Operating Manual for Cast-resin Dry Type Distribution Transformer

1.Scope of Application

This manual is applied to handling, transportation, warehousing, installation, operation and maintenance of the non-excitation tap-changing and on-load tap-changing resin-insulated dry-type power transformer produced by our company, which has a rated capacity of 31500kVA and below and a voltage grade of 35kV and below.

2.Operating Condition

2.1 The transformer should be used in an ambient temperature range of-25℃ to 40℃, and at the altitude no more than 1000m. If the ambient temperature exceeds 40℃ or the altitude exceeds 1000m, the relevant rated values of the transformer should be regulated in accordance with IEC60076-11 Power Transformers-Part 11: Dry-type Transformers, and if the ambient temperature is lower than-25℃, the product should be considered specially.

2.2 There are protection grades of IP00, IP20, IP23 and ete,

2.3 There are two types of cooling ways: natural air cooling (AN) and forced air cooling (AF). Both natural air cooling (AN) and forced air cooling (AF) transformers should have a good ventilation capacity.

3. 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)

Specific reference standards shall be subject to the contract requirements.

4. Safety Guidelines

4.1 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.
	Before the transformer is put into operation, the staff should make clear safety precautions and emergency measures to deal with emergencies.

4.2 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 repaired 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.

4.3 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.

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:

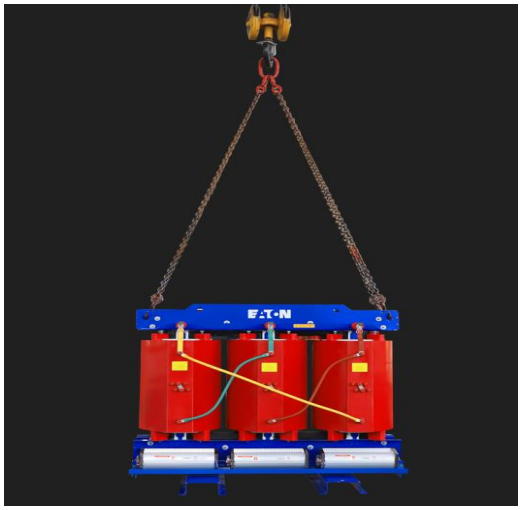
5.2.1 If the transformer is packed in wooden cases, the lifting shall be carried out according to the lifting marks on the wooden cases. Or it shall be transferred according to fork-lift signs, as shown below.

Wooden case packing and transportation

Wooden case packing and fork-lift transportation

5.2.2 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.

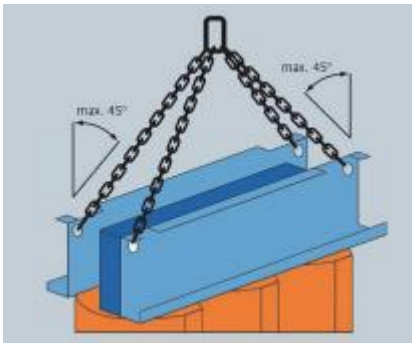
Warnings: • The lifting process shall be uniform and stable, so as to avoid sudden lifting or landing, and prevent the transformer from being subjected to external impact. • When lifting the transformer body, attention should be paid to lifting angle not exceeding 45. • For the fork transportation, please 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:

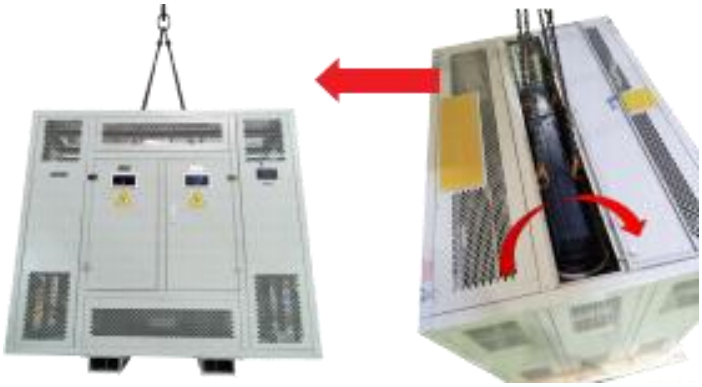
1. The transformer has no protective enclosure and can only be lifted by slings through the lifting holes of the upper clamping piece. The lifting angle must comply with the requirements on the labels affixed beside the lifting holes, as shown in the following figure.



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

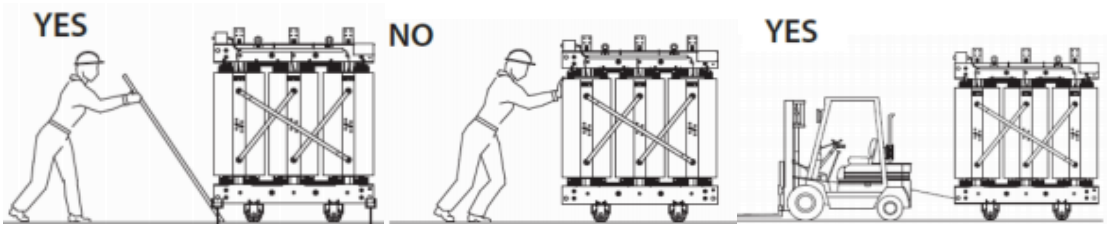


Warnings: • It is forbidden to lift the lifting rings on the top of the transformer enclosure. • Before lifting, check whether the slings are completely fixed, and note that the lifting angle shall not exceed 45 º. • The lifting process shall be uniform and stable, avoid sudden lifting or landing, and 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.

5.3.2 Horizontal transfer

1. When the transformer has no protective enclosure and needs to be transferred:

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.

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

The customer should check the transformer immediately after receiving it.

a. Check whether the data on the nameplate are consistent with those on the purchase order, such as product model, rated capacity, rated voltage, connection symbol, short-circuit resistance, and etc.
b. Check whether the factory files are complete.
c. Check whether the parts in the packing box are consistent with those in the packing list.
d. Check whether the product is damaged, whether the product parts are damaged or moved, whether the wiring is loose, broken, or damaged in the insulating layer, whether there are contaminants or impurities during transportation, and so on.Meanwhile, objects such as stow-wood used in the transportation must be moved away;
e. Products should be kept well or packed again after the unpacking check if are not put into operation immediately in case of damage or theft.
f. Should problems that the packing box and product are damaged seriously be found, report to the transportation andinsurance departments immediately, and preserve the site for disp

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 ºC 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 warehouseshall be cleaned, dried and ventilated and transformers shall not be stored together with active chemicals and corrosive substances.

c. Stacking in warehouse is not allowed for all products.

6. Installation

6.1 Before installation, read the manual, product nameplates and product overall dimension figures learn about the product weight, installation methods, etc, and get ready the relevant hoisting devices and tools.

6.2 Product should be installed generally at a distance of 800mm away from the wall and other obstacles, and a distance of 1000mm should be kept between two adjacent transformers.

6.3 The minimum safety distance between live conductor and the ground should be in accordance with IEC60076-3 Power Transformers-Part 3:Insulation Levels,Insulation Tests and External Clearances in Air.

6.4 The minimum safety distance between the surface of the high-voltage coil and the ground is listed in the table below:

High Voltage	≤1kV	6kV	10kV	15kV	20kV	35kV
Distance(mm)	40	60	90	120	160	250

6.5 Generally, the transformer can be placed at the operating site directly, and can be put into operation after the installation and check. In case of shockproof and other special requirements, bolts should be embedded into the foundation for installing the transformer, and the bolt is placed at a position by referring to the overall dimension figure of the transformer, to make the bolt corresponding to the mounting hole of the transformer. The wheels of the transformer are removed and the transformer is secured by the embedded bolt.

6.6 The connection between live parts must be firm, and the torque of the fastener is listed in the table below:

Fastener Specification	M10	M12	M16	M20
Pretension torque(N.m)	15	25	35	45

6.7 Weak parts of the transformer, such as connecting rod, fan, base plate of the enclosure cannot be trampled during installation.

6.8 When product with enclosure is installed, the upper and lower plates are not allowed to block off, especially when the enclosed busbar is installed at site. After installation, the opaque objects on the enclosure should be removed to avoid affecting ventilation and radiating.

7. Check before Operation

7.1 Check whether all the fasteners and connectors are loose, and retighten them. The fastening torque of the copper nut cannot be too big.

7.2 Check whether the removed parts are properly installed again, and check whether there are impurities in the transformer, especially in the air duct, and if there is too much dust, clear it according to Article 11.2.

7.3 Check whether fan, temperature controller and other auxiliary devices work normally. Pay attention to the rotation direction of three-phase fan, the wind blows into the coil from the bottom of the coil, when the fan rotates normally, otherwise, the fan rotates reversely, and the phase sequence of the power should be changed immediately according to the instructions. Other auxiliary devices such as temperature controller (temperature displayer) should be connected correctly and reliably according to the instructions.

8. Test before Operation

The transformer should be tested before operation:

8.1 Measure the DC resistances at all the tapping positions of the winding.

8.2 Determine the polarity, measure the voltage ratio at all the tapping positions of the winding, and determine connection symbol.

8.3 Check cabinet and steel cores of the transformer are grounded permanently (steel cores should have no multi-point grounding).

8.4 The insulating resistance test of the coil is generally as follows (temperature: 10℃~40℃, humidity: no more than 85%)

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 theiron core-ground, it is necessary to restore the connection of the grounding strap.

8.5 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.

9. Transformer Operation

9.1 The transformer should be regulated to an appropriate position according to the instructions on transformer nameplate, tap indicator.

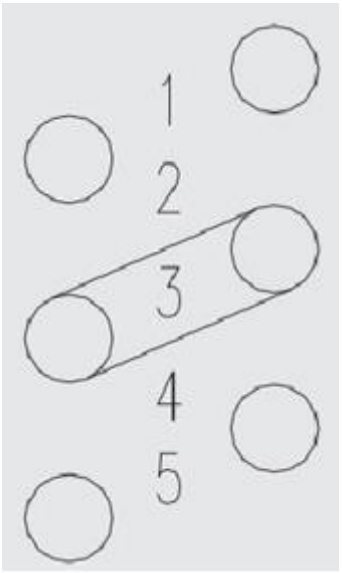
9.1.1 In a non-excitation tap-changing, the connection flaps of the tap changer should be connected to the corresponding positions according to marks on nameplate and tap indicator, and network voltage.

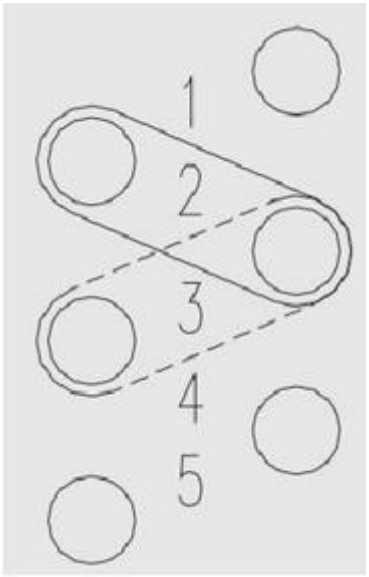
For example, the transformer with a voltage of 10000±2×2.5%V has the following nameplate voltages:

	1-2	10500V
	2-3	10250V
Rated voltage	3-4	10000V
	4-5	9750V
	5-6	9500V

If the actual voltage of the local network is 10kV, the connection flaps should be at the 3-shift (our product is often at this shift before leaving the factory), as shown in Fig.4.

When the output voltage is a little higher, the connection flaps of the tap changer should at the upper position for ensuing high voltage power off, as shown in Fig. 5; when the output voltage is a little lower, the connection flaps of the tap changer should at the lower position for ensuing high voltage power off, as shown in Fig. 6.





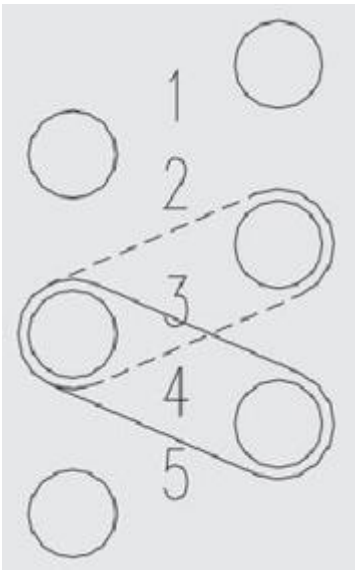


Fig.4 Fig.5 Fig.6

9.2 When the transformer is equipped with temperature controller or temperature displayer, please regulate the temperature controller or temperature displayer to a normal state by referring to

the instructions on temperature controller or temperature displayer, and operate the transformer first and then temperature controller or temperature displayer.

9.3 Transformer should be put into operation in the no-load closing, the peak of closing inrush current can be up to 10 - 15 times the rated current of the transformer, and current surge protection settings should be larger than the peak of inrush current.

9.4 After the transformer is put into operation, the loads should be added from light to weight, check whether there are abnormal sounds in the product, and do not put blindly a big load at a time.

9.5 Transformer overload operation shall be in accordance overload curve of our company "Dry-type Transformer Technical Manual".

9.6 Generally, the transformer can be put into operation again after it is withdrawn from operation. However, if dewing is produced on the transformer because the transformer has suffered from exceptional humidity and the transformer must be dried before it is put into operation.

10. Transformer Maintenance

In order to ensure normal operation of transformer, the transformer must be checked and maintained regularly.

10.1 Generally, the transformer should be checked every year or a little longer at dry and clean places; and the transformer should be checked every three to six months at other places, such as when the air is polluted by dusts and chemical smokes.

10.2 If too much dust is accumulated, clear it during check to make sure the air is circulated and avoid insulation breakdown. Much attention should be paid to the cleaning of the transformer insulator and boss of the bottom pad, and dust in the air duct should be blown with dry compressed air (2 to 5 atmospheric pressures).

10.3 Check whether the fastener is loose, whether conduetive parts have rusty and corrosive traces, and whether there are creepage traces and carbonizationon on the insulated surface, and corresponding measures should be taken when necessary.

10.4 When the transformer has been operated for several years (5 years is recommended), tests on insulting resistance are done to determine whether the transformer can be used again according to Articles 9.4 and 9.5, and other tests are generally not required.

11. Safety Considerations

11.1 After the transformer is installed, check the reliability of the grounding system to make sure the grounding portions are safety and sound.

11.2 Before the transformer is put into operation, fix isolating fences around the transformer, which has no enclosure, in case of accidents; after the transformer is put into operation, the transformer body is not allowed to touch in case of accidents.

11.3 The testing, installation and maintenance of the transformer must be in charge of qualified professionals.