

Industrial Solutions

# Wave Cast Dry Type Transformer

## User Manual



**AEG**

 **YATRON**<sup>®</sup>  
Intelligence Makes The Dream Come True | [WWW.YATRONGROUP.COM](http://WWW.YATRONGROUP.COM)



## CAUTION

- BE CAREFUL READING THIS MANUAL BEFORE ANY OPERATING
- TOUCHING TRANSFORMER MAIN BODY IS STRICTLY PROHIBITED WHILE THE TRANSFORMER IS ENERGIZED
- DO NOT ATTEMPT TO CHANGE TAP CONNECTIONS WHEN TRANSFORMER IS ENERGIZED

*Notes: To change taps when energizing is prohibited except ON-LOAD TAP-CHANGING transformer.*

- ENSURE TRANSFORMER AND ENCLOSURE OR ISOLATE FENCE (IF APPLICABLE) PROPER GROUNDED BEFORE ENERGIZING TRANSFORMER
- DO NOT MAKE ANY CONNECTIONS THAT ARE NOT AUTHORIZED BY THE NAMEPLATE
- TERMINALS AND ITS ACCESSORIES ARE ONLY FOR ELECTRICAL LOADING. DO NOT REPLACE THEM WITH OTHERS
- DO NOT APPROACH TO TRANSFORMER WITHOUT WEARING PROPER LABOR PROTECTION APPARATUS, ESPECIALLY IN OPERATING TRANSFORMER



Notes:

1. These instructions in this manual do not propose to cover all details or variations in equipment, not to provide for every contingency in installation, operation, or maintenance. For further information desired, or particular problems not covered in this manual, please contact the manufacturer.

## MANUAL APPLICABLE SCOPE

This manual applies to Wave Cast dry-type power transformer with rated power up to 20000kVA and HV up to 35kV. Those transformers should be manufactured by Shanghai GE Guangdian Co., Ltd.

## TRANSFORMER NORMAL SERVICE CONDITION

Standard transformer ratings are designed, based on:

Altitude:  $\leq 1000$  m or 3300 ft,

Ambient temperature: from  $-5^{\circ}\text{C}/-30^{\circ}\text{C}$  (indoor/outdoor use) to  $+40^{\circ}\text{C}$ ,

Monthly average temperature:  $\leq +30^{\circ}\text{C}$ ,

And yearly average temperature:  $\leq +20^{\circ}\text{C}$ .

Notes:

1. Before operating standard transformer in other service conditions, please enquire your supplier or manufacturer.
2. Air natural cooling (AN) transformer is not equipped with fans.
3. Air natural / air forced cooling (AN/AF) transformer is equipped with fans and overload according to nameplate in AF state is permitted for long time. In the meantime, load losses of the transformer will increase, so the running might be uneconomical.
4. The insulation class is F class ( $155^{\circ}\text{C}$ ) or H class ( $180^{\circ}\text{C}$ )

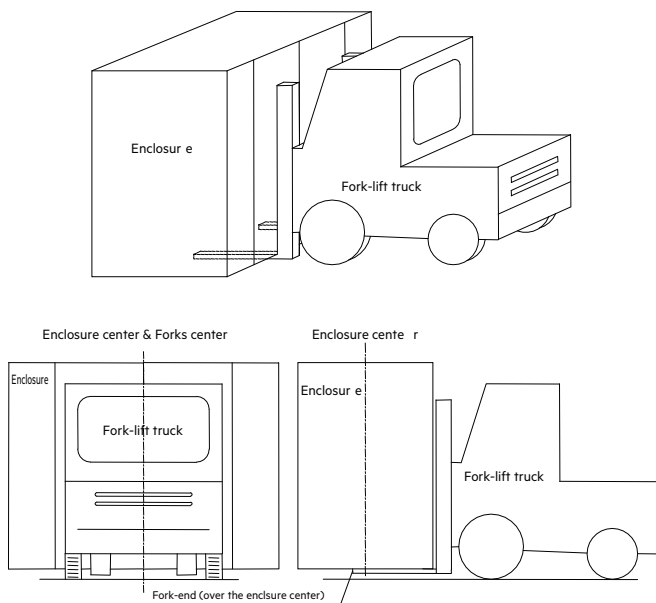
# GENERAL REQUIREMENT OF MOVING AND STORAGE

## Transportation

1. While transporting transformer, some action should be made to avoid rain, snow, humidity, and dust into transformer package.
2. The inclining angle of length direction from level should not exceed 20°. The inclining angle of width direction from level should not exceed 15°.
3. Keep smoothly moving in transportation. Any intense impact might damage transformer.
4. The special wheels are available for short-distance level move. The special wheels should be specified in order.

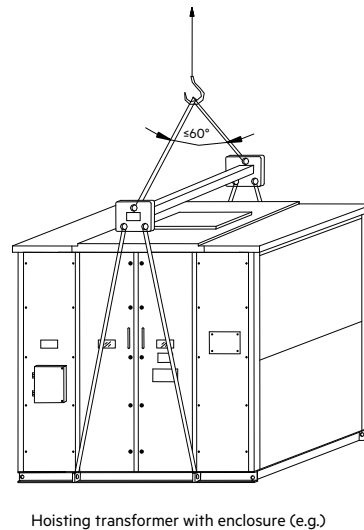
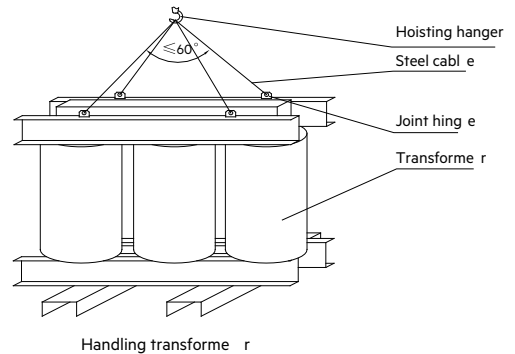
## Transporting by fork-lift truck

1. The fork shall be symmetrically placed under the enclosure base to avoid declining and overturn.
2. The fork end shall be over the enclosure center to avoid declining and overturn.
3. The speed shall be limited to avoid tossing.



## Hoisting

1. For the packed transformer, hoist it from wooden package bottom by steel cables.
2. For the transformer with enclosure, follow hoisting instruction on enclosure.
3. For the naked transformer, hoist it from 4 lifting eyes on the upper clamps.



## Storage

1. The transformer shall be protected against humidity, rain and damage before running even it had been installed.
2. It is better to pack the transformer well after receiving inspection if applicable.
3. Severe humidity and rain shall make core rust and insulation resistance low. It shall be dried before put into service and little rust shall not degrade its performance.
4. Storage environment:
  - a. Relative humidity:  $\leq 85\%$ .
  - b. Ambient temperature:  $-5^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ .
  - c. No contaminative environment.

# RECEIVING

**CAUTION:** One thorough inspection of each unit is very important before acceptance.

Users should check & inspect the transformer immediately after receiving the transformer.

## Check items should be as below:

1. Check the nameplate data to ensure rated capacity, rated voltage, tapping range, tapping method, connection symbol, method of cooling and others.
2. Check the attached documents that should include transformer instruction & manual, certification of proof, factory test report, and packing list.

Notes: the certifications and operation manuals of temperature controller, fans, or on-load tap changer (if applicable) should be provided with itself.

3. Check the transformer accessories and parts enclosed in package that should be identical with the packing list and should be well without any damage.

## Inspect the transformer carefully to ensure:

1. the parts are not damaged or removed,
  2. the connections are not loosened or broken,
  3. the insulation are not worn
  4. HV winding has not crack or damage
  5. and no foreign bodies are on the transformer body, etc.
- If damage is detected or shortages are noticed, record that with brief description and contact the factory.

Notes: Temporary tighteners should be removed carefully in inspecting (if applicable)

# INSTALLATION

## Environment & location requirement

1. The installation environment should exclude harmful smoke, harmful steam, excessive corrosive dust, severe humidity, or dropping water.
2. The ventilation volume for 1 kW loss shall be not less than 4m<sup>3</sup>/min.
3. Fix the bottom bracket of transformer on the base or the rail after removing the wheels. The transformer base and the chamber illumination should accord with relevant standards.
4. The transformer should be out of person contact when being energized. So, for naked transformer (without enclosure), well-earthed isolation fence should be installed around it. Safety warning should be noticeable on transformer body, enclosure, and isolation fence.
5. For altitude not exceeding 1000m, the minimum phase-to-phase and phase-to-earth insulation distances should be:

Highest voltage for equipment (kV)	≤1.1	3.6	7.2	12	17.5	24	40.5
Distance (mm)	25	60	90	125	180	225	340

6. The minimum distance between transformer and the operator should be:

Rated voltage (kV)	≤10	15~35
Distance (with fence)(mm)	350	600
Distance (without fence)(mm)	700	1000

## Electrical connection

1. All terminals shall be correctly connected. The connecting cables and bus bars should comply with both relevant standards and the above minimum distance, and be fixed by immobile support. The connection should not cause too much mechanical strength or torque on the transformer terminals.
2. When terminal connects to solid bus bar, the soft connecting bus bar should be used.  
Notes: The soft bar is not provided by manufacturer.
3. All connections should be reliable. For bolt connection, measures should be taken to prevent corrosion and looseness, and keep necessary pressure. Recommended torque is as below:

For steel fixing parts:

Screw (mm)	M10	M12	M16	M20	M24
Torque (N.m)	18~22	32~39	79~98	157~196	275~343

For copper fixing parts:

Screw (mm)	M10	M12	M16
Torque (N.m)	9~11	16~20	35~40

4. The earth bolts of transformer, enclosure, and the isolation fence should all be connected to the protective earthing system.
5. The temperature controller should be located on noticeable places for convenient inspection and adjustment. The minimum distance between the connection wires and live parts should accord with the above distance. All connections should be correct and reliable.

Notes: The automatic tap-changing controller of on-load tap changer (if applicable) should comply with the above requirement as well.

# INSPECTION BEFORE SERVICE

## Inspection items:

1. Inspect all fixing parts, connecting parts, and fix them once again if they are loosened.
2. Inspect transformer main body and important parts, i.e. windings, terminals, core, and cooling equipment. Remove foreign material if there is any. Check cooling equipment and temperature controller if they can put into service normally. Be familiar with relevant instruction books.

Notes: For on-load tap-change transformer, on-load tap changer and its controller should be inspected to ensure they are ready for service before service as well. The inspection should comply with the on-load tap changer instruction book.

3. Inspect the earthing of transformer enclosure and transformer if they are correct and reliable. Check the earthing resistance as relative regulations.
4. Inspect the epoxy resin surface of HV windings if it is damaged.

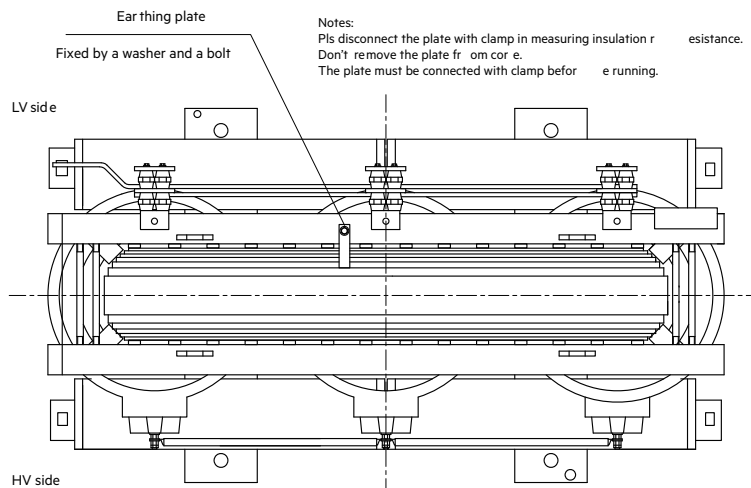
## Test items:

The following data of test need to record.

Test items	Recorded testing data				Ambient temperature °C	
Measurement of winding resistance ( $\Omega$ )	HV winding	3-8	4-8	4-7	5-7	5-6
	AB					
	BC					
	CA					
	LV winding	ab	bc	ca	oa	ob
Measurement of deviation of voltage ratio (%)	Tap position	3-8	4-8	4-7	5-7	5-6
	AB/ab					
	BC/bc					
	CA/ca					
Check of connection group	Check method			Check result	(Pass/Fail)	
Measurement of insulation resistance	HV winding to LV winding and earth			LV winding to HV winding and earth		
	(M $\Omega$ )			(M $\Omega$ )		
Insulation resistance of core to ground (Disconnect the core earthing temporarily, see below fig.)				(M $\Omega$ )		
Separated-source AC withstand voltage test (1 min, 85% of the factory test voltage)				(Pass/Fail)		
Start the self-check program of the temperature controller				(Pass/Fail)		
Check the earthing of transformer enclosure and transformer if it is correct and reliable.				(Pass/Fail)		

## Notes:

1. Test standard: IEC60076-11
2. For on-load tap changing transformer, the on-load tap changer test should be taken according to its instruction book or relative standards before energizing.



### Acceptable scope:

1. The difference of winding resistance from factory test data should not more than 2%. (Need to be corrected into the same temperature)
2. The variation of voltage ratio should not exceed ? 0.5% on rated tap, ? 1% on other taps ( Not applicable for isolation transformer)
3. Insulation resistance of core to ground shall be more than 5MΩ
4. The insulation resistance of windings should not lower than 70% of the factory test data. If the transformer is affected evidently with damp or water before put into service, it must be dried at the temperature from 60°C to 80°C till the insulation resistance meet the requirements in following table:

Highest voltage for equipment (kV)	≤1.1	3.6	7.2	12	17.5	24	40.5
insulation resistance (MΩ)	5	10	20	30	40	50	100

5. Start the self-check program of the temperature controller, fault should not occur.

Notes: If any not acceptable item appears, please contact manufacturer before energizing.

## PUT INTO SERVICE

1. Before energizing unit, inspect if the tap connector is suitable for the actual primary voltage according to nameplate and measure winding resistance to ensure the tap-change is right and well contacted.

Notes: For transformers with on-load tap changer, connect the automatic tap-changing controller to distribution voltage according to its instruction book before put the transformer into service.

2. Preset the temperature of the temperature controller according to its instruction book.
3. Put all protective equipment into service, then switch on the transformer at no-load for five times (at 10 minutes intervals for each time). No special phenomenon should occur in switching. If any special phenomenon occurs, please stop to contact manufacturer.

Notes:

1. The switch-on shall conduct at high-voltage side of the transformer.
2. For neutral earthed power system, the neutral point of transformer must be earthed when testing.

4. After putting the transformer into service, add load to the transformer from light to heavy, and in the meantime, inspect if there is special noise. Avoid adding heavy load at once.
5. During the first 72 hours after the transformer put into serve, to inspect the transformer should be more frequently.
6. The following documents on transformer in service should be prepared:
  - 1) Daily record of the transformer;
  - 2) All hand over files after the installation;
  - 3) The factory routine test report and the acceptance test report;
  - 4) Instruction books of the temperature controller and fans (instruction books of on-load tap changer, if applicable);
  - 5) Records of accident and abnormal operation;
  - 6) Records of other test and inspect.

Notes: The transformer can be put into service again after it is out of use without taking any measures except that there is condensation on the surface of the transformer. The transformer with the condensation can be put into service only after it is dryly treated.



## OPERATION SUPERVISION

1. The operation voltage of the distribution transformer should not exceed 105% of operation rated tapping voltage. The rated capacity would not change when its taps are changed within  $\pm 5\%$ .
2. Supervise the meters of voltage, current and the value of the temperature controller.
  - 1) Record those data when the operating current exceeds the rated current or the temperature is higher than normal value.
  - 2) Notice abnormal noise, vibration, or scent. If there is any, please analysis and deal with it or contact manufacturer.
3. When the loads of three phases of the transformer are not balanced, supervise the phase with biggest current and the phase with hottest temperature. The maximum permitted neutral current is same as the low-voltage line current.
4. Operation methods under different loads. Refer to "IEC 60076-12 Loading Guide for Dry-type Power Transformers" and the overload curve provided by this manual.
5. Check reason or contact with the manufacturer if the transformer has comparatively serious fault that cannot operate normally (such as the fans cannot operate normally, temperature indicating is abnormal, the appearance of the insulation has light crack, etc). In such occasions, avoid overload.

## MAINTENANCE

### Routine maintenance

1. Inspection and maintenance should be performed:
  - 1) once per year for the place dry and clean;
  - 2) once for every 3~6 months for the place may be polluted by dust or chemical foggy air;
  - 3) once per month for the serious filthy place.
2. clean the insulator, terminals, insulation blocks and the windings,
3. use dewatered pressurized air to blow off dust on the air channels or use vacuum cleaner to aspirate dust.
4. Inspect the fixing parts and connecting parts if they are loose,
5. inspect the conductive parts and other parts if they are rusted and corrosive.
6. Inspect the surface of the insulation if there are crack, creepage or carbonization traces.

# MAINTENANCE

## Preventive test

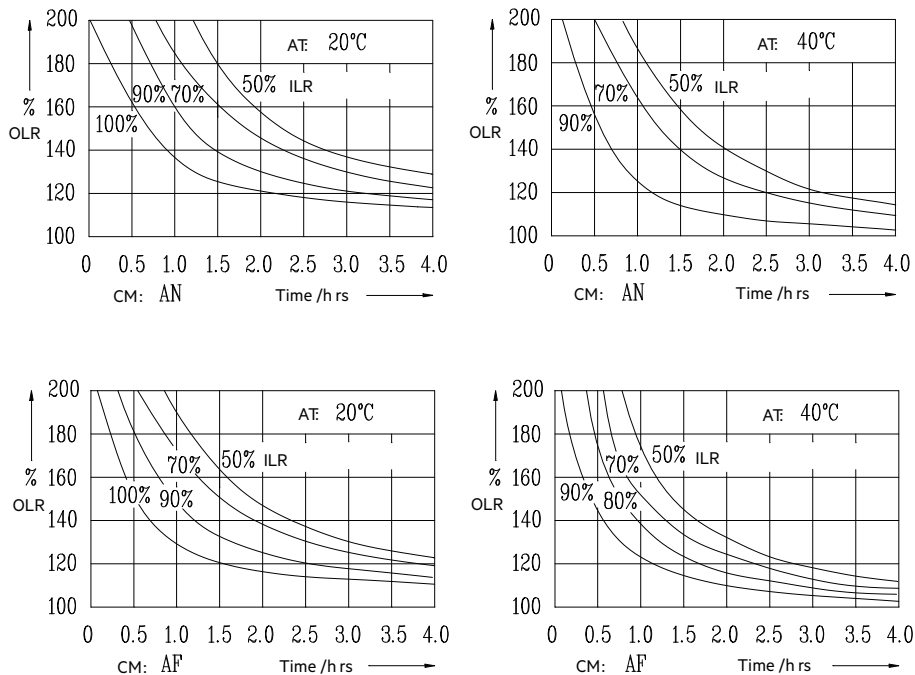
- In general, the preventive test is performed once every three years. This schedule can be brought forward if fault occur. The items of the test include:
  - 1) measurement of winding resistance,
  - 2) insulation resistance of windings,
  - 3) insulation resistance of core,
  - 4) separated-source AC withstand voltage test (85% factory withstand voltage)
  - 5) and induced AC withstand voltage test (85% factory withstand voltage)
- Perform partial discharge test once every 3~5 years. Before the test, clean the dust and condensation on the windings, insulation blocks, and insulators. Compare the test data with the factory data and the previous test data, and if the partial discharge is more than 50pC, analysis and judging the

source of partial discharge must be conducted and enhanced supervision and shorting the test period is needed. If the partial discharge is up to 100pC or more, the transformer should be out of service; analysis and judging the source of partial discharge must be conducted.

- When apply preventive test, the temperature controller should be checked.
- When apply preventive test, measure the insulation resistance of the fans, measure, and compare the noise level of the cooling equipment. According to the operation condition to determine check and maintenance or repairing schedule.
- Preventive inspection and test schedule of on-load tap changer: For on-load tap changing transformer, the preventive inspection and test should comply with its instruction book or the relative standards.

## Short time overload

Transformer short-time overload capability is relevant to transformer windings time constant, initial load and environment temperature, recommended overload curves of AN/AF cooling method of this series products are as follows.



Notes: AT=ambient temperature; ILR=initial load rate; OLR=over load rate; CM=cooling method;

For AN running, OLR=actual capacity/AN rated capacity

For AF running, OLR=actual capacity/AF rated capacity

## Parallel operation (if applicable)

The two transformers of parallel operation should meet:

1. Same connection symbol, same rated HV and rated LV.
2. Voltage difference at same tap not more than 1%,
3. Short-circuit impedance difference not more than 10%,
4. Rated capacity ratio within 1/2~2.



# AEG



样本如有修改，恕不另行通知  
本手册纸张可循环利用  
版本号：202001SJ01EN

官方网址：  
<https://www.aeg-imc.com/>  
热线电话：  
400-820-5234

