

Back To Back Test on Three Phase Star-Star Connected Transformer

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ABSTRACT - A back-to-back test of a 3-Phase Star-Star connected transformer is a critical assessment used to evaluate the performance, efficiency, and reliability of such transformers. This test is particularly significant in the context of electrical power distribution systems, where transformers play a pivotal role in voltage conversion and distribution. The test involves two identical Star-Star connected transformers placed in close proximity, with one transformer serving as the primary and the other as the secondary. A comprehensive set of measurements is conducted to analyze the transformers' electrical, thermal, and mechanical characteristics. Key parameters under scrutiny include voltage regulation, load losses, no-load losses, impedance, and short-circuit performance. By subjecting these transformers to various load conditions, engineers can assess their efficiency and ensure that they comply with industry standards. The back-to-back test also helps identify any discrepancies in the transformer's design, manufacturing, or operation. This knowledge is invaluable for diagnosing and rectifying any issues, ultimately ensuring the transformers' reliability and prolonging their operational lifespan. In summary, the back-to-back test of 3-Phase Star-Star connected transformers is an essential procedure to guarantee the optimal performance and safety of these vital components in electrical power systems. It provides a robust assessment of their operational parameters and helps in maintaining the integrity of the power distribution network.

I. INTRODUCTION

A back-to-back test on a 3-phase star-star connected transformer is a method used to determine the transformer's performance and to verify its parameters. This test involves connecting two identical transformers in a back-to-back configuration and subjecting them to various test conditions to assess

their electrical characteristics, such as impedance, voltage regulation, and efficiency. It is a common method for evaluating the quality and compatibility of transformers in power systems and ensuring their proper operation in real-world applications. Transformers play a fundamental role in transmitting electrical power efficiently from one circuit to another by electromagnetic induction. In many applications, transformers are connected in various configurations, one of which is the star connection. Amidst this critical role, the reliability and efficacy of transformers remain paramount, prompting the need for stringent testing protocols to validate their performance and mitigate potential operational risks. The significance of our research extends beyond mere scrutiny of the transformer's functionality; it embodies a commitment to advancing the frontiers of electrical engineering knowledge. By subjecting the transformer to rigorous back-to-back testing procedures, we aim to glean invaluable insights into its dynamic response to varying load demands and transient conditions. Through meticulous analysis of test data and empirical observations, we endeavor to unveil the underlying phenomena governing its operation, shedding light on both its strengths and limitations. Moreover, our endeavor underscores the broader imperative of quality assurance within the electrical engineering domain. In an era characterized by burgeoning energy demands and evolving technological paradigms, the efficacy of power distribution systems hinges upon the reliability of individual components. By subjecting the 3-phase star-star connected transformer to rigorous scrutiny, we not only bolster confidence in its performance but also pave the way for enhanced system resilience and operational efficiency. In essence, our exploration of the back-to-back test on a 3-phase star-star connected transformer transcends the confines of mere academic inquiry; it embodies a steadfast commitment to advancing the frontiers of

electrical engineering knowledge and bolstering the reliability of power distribution systems. Through meticulous experimentation and analytical rigor, we endeavor to unravel the intricacies of this indispensable component, laying the groundwork for future innovations and advancements in the field.

II. METHODOLOGY

In conducting a back-to-back test on a 3-phase star-star connected transformer, a systematic methodology is essential to ensure accurate and reliable results. The test begins with thorough inspection and verification of the transformer's connections, ensuring proper phase sequencing and terminal labeling. Subsequently, precise measurements of voltage, current, and power factors are taken at both the input and output terminals under various load conditions. Careful consideration is given to maintaining balanced loads across all phases to accurately assess transformer performance. Data collection is followed by comprehensive analysis, comparing input and output parameters to evaluate efficiency, impedance, and voltage regulation. Any deviations or discrepancies are meticulously documented and investigated to identify potential issues or abnormalities. Throughout the test, adherence to safety protocols and industry standards is paramount to safeguard personnel and equipment.

Transformer

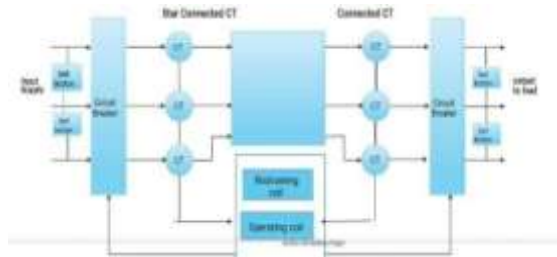


Fig -1: Basic Block Diagram

3. COMPONENTS

1. Miniature Circuit Breaker

MCB, short for Miniature Circuit Breaker, is an electrical protection device that automatically switches off circuits in case of overload or short circuit, serving as a safety measure to prevent damage to equipment and reduce the risk of fires. It operates by detecting abnormal current flow, utilizing either a bimetallic strip or electronic sensor to trip and interrupt the circuit when the current exceeds its rated capacity.

2. Indicators

Indicators in the context of electrical engineering and electronics refer to devices used to visually convey information about the status or

condition of a system, circuit, or equipment. Here's detailed information about indicators: Indicators are used to provide visual feedback on the operational status, performance, or condition of electrical and electronic systems. They convey information through visual cues such as light, color, or movement, allowing users to quickly assess the state of a system or component. Light Emitting Diode (LED) indicators are commonly used due to their low power consumption, long lifespan, and high visibility.

3. Ammeter

An ammeter is a device used to measure electric current in a circuit. It typically has a low resistance and is connected in series with the circuit whose current is to be measured. Ammeters come in various types, including analog and digital, and they have different ranges to accommodate different current levels. When measuring current with an ammeter, it's important to ensure that the ammeter's range is suitable for the current being measured to prevent damage to the ammeter or inaccurate readings.

4. Voltmeter

A voltmeter is a device used to measure the voltage difference between two points in an electrical circuit. It is typically connected in parallel with the component or circuit across which the voltage is to be measured. Voltmeters come in analog and digital varieties, with various ranges to accommodate different voltage levels. When using a voltmeter, it's essential to select the appropriate range to ensure accurate readings and prevent damage to the voltmeter. A voltmeter is an electrical instrument used to measure the voltage or potential difference between two points in a circuit. It operates based on Ohm's law, which relates the voltage across a resistor (such as the voltmeter's internal resistance) to the current passing through it. Voltmeters come in two main types: analog and digital. Analog voltmeters use a moving pointer on a scale to indicate voltage, while digital voltmeters display numerical values on a digital screen.

5. Terminals Panel Mounting

Mounting a voltmeter on a terminal panel is a straightforward process that involves several key steps. Firstly, you'll need to select an appropriate location on the panel, ensuring it offers easy access and clear visibility. Once the location is determined, prepare a mounting hole that matches the size and shape of the voltmeter's mounting flange or bezel. Securely attach the voltmeter to the panel using suitable mounting hardware such as screws, nuts, and washers, ensuring proper alignment of the mounting holes. Next, make the necessary wiring connections to the voltmeter terminals according to the manufacturer's instructions,

taking care to route and secure the wiring properly. After wiring, perform a thorough test to verify the voltmeter's functionality and accuracy. Finally, complete the installation by securing any loose wiring and ensuring the panel is properly closed and sealed to protect the voltmeter and wiring connections from environmental hazards. Following these steps ensures a reliable and accurate voltmeter installation on a terminal panel.

6. Panel Sheet

Panel sheets also serve as mounting surfaces for various components, such as switches, indicators, terminals, and circuit breakers, allowing for organized and accessible arrangement of electrical components within the enclosure.

7. Wires

Wires are essential components in electrical and electronic systems, used to transmit electrical power, signals, and data between devices, components, and circuits

4. DESIGN

1. Back to Back test or Sumpner Test as it is called is done to test a transformer on full load.
2. Where in the LV side of the two transformers are connected in parallel with each other and to the source connected to variable supply voltage.
3. The High voltage side of the two transformers are connected in series so that the voltage across them is equal and opposite simulating a zero voltage condition and a variable voltage source is connected in series.
4. Now rated voltage is applied in the LV side with the variac supplying to HV side is set on zero at this condition both transformers are working at Open Circuit condition and wattmeter reading reads the sum of core losses of both transformers
5. Now gradually the variac setting of the HV side is increased till the current in the HV side reaches rated HV current, in this condition wattmeter reads the sum of copper loss in two transformers
6. Hence the transformers are working in full load losses without actually loading them fully hence making it site compatible and efficient.
7. Also, two transformers are checked simultaneously.
8. This method is used for heat run test of the two sister units. The transformers are kept in this condition for 48 hours and temp. Is noted in an hourly basis and a curve is plot , which should become constant after some time also it should be within

III. CONCLUSION

The back-to-back test on a three-phase star-connected transformer is a vital procedure to analyze its performance and characteristics. By evaluating the transformer's efficiency, losses, and impedance, we gain insights into its operational behavior. The test helps us determine the transformer's ability to regulate voltage under various loads and ensures its compliance with industry standards. The results from this test guide us in making informed decisions about transformer utilization and maintenance. In conclusion, the back-to-back test is an essential tool for ensuring the reliability and functionality of these transformers in a variety of applications, from industrial settings to power distribution systems.

1. Future Scope

The future scope of back-to-back tests on 3-phase star/star-connected transformers is dynamic and continuously evolving, driven by advancements in technology, energy demands, and environmental concerns. Here are several areas where the future scope of these tests is expected to expand: Smart Grid Integration, Renewable Energy Integration, Energy Efficiency, Artificial Intelligence (AI) and Machine Learning (ML) Explore more sophisticated techniques for performance analysis, such as transient response testing, harmonic distortion analysis, and dynamic modeling. These advanced methods can provide deeper insights into transformer behavior under diverse operating conditions. Investigate strategies to enhance transformer efficiency through optimization of core materials, winding configurations, cooling systems, and insulation techniques. Implementing efficiency-enhancing measures can lead to energy savings and reduced environmental impact

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