

Manufacturing and Testing of Three Phase Transformer and Improvement in the Design Parameters

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Abstract: This paper describe about industrial project of manufacturing, testing and improvement in the design parameters of three phase transformer. This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed, naturally cooled distribution transformers for outdoor use. Currently in transformer manufacturing industry or in any industry problems are there. Any Industry wants efficient product with comparatively low cost. In this project we study the whole process of manufacturing and then to find out the problems that currently industry facing and solution for them. In transformers various tests are done to check out the losses and many other parameters. The test like open circuit test, short circuit, ratio test, impulse test, oil and winding test, insulation test, polarity test etc. This tests are done before the delivery of transformer and to check whether it giving the losses in desired limit.

Keywords: Distribution Transformer, Manufacturing, Improvement in Design Parameters, Testing.

1. Introduction

The main objective of this whole study is to manufacture and test the transformer and simultaneously find out the problems that industry facing and solution for that problems. Transformer manufacturing contain lots of processes, to study that processes deeply and working there as an employee to find out problems that industry facing. Before delivery of transformer various test are performed on it to check out the losses and various other parameters. Transformer is a device which work with 95 to 96% of efficiency. This is to be check out during the various tests. In the recent development of power systems, increase in power plant capacity has been a major achievement in the power industry, the purpose of distribution transformer is to reduce the primary voltage of the electric distribution system to the utilization voltage serving the customer.

2. Manufacturing

A. Process including in manufacture

1) Core construction

It is consist of limbs depends on the phase of transformers. The material used is CRGO steel and HRGO steel. The laminated

sheets are used to reduce eddy current losses. The sheets are varnished layer on them to insulate them from each other

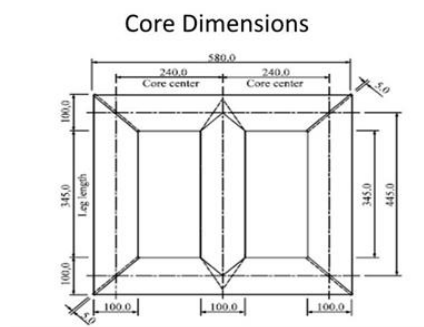


Fig. 1. Core dimensions

2) Stepped core

As round shaped winding are used in transformer construction if we used rectangular core then the lots of space remain utilized hence we usually use stepped or square core.

Core Dimensions

Circular core cross section:

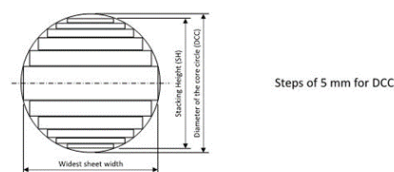


Fig. 2. Stepped core

3) Winding

There are two types of windings we use that is high voltage and low voltage winding, we use two types of insulation for them one is paper insulation wrapped over it and one is it is already coated with insulated layer. Low voltage winding is always near to core to reduce insulation cost and the percentage of problems that can occur. High voltage winding is over the low voltage winding.

4) Transposition

Low voltage winding is transposed while wrapping it around its periphery. It increase the efficiency and various problems that can happen. It also reduce losses.

5) Heating and Megger test

After assembling of transformer we send it for heating in heater to remove the moisture remaining in the winding or in whole assembly of it. Megger test is carry out for checking the insulation resistance. Importantly in transformer it is carry out to check whether all insulation are proper or not.

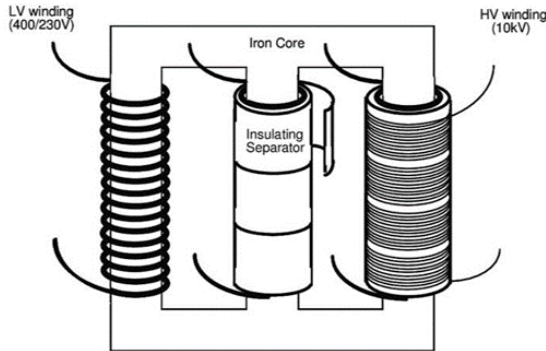


Fig. 3. Winding

Continuously Transposed Conductor

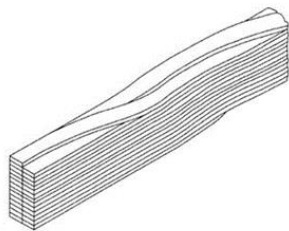


Fig. 4. Transposition

3. Testing

- *Short circuit test:* This is carry out to check the copper losses, voltage regulation in industry.
- *Open circuit test:* This is carry out mainly to get core losses.
- *Ratio test:* Transformer turn ratio tester is used to perform this test. It determines the ratio of high voltage winding to all other windings: Measured ratio variation should be within 0.5 %.
- *Impulse test:* It checks whether it can withstand the lightning strokes i.e. it checks the dielectric strength of transformer. Lightning impulse test and switching impulse test are included in this category.
- *Oil and Winding test:* In this test we check whether the temperature rising limit of transformer winding and oil as per specification or not.

- *Polarity test:* We check the polarity of transformer between two points.
- *Tanking:* After all the procedure of assembling and primary testing like megger test we insert the three phase distribution transformer in the tank. The transformer is made ready for testing after assembly of bushings, conservator, radiator, and all other protecting devices. After inserting the transformer we pour oil inside of it which is again filtered while pouring and the process get done.

Table 1

The transformers as per losses and other efficiency parameters.

Voltage Ratio	Rating (kVA)	3 Star		4 Star		5 Star	
		Max. Losses at 50% loading (Watts)	Max. Losses at 100% loading (Watts)	Max. Losses at 50% loading (Watts)	Max. Losses at 100% loading (Watts)	Max. Losses at 50% loading (Watts)	Max. Losses at 100% loading (Watts)
11000/433 - 250 V	16	150	480	135	440	120	400
11000/433 - 250 V	25	210	695	190	635	175	595
11000/433 - 250 V	63	380	1250	340	1140	300	1050
11000/433 - 250 V	100	520	1800	475	1650	435	1500
11000/433 - 250 V	160	770	2200	670	1950	570	1700
11000/433 - 250 V	200	890	2700	780	2300	670	2100

4. Problems we found and solution for them

- *Problem:* Mechanical tap changers that are used currently in transformer industry creates problems like arching between taps which leads to carbonization and degradation of transformer oil. It also leads to various losses and machine life will get reduced. This increases maintenance cost.
- *Solution:* To tackle this problems solid state tap changer can be used over here. All the losses that are happening because of mechanical tap changer are overcome by solid state tap changer.

5. Conclusion

Hence we studied the whole process of manufacturing of transformer and testing of it. While studying in industry we got the problem that currently industry facing and we gave solution to that problem.

References

[1] <https://www.electrical4u.com>
 [2] <https://electrical-engineering-portal.com>
 [3] TS for 3 Phase DT 1, 3-Phase Distribution Transformers 11 or 33 kV/415-240V (Outdoor Type)
<https://www.mstcecommerce.com/auctionhome/RenderFileViewVideo.jsp?file=ddugjy-3-Phase-DTs.pdf>
 [4] Guidelines for specification of energy efficient outdoor 3 phase distribution transformer—Govt. of India