

## Technique Control for Transformer

### I. Summary

This plan is formed to realize the design idea of transformer, make the working procedures going on smoothly, guarantee the quality and reliability of the transformer, satisfy the customers and establish the brand of DAELIM BELEFIC Power Transformer.

### II. Technique Assurance Plan

#### 1. Quality Control of Technological Equipment, Facilities and Casts

1) Organize the persons from departments of equipment, production and technique to start the inspection promptly on the key technological equipment, facilities and casts, ensuring them meeting the requirements in usage.

2) To thoroughly comprehend all the customer's requirements in production and make prepared the possible addition of technological equipment by communicating with the customers on technologies.

#### 2. Process control of the production

1) Once the design drawings are completed, organize the process engineers in charge and technicians of every process to review the drawings. To pick out the emphases of every process and to compile the technique instruction cards by process engineers in charge.

The persons participating in the power transformer technique work are as following:

No.	Process	Person in charge	Position
1	Winding	Zhou Wanjie	Process engineer in charge
2	Final Assemblage	Baofeifei	Process engineer in charge
3	Iron Core	Song Baozhen	Process engineer in charge
4	Oil-tank	Lei Fei	Vice Process engineer in charge

2) Organize training on the techniques of the power transformer for every workshop and organize the experienced technicians training the workers of different workshop sections.

3) Determine and report the personnel list in which the persons participate in producing the power transformer. The list should be as detailed as to indicate the maker of every accessory in order to keep track of the responsibilities

4) All the persons in charge of every process shall trace and record all the problems appeared, their solutions and results during the whole production period.

5) Before the beginning of factory operations, the designing engineers and technique engineers shall explain the detail of the drawings and techniques respectively to the production workers. It shall contain at least the technique instruction cards and the following technique documents:

No.	Document Code	Document Name
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1	DBTZ.913.003	Welding of bending structure transformer oil-tank
2	DBTZ.913.006	Wind pressure and water pressure Leakage test for transformer welding group
3	DBTZ.913.015	Welding and assembling of magnetic-resisting steel board
4	DBTZ.913.020	Auto and semi-auto torch cutting
5	DBTZ.913.021	Manual torch cutting
6	DBTZ.915.002	Rounding
7	DBTZ.915.003	Plate clamping piece manufacturing
8	DBTZ.915.005	Ate edge planing
9	DBTZ.915.009	Baiting lineation
10	DBTZ.916.002	Technique instructions of Silicon-steel sheet cross cut shearing
11	DBTZ.916.003	Operation of Silicon-steel sheet longitudinal shear line
12	DBTZ.916.006	Large Sized Transformer Iron-core Assembling
13	DBTZ.916.016	Bending Technique
14	DBTZ.918.017	Working Insulating Material on Machining Center
15	DBTZ.919.004	Colligation and Tightening of the heads of Coils
16	DBTZ.919.005	Preparation work before winding
17	DBTZ.919.008	Winding the Interleaved Coil
18	DBTZ.919.010	Winding the Helical Coil
19	DBTZ.919.011	Winding the Voltage-adjusting Cylindrical Layer Coil
20	DBTZ.919.013	Coil Assembling and Pressuring
21	DBTZ.919.021	Transformer external accessories assembling
22	DBTZ.919.057	Vapor-phase drying process of the transformer body
23	DBTZ.971.009	Transformer body pinching in axial direction
24	DBTZ.971.031	Assembling technique of the transformer body
25	DBTZ.971.037	Controlling of the impurities during assemblage
26	DBTZ.971.038	Connecting, shielding and insulation wrapping of Leading wire
27	DBTZ.971.101	Final assemblage of the power transformer
28	DBTZ.971.102	On-load tapping changing switch assembling
29	DBTZ.971.104	Lifting base assembling
30	DBTZ.971.105	Final assemblage of the sealing face
31	DBTZ.971.106	Assembling techniques of product
32	DBTZ.971.107	Transformer oil testing and laying still
33	DBTZ.971.111	Transformer vacuum oiling
34	DBTZ.971.116	Assembling of corrugated oil-tank
35	DBTZ.971.117	Transformer oil purification

6) Establish the project teams of design, technique, quality inspection and production.

Carry out the project management in all the links such as designing, production and material procurement, etc. There shall assign the persons of responsibility for the manufacturing schedule and quality of every process to make the project quantity and quality guaranteed.

7) Execute strictly according to <Disqualification Regulation> in the whole production period. Fill in the disqualification report if any deviation occurs. The technique and inspection department shall work together to make a good quality job.

8) Organize the operation staff, inspection staff and technique staff to summarize and adjust the techniques after every process and after completion of the whole product, to ensure the transformer with high quality and high reliability.

### III. Technique main points and control requirements in major processes

#### 1. Insulation material and coil

- 1) Once the insulation material has been manufactured, put them in sealed package by plastic film and store them in special storehouse, ready for use.
- 2) Forbid unnecessary persons entering the coil workshop, the operators, technicians and supervisors shall wear the work clothes, caps and shoes and be air showered to enter the workshop.
- 3) All the cardboard cylinders of the coils shall pass the drying process and be stored in the hot chamber and the tolerance of the cylinders shall be less than 1mm. All the insulator material shall be polished and the tolerance of the length and width of the cushion block shall be less than 0.5mm.
- 4) The insulator material and leads shall not touch the ground directly. The coils shall be covered by plastic films once leave the processing machine.
- 5) Use the pneumatic tools to bend the heads and tails of the transposed conductor coils to keep good consistency for bending. Use pneudraulic trans-poser to do the wire transposition to keep good consistency for transposition. The limit distance of the trans-poser shall be conductor width \* 2 + thickness of oil clearance cushion block.
- 6) Adopt carbon jointing for multiplexed wires, the wiped joint shall be 1 meter away from the coils and the protection films shall be one-off. Adopt argon-arc welding for tanglements. After being welded successfully, all the wires and tanglements shall be inspected by the inspectors and the welding positions be recorded before wrap up.
- 7) The tolerance of inner diameter of coil shall be no more than 1mm and that of radial direction shall be no more than 2mm. The surface of coils shall be neat and all the leads shall be consist in length.
- 8) Adopt kerosene vapor-phase drying process for the coils with the temperature more than 110°C, vacuum degree less than 20Pa and highly vacuum time more than 10h.
- 9) Considering the test data of compression ratio of cushion block, the axial height shall have a tolerance less than 2mm. Use the inflatable packer to raise the wires to add/reduce the cushion blocks, prevent the impact on the coils by not using insert-plate.

#### 2. Transformer body, leader

##### 1) Transformer body assembling

The transformer body assembling shall be done in the cleaning room. In order to guarantee the verticality of

the iron core, it shall be directly put on the assembling platform after the iron core is upraised and then use the infrared ray aligning level to measure the verticality of the iron core. Measure the outside diameter of the inner coil and the inside diameter of the outer coil at top, middle and bottom positions, the margin of inner and outer coils shall be between 0~0.5mm. Use 15t combining hanger to make the coils falling stably.

After the assemblage is finished and pressure pad is lay on the coils, fill the gap between iron core and pressure pad, the lead opening and oil-conducting hole on the pressure pad by white stripes, cover the surface of the pressure pad by 0.5mm cardboard, and then round the pressure pad and coils by dust cloth. Use hydraulic equipment to prevent the windings from rebounding. Insert top yoke board, and then clamp upper yoke by big size C clip.

#### 2) Leader assembling

In order to keep high merit rating of the transformer body, adopt cold pressed joint and bolt fastening for the connection of leaders. The cold pressed joint is shielded by semiconducting paper, careful to erase the taper angles of the semiconducting paper. The shielding work shall be checked and confirmed by inspectors, then cover the external insulation to the required thickness.

#### 3) Transformer body drying

In order to decrease the humidity content of the solid insulation to less than 0.3%, 2 drying processes shall be applied to the transformer body. The first process is kerosene vapor-phase drying, keeping the iron core and coil over 125°C for more than 110h with the residual pressure less than 10Pa. The second process is vacuum drying, keeping the iron core and coil over 125°C for more than 48h with the residual pressure less than 10Pa.

### 3. Final assemblage

1) Put the oil-tank with magnetic shade in the dryer the night before the end of second transformer body drying process, with temperature about 100°C, period about 8~10 hours and residual pressure less than 133Pa. Take out the oil-tank 0.5h before the transformer body. Once the transformer body is taken out, check if any fasten pieces become flexible and then load it in the tank immediately. Seal all the holes except the necessary flange holes at the bottom of the tank to avoid cross-ventilation. The time that transformer body is exposed in the air shall be controlled within 6 hours since the opening of vacuum drier to being sealed all over.

#### 2) Vacuum oiling

Vacuumize the oil-tank at the top position. When the residual pressure decreases to less than 30Pa, start counting time for 30h then inject oil, the specification of which is: withstand voltage $\geq 65\text{kV}$ ,  $\text{tg}\%(90^\circ\text{C})\leq 0.3$ , humidity content $\leq 8\text{ppm}$ , gas content $\leq 0.5\%$ , solid particles(quantity/100ml) $\leq 3000(\geq 2\mu\text{m})$ . The oiling speed is about 5000L/h, oil temperature about  $55\pm 5^\circ\text{C}$ . Stop oiling for 1 hour every 5000L. Keep vacuumizing during the oiling process.

#### 3) Hot oil circle

When hot oil circulating, adjust the flow rate vacuum filter to 12000L/h. Calculate the time according to the flow rate, and circulate more than twice, then stop hot oil circle after the quality confirmation of oil sampling test.

#### 4) Whole seal test and static discharge

According to GB standard, execute the oil column seal test in 24 hours when the top oil pressure is 0.03MPa, and move the products to be tested in the testing room after static discharge for 120 hours.

#### 4. Core material clipping and piling

##### 1) Inspection of silicon steel drum

If the paint film of silicon steel has bar section, corrosion, leak by asymmetrical painting, and the difference of thickness is bigger than 10%, it will not be use.

##### 2) Vertical shearing line

Adjust the precision of machine tool and ensure the punch burr, perpendicularity, undulation satisfy the requirements of technicals. To prevent rusting after uncoiling, we spray anti corrosive liquid on the terminal of the silicon steel sheet.

##### 3) Horizontal shearing line

Diameter of core is bigger than  $\Phi 1000$ , and each steel sheet of single phase pole has to be split joint. The design of sheet shape conforms the requirements of SOENEN horizontal shearing line.

##### 4) Core piling

We use 150T packed rolling table for piling. Because it is new products, to correctly measure core no load loss and current, at first we should adopt piling upper yoke technicals. All the silicon steel sheet has to be handled with care and dust proof.

##### 5) Col-ligation of cores

After pressing tight by hydraulic device, tie temporary metal strips and then colligate weft less cord adhesive tape.

##### 6) Control the thickness of core

A. Strictly control the incoming stock, make sure the thickness, tolerance, quality of silicon steel sheet reach our standard, conform to the requirements of design.

B. Strictly control the thickness, measurement of each step, thickness bias of each step:  $\pm 1\text{mm}$ , thickness of primary step:  $0 \sim +2\text{mm}$ . At the last three step, measure the thickness against the clamp status of the steel strip, so as to adjust the total thickness of piling. The tolerance of total thickness is  $-1.0\text{mm} \sim +2.0\text{mm}$ .

##### 7) Control of the diameter of core

Strictly control the accuracy of core piling, make it symmetrical, keep it in concentric circles with bias of diameter:  $-3.0\text{mm} \sim +6.0\text{mm}$  according to the technical requirements.

##### 8) Control of seal

A. Reinforce the tolerance control of dimension in horizontal&vertical working procedure.

Width tolerance in vertical shearing:  $-0.5\text{mm} \sim 0\text{mm}$ ; Length tolerance in horizontal shearing:  $-0.5\text{mm} \sim 0\text{mm}$ . Reinforce the measuring inspection of first & last pieces.

B. Operate carefully when piling, measure the height, width of core window to ensure the size of seal conform to the requirement of technical as  $0 \sim +2\text{mm}$ .

##### 9) Control of compactness in assembling

Fasten the core pole by pneumatic tool; synchronously fasten the pull screw of upper & down yokes of fluid cylinder to ensure the thickness and tightness of core conforming to the requirements.

##### 10) Lift and delivery

We use the compensating beam lift cores to assure non-deform

#### 5. Oil tank

1) To make sure the quality of tank vacuum oiling, we should have a leak test in the end of welding and assembling works and de-rusting by sandblast when it pass the test.

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2) No taper angle allowed in clamping piece and steel stiffener inside the oil tank and all the taper angle should be inverted to circular bead of R10mm.

iv. Summary

As the execution of a series of technical control measures which improves the performance quality of each departments effectually, we are sure of our effective quality control of our products in the whole producing procedure, and we are able to produce high quality, reliable 500kV transformers, promoting the DAELIM transformers to develop and make a substantial step upon the super voltage field.