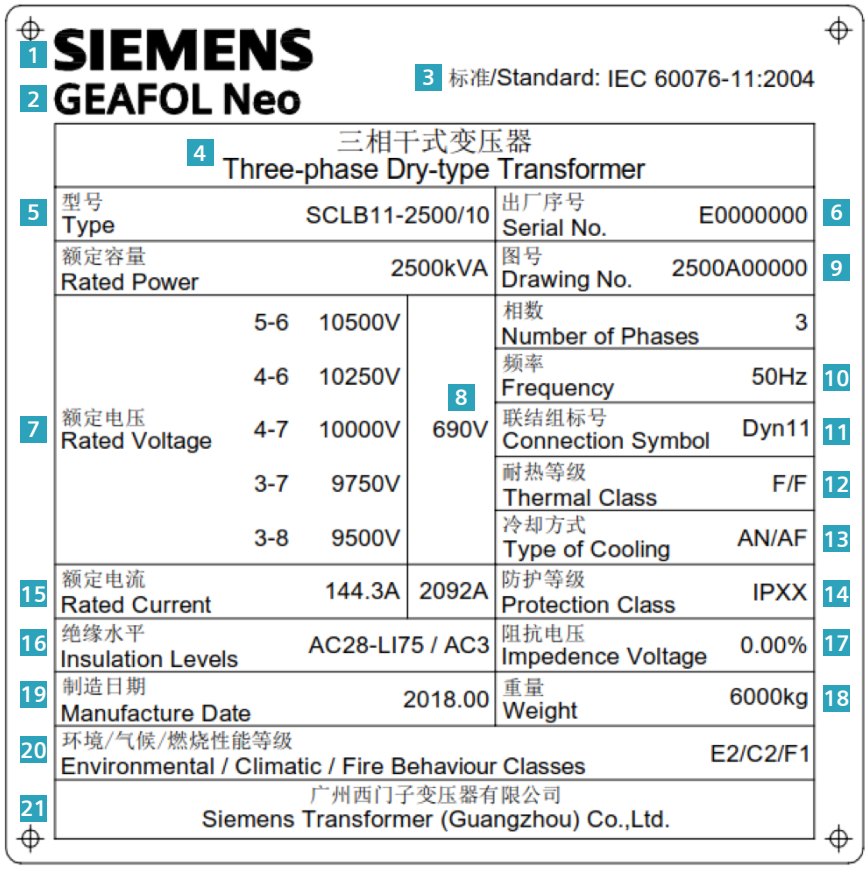
11 Connection group symbol:
D – Delta connections
Y – Star connections
N – Neutral

12 Thermal class: Thermal class of insulation material:
Y, A, E, B, F, H, C

13 Type of cooling:
AN – Natural air cooling
AF – forced air cooling

14 Protection class (IP class)

15 Rated current:
Rated current for long-term passage



16 Insulation level:
LI75 – Rated lightning impulse withstand voltage
AC28/AC – Rated withstand voltage

17 Impedance voltage: Impedance voltage, also known as short circuit voltage, represents the voltage loss (percentage) on the transformer's impedance when the rated current passes

18 Weight: Design weight of transformer body kg

19 Manufacture date: Year of manufacture

20 Environment /climatic/fire behavior classes

21 Manufacturer: Siemens Transformer (Guangzhou) Co., Ltd.

Remarks:
The technical parameters in this picture are standard parameters and do not cover all types of transformers.

Remarks

- The IP class is in the form of IPXX, where XX is two Arabic numerals, the first number indicates the level of contact protection and foreign object protection, and the second number indicates the level of waterproofing protection (the greater the number, the higher the class).
- Environment
  Class E0 : There is condensation on the transformer, the contamination is ignored. Suitable for clean and dry indoor installation.
  Class E1: There is condensation on the transformer occasionally and the contamination is limited.
  Class E2: Frequent condensation and severe contamination, or both.
- Climatic
  Class C1: Suitable for transformers operating at temperatures not less than-5 °C, but exposed to temperatures above-25 °C during transportation and storage.
  Class C2: Suitable for transformers operating, transporting and storing in environment above-25 °C.
- Fair behavior
  Class F0: Combustion performance is not specified except for the inherent characteristics of the transformer. No special fire protection measures have been taken. However, the escape of toxic substances and opaque fumes should be minimized.
  Class F1: Transformers are suitable for fire hazards and require limited combustion. The escape of toxic substances and opaque fumes should be minimized.

5. Transportation, Transfer, Lifting, Handover, Storage

5.1 Transportation

According to the packaging requirements of the destination and customers (such as moisture-proof or waterproof), the appropriate transport and packaging scheme shall be selected. During the transportation process, the products are firmly placed, and shaking, collision and movement are prohibited. If there are multiple accessory wooden boxes, it is not allowed to stack more than two wooden boxes to avoid damage to the wooden boxes. The transformer shall be well protected against rain during transportation to prevent rainwater from wetting the transformer.

⚠ **Warnings:**

- Stacking and Extrusion of Transformer Body Wooden Box.
- Transformers are forbidden to be placed horizontally on transport vehicles. The direction of the transformers should be the same as that of the vehicles..
- Transport vehicles should avoid sudden braking in the course of moving and should slow down on rough and pitted roads.

5.2 Transfer

When the product arrives at the destination, select the appropriate transfer method according to the loading and unloading requirements:

5.2.1 If the transformer is packed in wooden cases, the lifting shall be carried out according to the lifting marks on the wooden cases. Or it shall be transferred according to fork-lift signs, as shown below.

Wooden case packing and transportation

Wooden case packing and fork-lift transportation

5. Transportation, Transfer, Lifting, Handover, Storage

5.2.2 If the transformer is packed with wooden pallet support, it shall be lifted from the lifting hole of the transformer. Or shall be transferred according to fork-lift marks, as shown below.

Wooden pallet support packing and lifting

Wooden pallet support packing and fork-lift transportation

5.2.3 If there is only the transformer body (without packaging), it shall be lifted from the lifting hole of the body, as shown in the following figure.

⚠ **Warnings:**

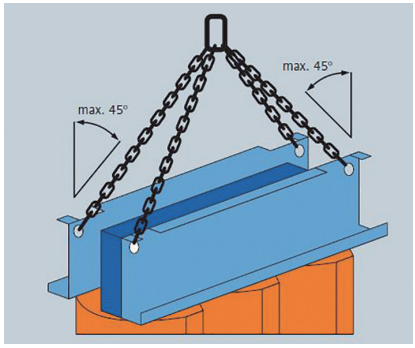
- The lifting process shall be uniform and stable, so as to avoid sudden lifting or landing, and prevent the transformer from being subjected to external impact.
- When lifting the transformer body, attention should be paid to lifting angle not exceeding 45.
- For the fork transportation, please pay attention to raising height, avoid unstable center of gravity, and ensure that no overturning or falling down occurs.

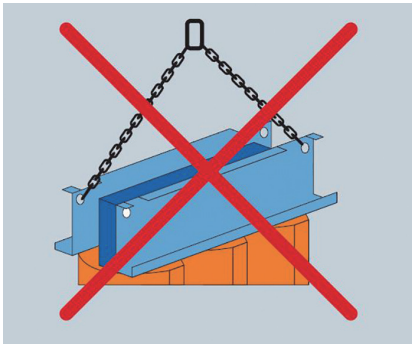
5.3 Lifting

5.3.1 Vertical lifting

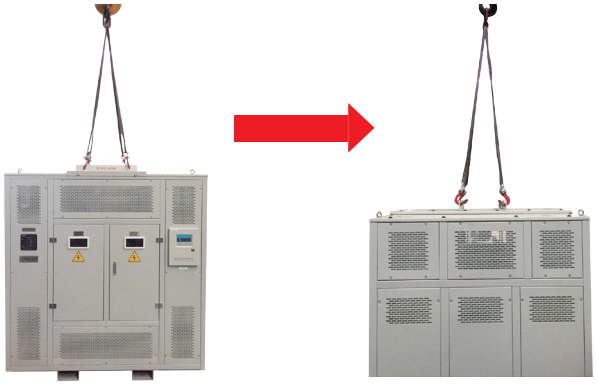
The unloading and transfer methods of transformers after unpacking shall be as follows:

1. The transformer has no protective enclosure and can only be lifted by slings through the lifting holes of the upper clamping piece. The lifting angle must comply with the requirements on the labels affixed beside the lifting holes, as shown in the following figure.

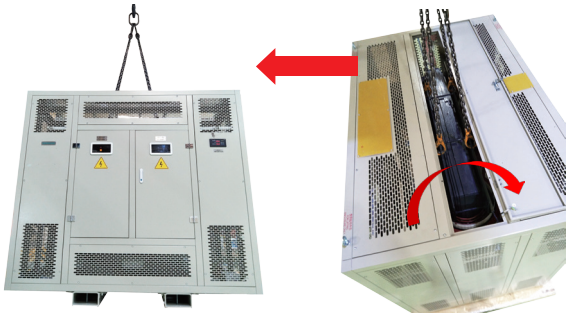




2. The transformer has a protective enclosure and can be lifted in two ways:
   a. If there is a specially designed lifting hole at the top cover of the enclosure, it shall be transported through the lifting hole, after the lifting mark is confirmed, as shown in the following figure.



   b. If there is not a lifting hole at the top cover of the enclosure, the top cover plate of the enclosure needs to be opened firstly. Then, the transformer shall be transferred according to the lifting position mark on the transformer body, as shown in the following figure



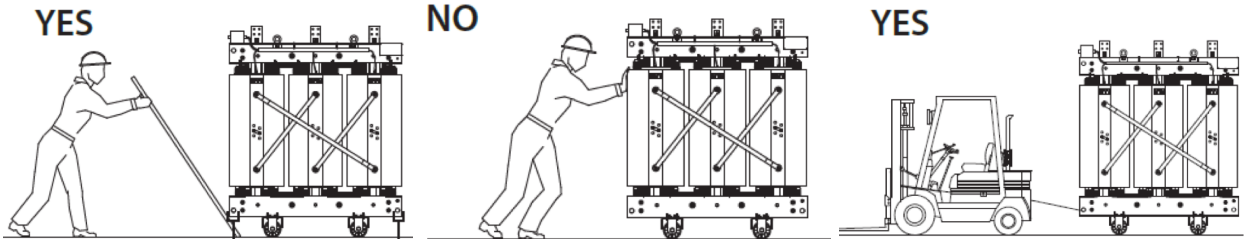
⚠ Warnings:

- It is forbidden to lift the lifting rings on the top of the transformer enclosure.
- Before lifting, check whether the slings are completely fixed, and note that the lifting angle shall not exceed 45 °.
- The lifting process shall be uniform and stable, avoid sudden lifting or landing, and prohibit the lifted transformer from falling to the ground quickly.
- Please pay attention to the lifting process to ensure that no overturning or falling down occurs.

5. Transportation, Transfer, Lifting, Handover, Storage

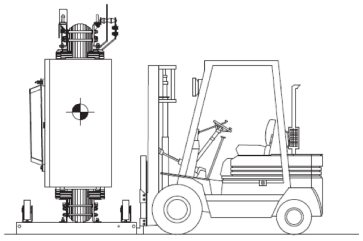
5.3.2 Horizontal transfer

1. When the transformer has no protective enclosure and needs to be transferred:
   a. If the transformer is equipped with rollers (unconventional configuration), the external traction equipment can be fixed through the traction hole of the lower clamping piece of the transformer. Afterwards, pull the transformer horizontally, as shown below.



Note:
- Do not push or pull the high-voltage winding or the delta connection tube.
- Avoid the collision against core and other components, such as fan and grounding terminals.
- The auxiliary rod should be inserted into the traction hole of the transformer to move the transformer by levering the auxiliary rod when levering the transformer with the lever.

   b. If the transformer is not equipped with rollers, forklift trucks are required to transfer the transformer by means of forklifting the bottom U-bar of the transformer, as shown below.



⚠ **Warnings:**
- Pay attention to the elevated height during forklifting to prevent the overturning or landing due to unstable center of gravity.
- During lifting and landing of the forklift truck, lifting and landing shall be slow to avoid hit the transformer hard against the ground.

2. The transformer is equipped with a protective enclosure and it needs to be transferred:
   The forklift truck shall be used for transfer according to the forklift sign on the enclosure foundation. Before the transfer, the forklift arm shall be fully extended into the base, as shown in the following figure.

⚠ **Warnings:**
- Pay attention to the elevated height during forklifting to prevent theoverturning or landing due to unstable center of gravity.
- Prevent deformation of the enclosure during transfer, which caused by external force.

5.4 Handover

Open the transformer package and immediately check for damage during transport. In case of damage, please claim compensation against the carrier and ask the representative of Siemens to coordinate this issue if necessary. Report the damage to Siemens through the Siemens representative who is in charge of such matters.

Please refer to the following steps to check the transformers delivered on site with the carrier and make relevant records.

a. Check the outer packing of the transformer, such as wooden box and the plastic hood, which shall be in good condition.
b. Check the transformer model and the quantity and documentation, which shall be correct and complete according to the order.
c. Check the appearance of transformer protective enclosure, such as door panel, base and other components, which shall be complete and free of damage.
d. Check the appearance of transformer body, such as winding, copper bar and other parts, which shall be complete and free of damage.

5.5 Storage

If not installed immediately, the transformer needs to be stored in a dry room to avoid direct sunlight. Indoor temperature shall not be less than minus 25 ° C (unless otherwise agreed) and humidity shall not exceed 90%. It shall be covered properly to prevent rain, dew and dust contamination.

Storage requirements:

a. Storage temperature-25 °C ~ 50 °C, humidity ≤ 90%. Installation and storage of transformers below-25 °C is prohibited (unless otherwise specified in the agreement).
b. It shall be covered with opaque materials to prevent damaging the transformer due to dampness, water, dust and sunlight.
c. The warehouse shall be cleaned, dried and ventilated and transformers shall not be stored together with active chemicals and corrosive substances.
d. Stacking in warehouse is not allowed for all products.

6. Installation

6.1 Positioning

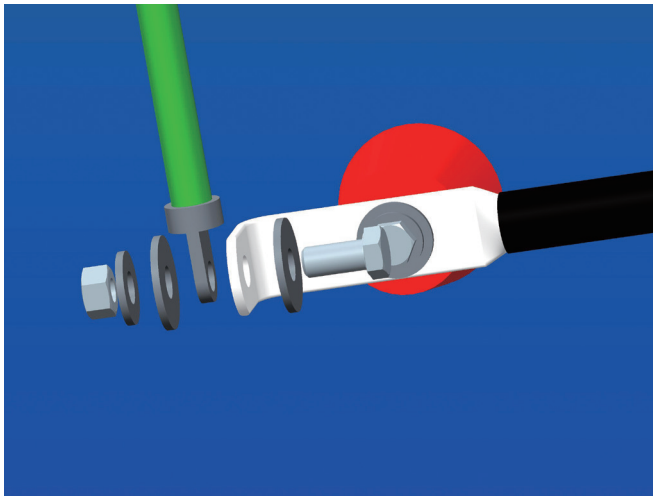
Before the transformer is positioned, check the product size drawing and foundation drawing, and check whether the actual size of foundation corresponds to the transformer base. Confirm that the foundation is level and able to withstand the weight of the transformer. Ensure that the transformer is placed in the same direction as inlet wire of the high and low voltage bus.

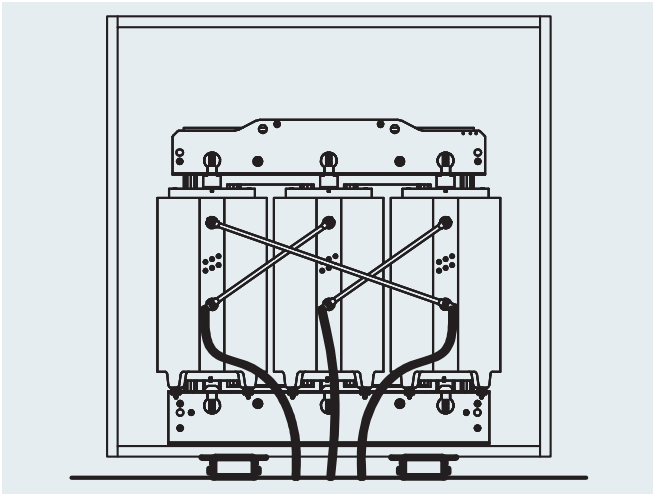
⚠ **Warnings:**

- In areas with strict vibration requirements, additional cushions should be considered to prevent the loud noise due to ground vibration of transformer.
- Do not block or plug the heat dissipation holes in the transformer enclosure.
- The transformer needs to be fixed on the foundation.

6.2 High voltage side cable connection

The cable connection holes are reserved at the upper and lower ends of the connecting rod on the high voltage side of the transformer. Taking the delta connection as an example, the phase sequence at the upper end is U-V-W and the phase sequence at the lower end is V-W-U. Attention should be paid to correct phase sequence when connecting high voltage cables. Fasteners shall be used during the connection, and loosening preventive measures shall be taken to fix the cable at the terminal of the high-voltage connecting rod of the transformer. At the same time, it is necessary to ensure that the cable is reliably supported so as to avoid obvious external force acting on the wiring. Refer to the figure below for connection mode.

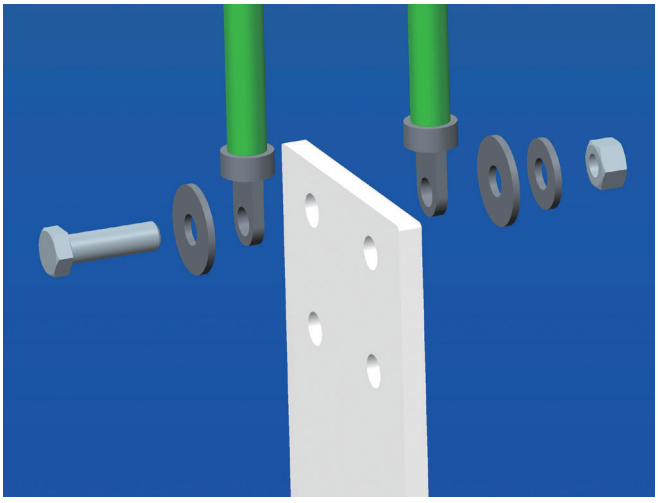


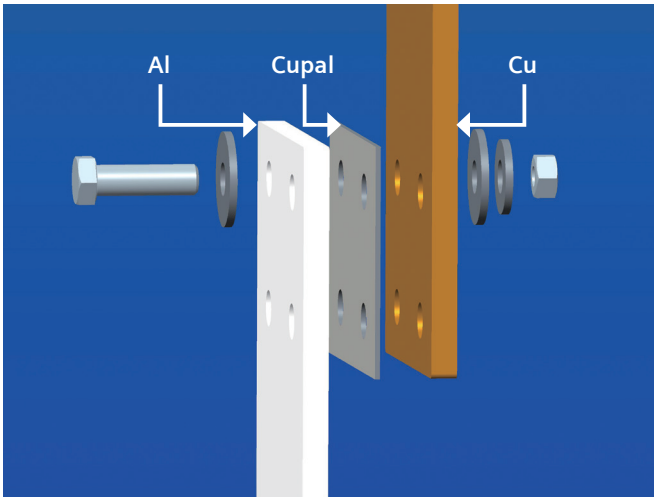


High voltage cable junction	Corresponding connection phase sequence
Upper terminal	U-V-W
Lower terminal	V-W-U

6.3 Low voltage side busbar or cable connections

The low-voltage terminal of the transformer has reserved cable connection holes, and fasteners with loosening preventive measures are required to fix the cable or bus bar. If it is required to be equipped with copper-aluminium composite foil (cupal) as specially specified in the contract, the copper-aluminium composite foil (cupal) shall be installed between the low-voltage terminal of the transformer and the cable, or between the low-voltage terminal of the transformer and the bus bar. Please refer to the figure below.





⚠ **Warnings:**

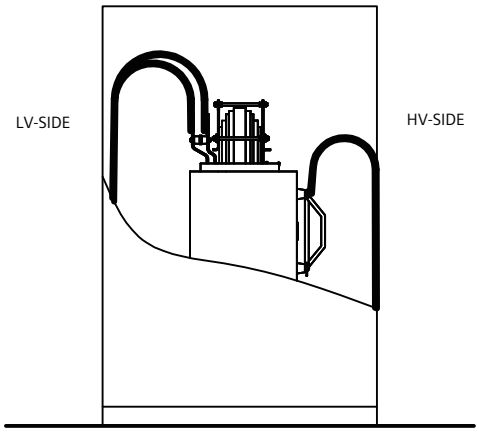
- The reliable connection of cables and busbars shall be ensured to avoid obvious external force acting on the connection of transformer.
- In the installation of copper-aluminium composite foil, the copper surface should be in contact with the copper bars and the aluminium surface should be in contact with the aluminium bars.

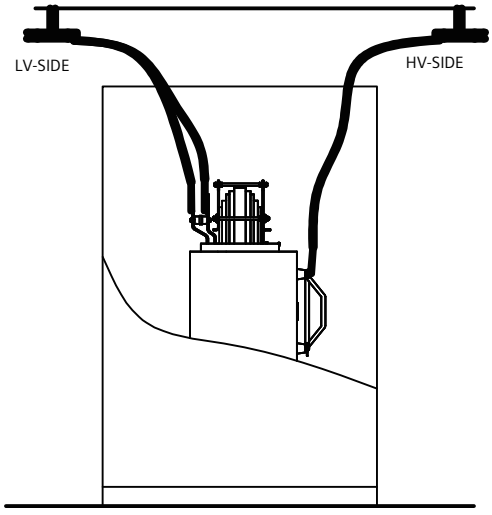
6. Installation

6.4 Cable installation layout

6.4.1 Installation wiring with enclosure:

For the transformer with protective enclosure, cables in its high-voltage side and low-voltage side can be imported to internal part of the enclosure through the top or bottom of the enclosure, which can be connected to the corresponding wiring site of the transformer. The cable wiring inside the enclosure can be shown in the following figure.



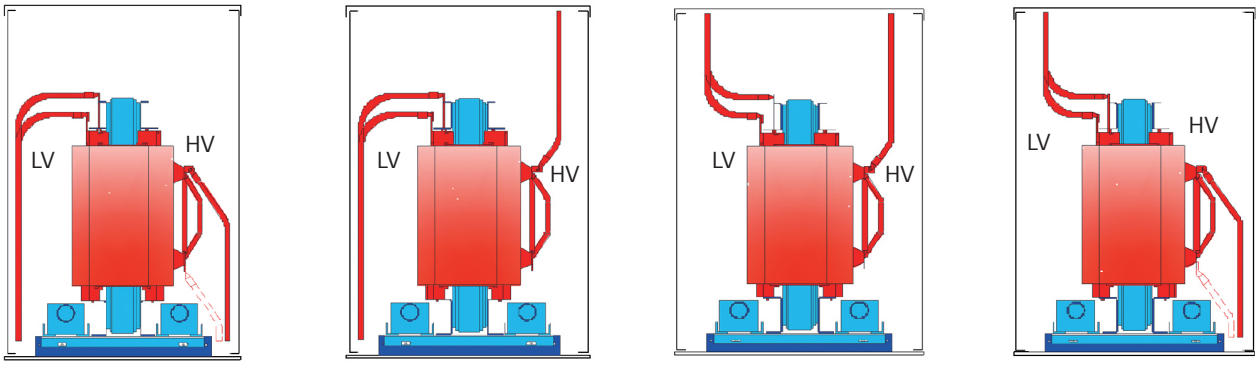


Note:

- The bending radius of the cable needs noting, to prevent force on end of cable connection.

6.4.2 Installation wiring without enclosure

The high voltage side cable can be connected to the transformer after layout in the bottom cable tray or after layout the top cable tray. Cable or bus bar can used for the low-voltage side connection. If the bus bar connection is used, soft connection transition is recommended to avoid mechanical impact on the low-voltage winding and reduce noise level due to structural reasons.



Warnings:

- The reliable support for cables and busbar shall be ensured to avoid obvious external force acting on the connection of transformer.
- High-voltage cables are not allowed to pass through the high-voltage connecting rod (delta connection) of the transformer.

6.5 Bolts fastening

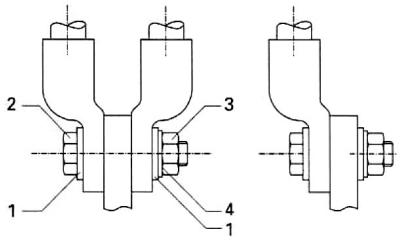
6.5.1 Contact surface preparation

Before bolting or terminal joining, the oxide layer (weak conductor) that is not visible on the contact surface must be cleaned. If the contact surface is rough and required to be polished (such as brushing, grinding stone, etc. If any of the contact surfaces is disassembled, the contact surfaces must be cleaned again before bolting.

If the transformer is installed in a room that is prone to condensation or contains more corrosive gases, the aluminium-copper contact area needs to be painted to protect the entire contact area, especially the contact edges. If this moisture-proof measure is not taken, aluminum-copper composite foil (cupal) shall be installed between the contact surfaces, so that the aluminum surface is connected with the aluminum bar, and the copper surface is connected with the copper bar.

6.5.2 Bolt requirements

Corrosion-resistant parts must be used for bolt connections, and it is recommended to use strength grade: galvanized bolts not be less than 8.8 and stainless-steel bolts not less than A2-70 hexagonal bolts. To transfer the bolt tightening pressure to the largest possible contact surface, a high-strength anti-loosening washer shall be used on the contact surface. Conical cushion is recommended (DIN6796).



1 Flat washer ISO 7093
2 Hexagon bolt, ISO 4014 or ISO 4017
3 Hexagon nut, ISO 4032
4 Conical cushion, DIN 6796

6. Installation

6.5.3 Connection torque

Bolts shall be secured with a torque wrench to ensure uniform clamping force. To eliminate any restoration after fastening at the contact areas, it is recommended that the fastening bolts be re-checked after several weeks. However, the torque shall not be higher than the torque used in the first installation. It is recommended that the bolts be tightened according to the torque values listed in the table below.

Torque values for busbar connections and tap connections

Bolt	Torque (Nm) (Ungreased)
M6	10
M8	20
M10	45
M12	75
M16	140

6.6 Electrical safety clearance

Sufficient space must be ensured around the transformer to ensure a smooth connection of the cable and the necessary electrical distance. Minimum clearance value for flashover protection is as bellow.

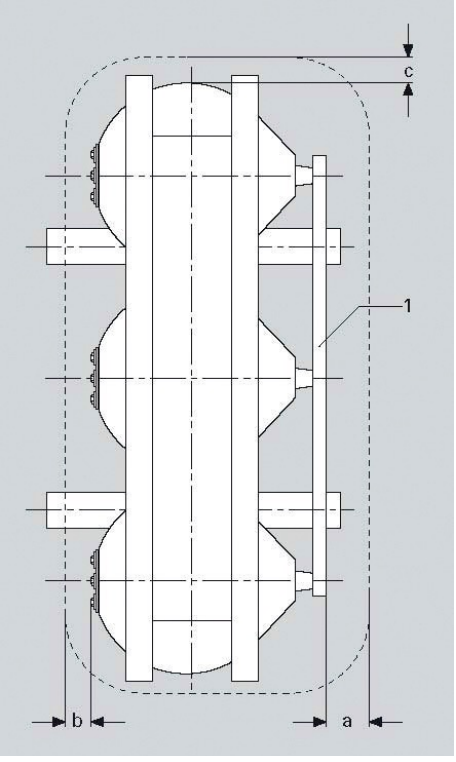


Figure 4 The high voltage side is the minimum clearance around the cast resin transformer connected to the junction box (1)

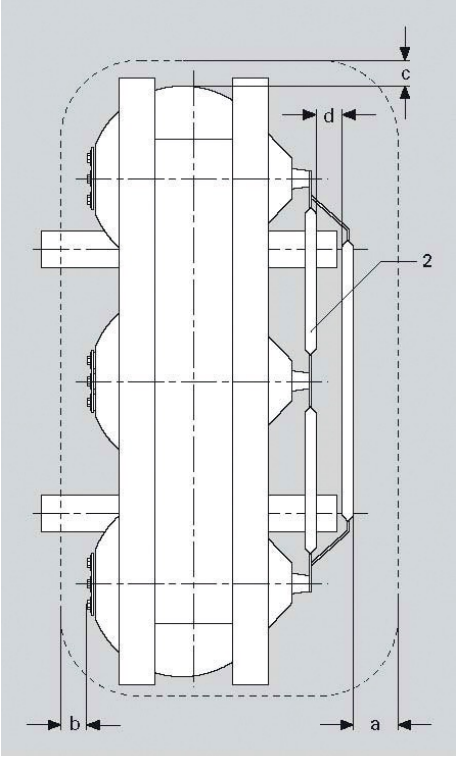


Figure 5 The high voltage side is the minimum clearance around the cast resin transformer connected to the copper tube (2)

Maximum voltage Um ① of the equipment (Effective value)	Rated lightning impulse withstand voltage LI ①		Minimum clearance value			
	List 1	List 2	a	b	c	d
kV	kV	kV	mm	mm	mm	mm
12	-	75	120	*	50	40
24	95	-	160	*	80	50
24	-	125	220	*	100	70
36	145	-	270	*	120	90
36	-	170	320	*	160	110

① See IEC 60071

* If there is a high-voltage tap on this side, parameters of column 'a' shall apply to column 'b'; Otherwise, column 'c' applies.

6.7 Grounding

After the transformer is installed, ensure that the transformer body and enclosure are reliably grounded.

7. Commissioning

7.1 Adjustment of transformer accessories

7.1.1 Commissioning of temperature control system

The transformer may be equipped with a temperature control system to monitor the temperature of the winding to prevent abnormal temperature rise of the winding, thereby protecting the transformer.

The temperature control system includes a temperature controller and a temperature sensor (PT100). The temperature sensor (PT100) is placed in the three-phase winding of the transformer. When the temperature reaches the set value, the temperature sensor (PT100) feeds back the corresponding temperature change to the temperature controller. After the temperature controller receives the corresponding feedback signal, it corresponds to different functional responses (as shown below). The over-temperature alarm and over-temperature trip functions need to be connected with the relay protection system of the front-end equipment so that the higher-level equipment can be linked when the temperature controller acts.

Temperature controller function description	Parameter settings
Over-temperature trip	150°C
Over-temperature alarm	130°C
Fan on	100°C
Fan off	80°C

The commissioning steps of the temperature control system are as follows:

a. Check the appearance of the temperature controller and temperature sensor.
b. Refer to the temperature controller manual for relevant parameters and setting methods.
c. To verify the function of the temperature controller at room temperature, the relevant functional parameters need to be changed.
d. After commissioning, the temperature controller settings need to be restored to the default parameters.

⚠ **Warnings:**

- Unless the wiring is equipped with the protection switch, it is forbidden to supply power to the temperature controller directly from the low-voltage bus bar of the transformer in order to prevent damage to the temperature controller caused by inrush current impulse.
- During the commissioning of the temperature control system, it is necessary to confirm that the upper and lower equipment of the transformer have been disconnected, to prevent the occurrence of malfunction.

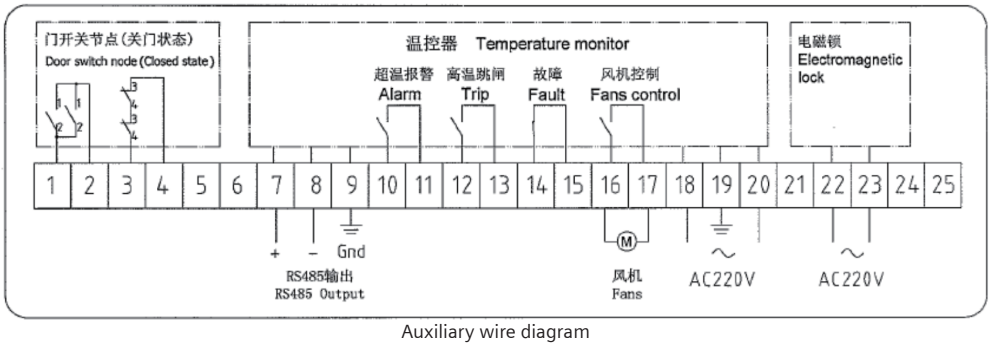
7.1.2 Travel switch commissioning

Before commissioning of the travel switch, please consult the secondary wire diagram of the transformer to understand the corresponding operation logics.

The commissioning steps of the travel switch are as follows:

a. Mechanical function commissioning: Open the door on one side of the travel switch by approx. 20 ° and you can hear the switch sound "ON/OFF".

b. Electrical function commissioning: According to the "Door Switching Node" section of the secondary wire diagram, terminals 1-2 and 3-4 correspond to "normally open" and "normally closed" functions, respectively. When all doors of transformer protective enclosure are closed, use multi-meter to measure terminals 1-2, without beeping sound ("normally open" state); Measure terminal 3-4 with beeping sound ("normally closed" state).



Auxiliary wire diagram

7.1.3 Electromagnetic lock

The electromagnetic lock (as shown below) is installed on the protective enclosure of the transformer (if electromagnetic lock is required in the contract) to realize the joint defense requirements of the equipment. Electromagnetic locks with different functions can be selected according to user requirements. Refer to the following commissioning steps:

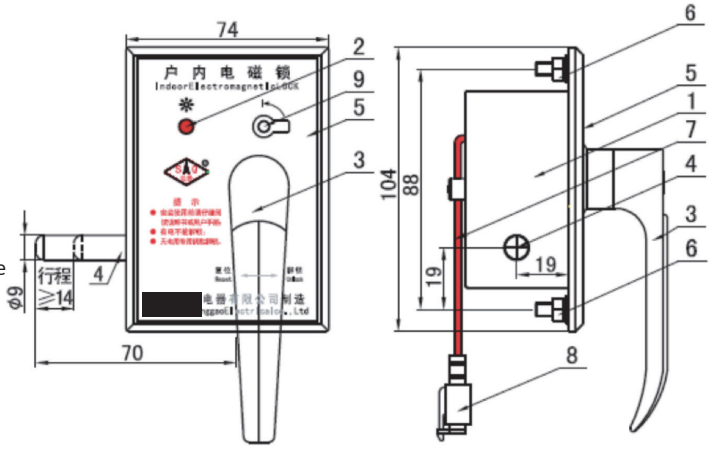
a. Check the mechanical structure, terminal of electromagnetic lock.

b. Understand the functional characteristics of the electromagnetic lock, according to the operation manual of the electromagnetic lock.

c. In the power-on and power-off states, verify whether the unlocking and locking functions of the electromagnetic lock meet.

1. Lock body
2. Indicator lamp
3. Handle
4. Lock bolt
5. Panel
6. Mounting nut
7. Power cord
8. Power cord connector
9. Unlock keyhole

Unlock key



Schematic diagram of electromagnetic lock

7.2 Inspection before operation

Before the transformer is put into operation, it is recommended that the following steps shall be followed to ensure that the transformer is under good operating conditions:

7.2.1 Remove transport aids such as plastic sheeting, wood cubes, tightening belts, etc. from the transformer prior to operation.

7.2.2 Check the appearance of transformer high-voltage winding, low-voltage winding, iron core, etc.

7.2.3 Check the appearance and function of transformer accessories such as temperature controller, fan and electromagnetic lock (refer to 7.1).

7.2.4 Check torque of electrical connection point such as transformer outlet terminal and tapping (refer to 6.5.3).

7.2.5 Check the distance between the live part of the transformer and its surroundings to meet the minimum electrical safety clearance requirement (refer to 6.6).

7.2.6 Clean the transformer to ensure that no foreign matter remains in the transformer (see 9.1).

7. Commissioning

7.3 Pre-commissioning test

7.3.1 Voltage ratio test: Measure the voltage ratio of the winding under all taps and the connection group. The allowable deviation of rated tap voltage ratio shall not exceed ± 0.5%, except for special transformers.

7.3.2 Wingding resistance test: Measure the DC resistance of the winding at all taps and records the winding temperature.

7.3.3 Insulation resistance test: Measure the insulation resistance values of the windings and cores (as shown in the table below) and record ambient temperature and humidity.
Typically, the insulation resistance is measured at ambient temperature of-25 ° C ~ 50 ° C, humidity ≤ 90%, and the insulation resistance of the transformer would decrease in humid environment. If the transformer suffers from dampness, the transformer can be dried. If the insulation resistance is not less than 2 MΩ, a voltage can be applied to the low-voltage side of the transformer and the transformer can be dried by no-load heating. If the insulation resistance value is less than 2 MΩ, it can be dried by air drying or baking with heat lamp.

Test position	Test equipment	Test value requirements
High voltage terminal - low voltage terminal + ground	2500 V Megohmmeter	≥100 MΩ
Low voltage terminal - High voltage terminal + ground	2500 V Megohmmeter	≥100 MΩ
High voltage terminal + low voltage terminal - ground	2500 V Megohmmeter	≥100 MΩ
Iron core - ground	2500 V Megohmmeter	≥10 MΩ

Note:
- After testing the insulation resistance of the iron core-ground, it is necessary to restore the connection of the grounding strap.

7.3.4 Applied withstand voltage test: The withstand voltage strength of the transformer is tested. The on-site tested withstand voltage value is 80% of the factory test voltage value. The factory test withstand voltage value can be shown in the factory test report and nameplate.

8. Operation

8.1 Voltage regulation. If the actual grid voltage deviates from the rated voltage of the transformer, the tapping gear of the transformer can be adjusted appropriately to control the output voltage value.

a. For no-load voltage regulation, the transformer gear tap shall be adjusted to the appropriate gear to keep in line with the grid voltage.

For example: The rated voltage on the high-voltage side of the transformer is 10000 ± 2 x 2.5% V, and the rated voltage on the low-voltage side is 400V. The nameplate identification gear voltage of the transformer is:

Rated voltage	5-6	10500V	400V
	4-6	10250V	
	4-7	10000V	
	3-7	9750V	
	3-8	9500V	

If the grid voltage is 10000V, the three-phase tap shall be adjusted to gear 4-7, as shown in Figure 1. If the input voltage is up to 10250V, adjust the three-phase tap to gear 4-6 so that the output voltage on the low-voltage side reaches 400V, as shown in Figure 2. If the input voltage is as low as 9750V, adjust the three-phase tap to gear 3-7 so that the output voltage on the low-voltage side reaches 400V, as shown in Figure 3.

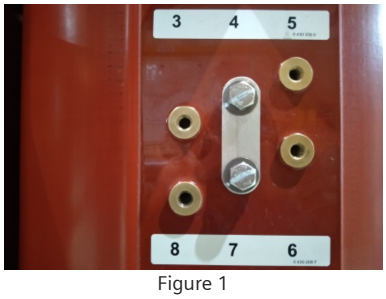


Figure 1

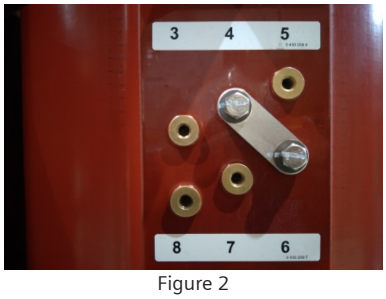


Figure 2

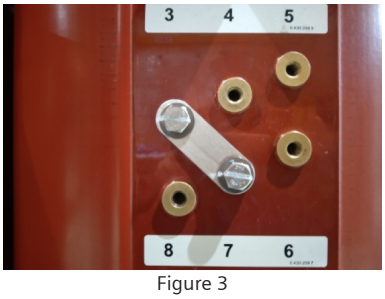


Figure 3

⚠ **Warnings:**

- The gear of transformer is set at rated gear (4-7) by default when it leaves factory. Make sure that the transformer is powered off before adjusting the gear.
- The three-phase tap must be adjusted at the same time. The rear gear bolt must be tightened after adjustment and the torque value must be restored.

b. For on-load voltage regulation, please refer to the operation manual of on-load tap changer.

8.2 When large capacity no-load transformers are put into operation, visible sparks may be generated at the joints of external components (especially at the core and clamps), but this phenomenon will soon disappear. This is due to physical reasons, and will not affect the safe operation of the transformer, so it is not a product defect.

8.3 There is inrush current when the transformer is switched on, and the peak value can reach 6-8 times of rated current. The setting value of current quick protection for the transformer shall be larger than the peak value of inrush current, and the time limit shall be ≤ 0. 5 s. Therefore, no-load inrush impulse test shall be carried out before operation to check whether the relevant protection of the transformer is malfunction or not. If the protection value is set improperly, it will cause the tripping phenomenon in the later closing.

Remarks:
It depends on the needs of users and the standard requirements of different countries and regions to decide whether the no-load inrush impact test is to be carried out at site or not.

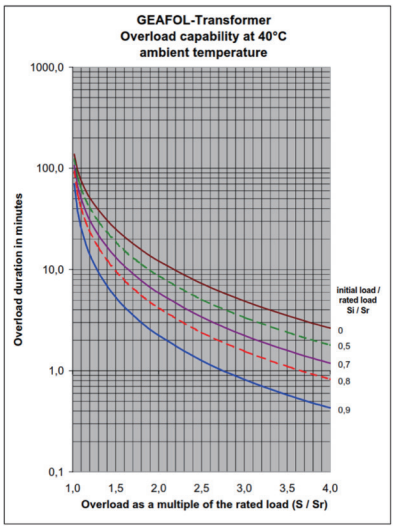
8.4 For long-term storage (storage time more than 3 months) or overhauled transformers or transformers to be used at ambient temperature below 0 ℃, it is recommended to operate without load for 12 hours before putting the transformers into load, and the load shall be gradually increased.

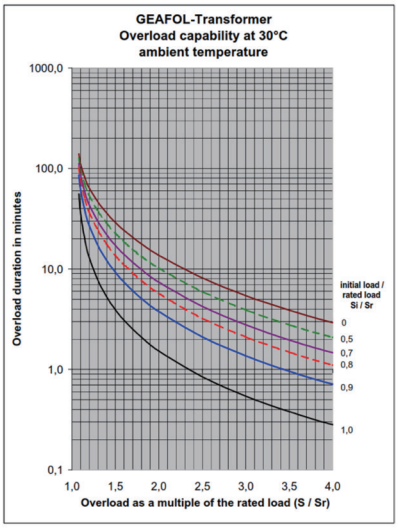
8. Operation

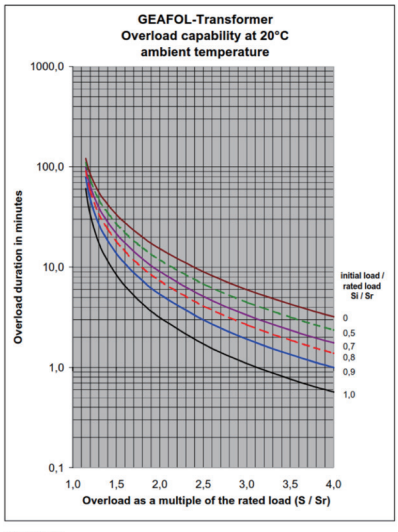
8.5 Transformer overload operation shall be in accordance with IEC 905 Load Guidelines for Dry-type Power Transformers, allowing short-term overload. The following table shows the permissible overload time curves at ambient temperatures of 40 °C, 30 °C, 20 °C, 10 °C.

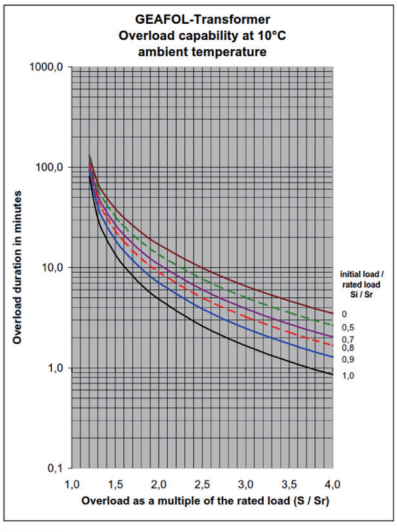
8.6 The three-phase voltage, current and temperature values shall be recorded periodically during the operation of the transformer so that the historical data of the transformer can be consulted in case of overhaul or fault.

Overload curve of SIEMENS GEAFOL® CRT (without cooling fans)









Note:
Above are the overload curves of the transformer under natural-cooling condition. The design of overload capacity of the transformer is not the same because of the different needs of users.

9. Maintenance

Cast-resin transformers are maintenance-free. Routinely inspect and clean the windings, bolt connections, alarm devices and all fan functions once a year. If the transformer is in dusty environment or close to the pollution source, it is recommended to clean the equipment every six months. It is recommended to fully inspect and clean the transformer every 5 years. Before maintenance, the transformer must be powered off and all terminals must be short-circuited and grounded.

9.1 Transformer cleaning

Blow off the transformer with dry compressed air or wipe with dry cloth and alcohol (concentrations above 85%) to prevent the formation of creepage paths and blockage of cooling air passages. Select the appropriate cleaning method from Table 1 according to the type of contamination.

Sediment	Cleaning method
Oily	2
Carbonaceous	1+2
Metal-containing	1+2
Saline	1+2
Dry dust	1+2
Wet dust	2

Cleaning method 1

Use compressed air to blow the transformer. The compressed air must be oil-free and water-free, and the air pressure ≤ 6 bar. Vacuum cleaners can also be used instead of compressed air for dust collection.

Cleaning method 2

Wipe with a dry rag and alcohol (concentrations above 85%).

9.2 Maintenance matters

S/N	Maintenance items	Maintenance cycle (recommended)	Use Tools	Methods:
1	Clean the surface stains of windings, pads and cores and stains at the heat dissipation holes of the enclosure	Normally, each year or more. Every 6 months for dusty and other polluted environment	Dry compressed air, pressure ≤ 3 bar, dry rags and alcohol	Select cleaning method according to Form 1
2	Check winding surface condition	Normally, each year or more. Every 6 months for dusty and other polluted environment	Visual inspection	No blackening or cracks on the surface of the winding (if any, please contact the manufacturer)
3	Check bolt and nut tightening status at cable connections	Each year or after maintenance	Torque wrench	According to the torque table
4	Check correct tapping connections and bolt tightening	Each year or after maintenance	Torque wrench	According to item 8.1 and torque table
5	Check grounding condition of transformer body and enclosure	Each year or after maintenance	Torque wrench and visual inspection	According to the torque table
6	Check whether temperature controller settings, temperature probe and PT100 are normal.	Each year or after maintenance	Heat gun, power supply	The temperature of the temperature controller can be displayed normally by blowing the temperature probe with a heat gun. The setting of alarm trip value is consistent with Item 7.1. 1. Refer to the operation manual of temperature controller for setting method
7	Check accessories such as electromagnetic lock, travel switch, etc.	Each year or after maintenance	Multimeter, power supply	The function is normal when the electromagnetic lock is energized. When the door panel of the enclosure is closed and opened at normal state, the normally open and closed terminal of travel switch are in the correct state.
8	Check the cooling fan	Each year or after maintenance	Power supply	Turn on the power supply, start the operation according to the manual of the temperature controller, and observe whether it rotates
9	Insulation resistance test	Each year or after maintenance or 5 years	Insulation resistance tester	Refer to Item 7.3.3 for test values
10	Transformation ratio test	Every 5 years or after maintenance	Transformation ratio tester	Refer to Item 7.3 for test
11	DC resistance test	Every 5 years or after maintenance	DC resistance tester	Refer to Item 7.3 for test
12	Power frequency withstand voltage test	Every 5 years or after maintenance	Power frequency withstand voltage tester	Refer to Item 7.3 for test

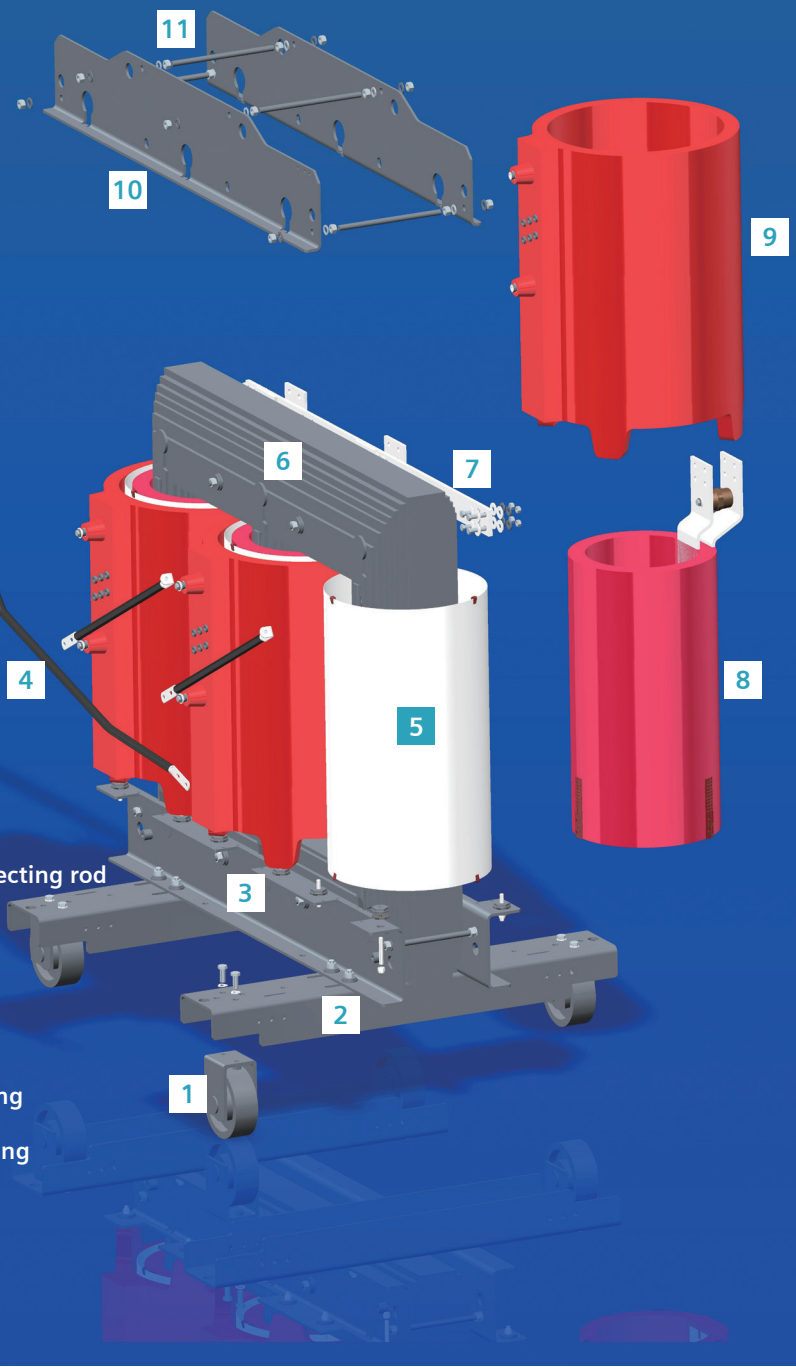
9. Maintenance

9.3 Frequently asked questions guidelines (chart)

S/N	Question	Possible cause	Corrective measure
1	Temperature controller does not display	Temperature controller power cord is not connected	Measure whether the temperature controller power interface is energized and required to reconnect the power supply (85 ~ 250 V)
		It is internal failure of temperature controller, power interface of temperature controller is energized, but panel indicator lamp is not on	Contact Siemens After Sales Service Center to replace with a new temperature controller
2	Temperature controller three phase temperature display FOC or FCC	Wrong or poor connection or loose connection of temperature sensor	Check and press the temperature sensor wiring and tighten it according to the auxiliary wire diagram on the transformer certificate of conformity
		Temperature sensor probe is damaged	Contact Siemens After Sales Service Center to replace the temperature sensor
	Three-phase temperature display of temperature controller differs greatly	Temperature sensor probe is not fully inserted into thermometer tube (three-phase probe is inserted at different depths)	Check the position of the temperature probe and place it correctly
		Cooling fan is damaged	Contact Siemens After Sales Service Center to replace with a new cooling fan
		Temperature sensor probe is damaged	Contact Siemens After Sales Service Center to replace with a new temperature sensor
		Three-phase load of transformer is not balanced	Check three-phase load and voltage, current
3	The temperature controller cannot communicate properly with the monitoring device	Wrong address setting for temperature controller	Please refer to the use manual for the temperature controller
		The communication cable of the temperature controller and the strong electric cable are arranged together, which causes the interference of the communication signal	Properly lay out the cables
4	Noise is abnormal	Primary side voltage exceeds tapping rated voltage	Disconnect the power of transformer and adjust tap gear, refer to Item 8.1
		The bus bar is not fixed well and there is resonance. The transformer is not well fixed with the ground, and the resonance enclosure plate is not fixed tightly, and there is resonance	Bus bar, enclosure board and transformer base are well fixed
		There are unclamped free ends in the iron core or clamping parts, and there are high frequency vibrations during the excitation of the iron core, resulting in abnormal noise	Check the fastening core and clamping piece and press the free end tight with insulating material
		Within the same power distribution room, multiple devices are placed close together, causing wall reflections and noise overlapping	Reasonably lay out equipment position in power distribution room
		In the transformer load, equipment such as frequency converter produces large harmonics in the system, which makes the core excitation uneven and causes noise	Filter device is designed in low voltage system
		Transformer is under overload operation state	Check the load and distribute the load reasonably
5	Cooling fan is not running	Temperature does not reach fan start temperature value	Refer to Item 7.1. 1 for factory temperature setting value and setting method
		Cooling fan is damaged	Contact Siemens After Sales Service Center to replace with a new cooling fan
6	Low side output voltage is high or low	Grid input voltage is high or low	Adjust the tap gear of transformer, refer to Item 8.1
7	Transformer over-temperature alarm, trip	Transformer overload (overvoltage, over current) operation	Check transformer load
		Cooling of transformer fails	Check whether the cooling fan is working properly and check whether the cooling air duct is blocked
8	Winding surface discharge	Severe stains (dust, etc.) on the surface of the winding	Clean stains on windings, pads, etc.
		Short circuit on high and low voltage lines	Check high-voltage lines
		High and low voltage transmission lines suffer from overvoltage impulse	Optimize system protection functions
		There is insufficient distance between metal structure and winding	Refer to 6.6 minimum insulation clearance requirements
9	Winding ablation and blackening	Upon the service life of the transformer and natural damage; poor heat dissipation; long-term overload; short circuit of external wiring; system overload; wrong cable connection; metal foreign body falling into the cooling air duct of the winding; unscrewed torque of tap gear bolt; short circuit fault inside the winding, etc.	On-site inspection is required. Please contact Siemens after-sales service center for such inspection.

10. Appendix

Disassembling diagram of cast resin transformer body

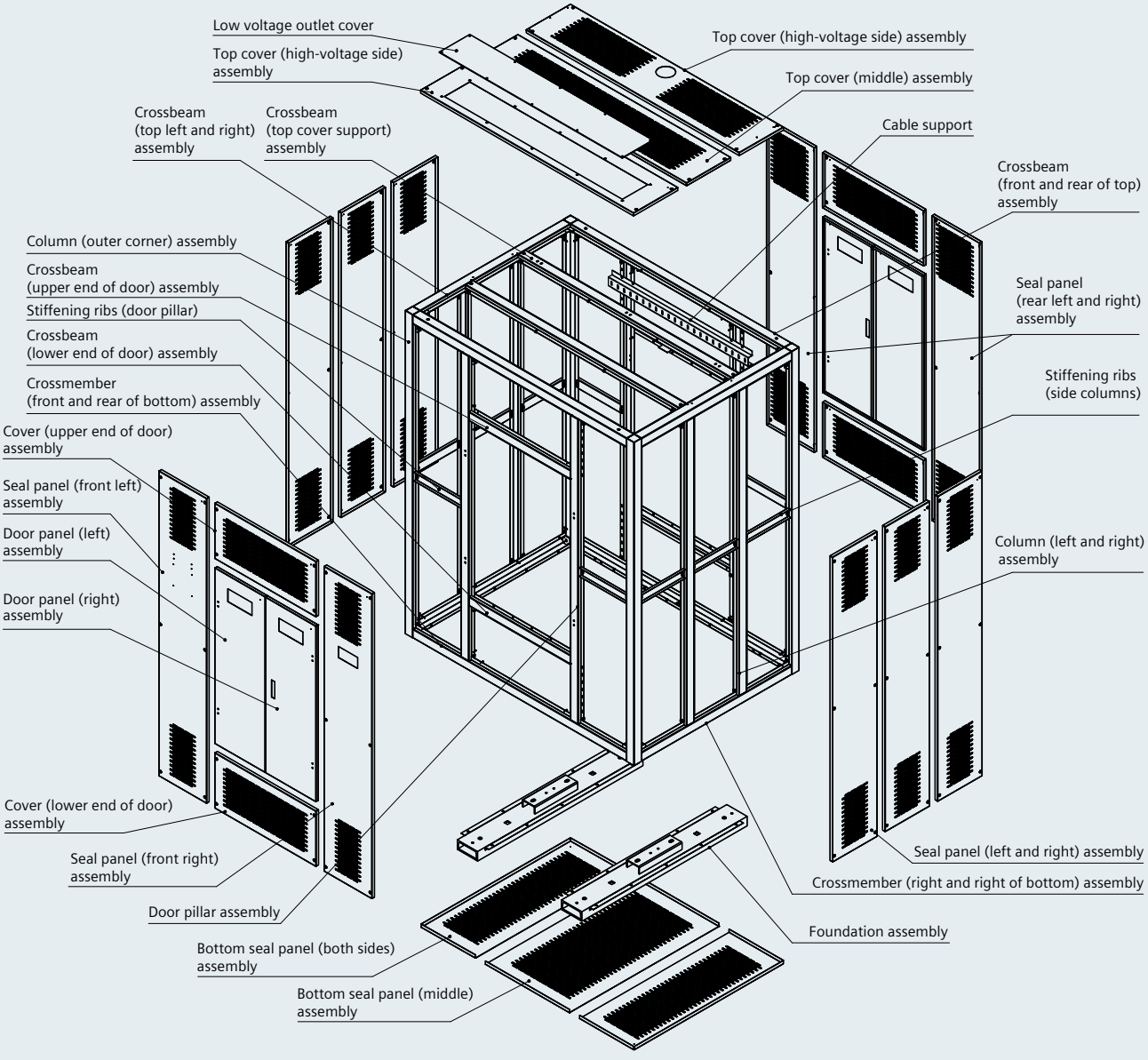


1 Wheels
2 Foundation
3 Lower clamp
4 High-voltage connecting rod
5 Insulating cylinder
6 Upper iron yoke
7 Neutral bar
8 Low-voltage winding
9 High-voltage winding
10 Upper clamp
11 Fixed screw

Remarks:
The picture is a standard legend and does not cover all types of transformers.

10. Appendix

Disassembling diagram of cast resin transformer enclosure



Remarks:

This image is a standard legend and does not cover all types of enclosures.

11. Warranty Instructions

Dear customer,

Thank you for purchasing our products. Please carefully read the manual and warranty instructions after receiving the products in order to better serve you.

I. Warranty Commitments

1. The warranty period of this product is 12 months from the date of commissioning and acceptance or 18 months from the date of delivery, whichever comes first. The specific warranty period shall be subject to the sales contract signed by both parties.
2. During the warranty period, under the operation conditions as stipulated in the contract, the faults caused by the quality problems of the products shall be repaired free of charge. The warranty period for the products repaired by Siemens shall follow the provisions of original contract.
3. For the products repaired for a fee, one-year warranty services shall be provided for the repaired part, and the warranty period shall be started from the date of shipment.

II. The following circumstances are not covered under the warranty policies

1. Warranty period expiry.
2. Damage caused by failure to use in accordance with the provisions of the contract and the requirements of the manual, dismantling or modifying the settings without the consent of Siemens.
3. Damage caused by sprinkling, collision, deformation, etc. during self-transportation, transfer and installation after purchase.
4. Failure caused by human factors (e.g. loss of components, etc.) during installation and storage.
5. Damage caused by improper manual operation or circuit system factors during commissioning and operation.
6. Damage caused by force majeure such as lightning strike, flood/fire, earthquake and other natural disaster. Notes: Our company can provide paid maintenance services for products not covered under the warranty policy.

III. Maintenance Mode

- When you find the fault, please call after-sales service center of Siemens Transformer (Guangzhou) Co., Ltd. and provide complete fault information to help us confirm the fault status and cause.
- If repair is needed, we will assess the severity of the failure and arrange engineers to go to the site for repair or you may send the products to our factory for repair.
- When our technical personnel arrive at the site or the products are returned to the factory, we have the right to claim the relevant fees (including travel fees, materials cost and other fees) after the removal of the faults not caused by the quality issue of the products.

IV. Others

The aforesaid service commitment applies to the products sold by our company. In case the after-sales service terms are separately agreed upon when the products are sold, the contract confirmed by our company shall prevail. The right to interpret and amend this warranty certificate shall be vested in Siemens Transformer (Guangzhou) Co., Ltd.

SIEMENS

Siemens Energy Management Customer Service Center Service Hotline: 4000705500
Siemens Transformer (Guangzhou) Co., Ltd.
Address: No.67 Hongjing Road, East District, GETDD Guangzhou, China.
Postal code: 510530
Tel.: +862062663406

12. Customer Satisfaction Questionnaire

Dear customer,

Thank you for using our products. Please fill in the following form after installation to help us complete the customer satisfaction survey, so that we can continuously improve our work and better serve our customers. Please mark " ✓ " in the corresponding column according to your impression of the product. Thank you for your cooperation, and sincerely hope that you will give us valuable comments or suggestions on all aspects of our work.

How do you rate our performance in the following areas? (If you do not address any of the following questions, you may not answer them.)

	Very satisfied	Satisfied	General	Not quite satisfied	Not satisfied
Product integrity on arrival	☐	☐	☐	☐	☐
Handling of problems (quality problem solving/response to complaints)	☐	☐	☐	☐	☐
Appearance quality of product body	☐	☐	☐	☐	☐
Appearance quality of product enclosure	☐	☐	☐	☐	☐
Service initiative	☐	☐	☐	☐	☐
On-site safety consciousness of service personnel	☐	☐	☐	☐	☐
Communication skills of service personnel	☐	☐	☐	☐	☐
Professional level of service personnel	☐	☐	☐	☐	☐

Your rating on overall performance of our products and services:

10 points	9 points	8 points	7 points	6 points	5 points	4 points	3 points	2 points	1 points
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Will you recommend our products to other customers?

☐ Yes ☐ Possibly Yes ☐ No

We sincerely hope and thank you for that you could give us your comments or suggestions on our company:

Customer Signature/Date:

Please fill in this page and send it to us by means of scanning or photographing via Email: allen.cao@siemens.com

欢迎扫码了解西门子配电设备与系统信息

If you have any questions about the distribution transformer, please contact us.

Siemens Energy Management Customer Service Center Service Hotline: 400 070 5500

Siemens Transformer (Guangzhou) Co., Ltd
Contact information of the after-sale service:
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hongjian.zheng@siemens.com
Tel.: +86 20 6266 3406 / 6266 3446

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