SAIEE Accredited
Transformer Design and Manufacturing Training Course

Powertech
Transformers
Transformer Design and Manufacturing Training Course

Overview
A transformer is a static device with two or more windings that are linked to each other by means of a strong magnetic field. Transformers are designed for specific purposes. The design requirements of transformers depend on the application.

Large power stations where the electric energy is generated are often situated far away from the numerous places where the energy is consumed. Therefore it is vitally important that proper maintenance and checks are done on transformers to ensure that they are operating correctly.

It is recommended that during the first year of operation the checks should be carried out frequently.

Considerations whether the transformer must be isolated, energized or loaded during maintenance must also be taken into account.

Powertech Transformers is offering a transformer design and manufacturing training course which covers various elements of power transformers over a five day period.

Course Content
The course covers design processes, both electrical and mechanical; fabrication; insulation; paper-lapping; core-cutting; core stacking, winding manufacture; winding assembly; quality assurance and control; factory testing; active part assembly; oil processing and tanking; protection components, first line maintenance and transport and dispatch of the transformers.

Format of the Course
The course will take the format of both practical and classroom training.

The course content will be covered over five full days at our factory in Pretoria West.

Competent Trainers will be covering the relevant topics in the course.

The course is accredited with the SAIEE—ref: SAIEE-0889-V and CPD and 4 points can be claimed.

Admission Requirements
Personnel from utilities, consulting engineers, etc. including Test Technicians and maintenance personnel.
Manufacture of windings for different applications
This topic comprises the different types of windings which can be designed for various applications. The selection and arrangement of windings required are also covered in the course.

Mechanical fabrication
This is the last module covered in Day 1 and encompasses all aspects of the transformer tank which is primarily the container for the oil and a physical protection for the active part. It also serves as a support structure for the accessories and control equipment.
Transformer Design and Manufacturing - Day 2

A power transformer consists of various parts that are manufactured for various purposes by Powertech Transformers. Transformer cores are built from thin sheets of special high grain magnetic steel metal. These sheets are manufactured specifically for use in transformers. There are various types of conductor material that may be used on the windings which are namely paper covered copper strip conductor, enamelled coated copper or continuously transposed cable (CTC) or aluminum. The choice of conductor material depends on design requirements, price and availability. Insulation material must be able to withstand the operating temperatures that occur in the transformer during its lifetime.

Course Content

Day 2 of the course involves the following:

**Insulation structures and cooling**
This topic covers mechanical and dielectric strength of materials, oil impregnation and the specifications regarding moisture content.

Different types of cooling systems available i.e. ONAN, ONAF, OFAN, OFAF, OFWF as well as ODAF.

**Mechanical design covers the following topics:**
- Mechanical Design Process Flowchart
- Design Procedure
- Automated Design Tools
- Mechanical Design System (MDS)
- Active part, core, cleats and leads, tanking and design verification

A session in various parts of the factory is the final topic covered in Day 2. This session focuses on insulation, paper-lapping, core cutting, core stacking, winding manufacturing and winding assembly.
Transformer Design and Manufacturing - Day 3

The functional reliability of transformer installations depends on the suitability and quality of the transformer, components and the processes employed. Powertech Transformers adheres to the international standard of quality management systems, namely ISO 9001-2008.

Course Content

Day 3 of the course involves the following:

Quality Assurance and Control

Quality control (QC) is a process by which the manufacturing quality of all factors involved in production is checked against set design requirements and manufacturing tolerances. Quality control focuses on in process testing of products to uncover defects and report to management.

Quality Assurance (QA) attempts to improve and stabilize production (and associated processes) to avoid, or at least minimize, issues which led to the defect(s) in the first place.

The focus from QA is on process improvement through trend analysis of reported defects.

Topics covered here include the following:
- Documented procedures and documentation development process.
- Internal audits.
- Incoming and on-the-job Inspections
- Customer complaints, NCR’s, etc
- Customer complaints, NCRIs, etc
- Testing of transformers

The purpose is to provide a guideline for customer representatives, as well as other interested parties, on routine and type tests. This covers test methods and sequences normally used.

The final session of the day focuses on active part assembly, oil processing and tanking. This session is in the format of a practical session in the factory.
Transformer Design and Manufacturing - Day 4

The transport, installation and commissioning is an important part in the supply chain of a power transformer. After the Factory Acceptance Test (FAT), the transformer is disassembled and made ready for transporting. Depending on the weight and size of the transformer special transport is required and should be performed by experts in handling heavy goods.

Course Content

Day 4 of the course involves the following:

Despatch of the power transformer from factory to site

Topics covered here include the following:

Use of impact recorders during transport, external and internal inspections, dry air pressure system, packaging of all components, preliminary commissioning test and oil handling on site.

Power system protection deals with the protection of electrical power systems from faults through the isolation of faulted parts from the rest of the electrical network. The objective of a protection scheme is to keep the power system stable by isolating only the components that are under fault, whilst leaving as much of the network as possible still in operation. Thus, protection schemes must apply a very pragmatic and pessimistic approach to clearing system faults. For this reason, the technology and philosophies utilized in protection schemes can often be old and well-established because they must be very reliable.

Protection on the transmission and distribution network serves two functions: Protection of plant and protection of the public (including employees). At a basic level, protection looks to disconnect equipment which experience an overload or a short to earth.

Protection components include the following:

- Pressure relief valve
- Rapid rise relay
- Bag leak detector
- Rubber bag
- Breathers
- Marshalling Kiosk
- Sudden flow stop valve
- Oil level indicator
- Temperature indicators

Commissioning tests covers when and under what circumstances transformers should be tested, the terminology as well as the recommended field tests that need to be performed and the reasoning behind the tests.

First Line Maintenance (FLM) is aimed at Operations Technicians with the purpose to train them in the basic maintenance tasks related to transformers in service. The training entails applicable product knowledge and the maintenance tasks that operators can perform themselves to proactively identify abnormal conditions and measure deterioration before it affects the transformer or leads to a failure. The final topic of the day covers factory training in the test and despatch areas.
The Powertech Transformers laboratory has been in existence since 1973. The main activities of the laboratory are testing of materials for transformers and calibration of instruments. The testing of transformer oil forms a large part of the testing activities, and this service is also offered to external companies. Calibration work is performed for our in-house customers.

Transformer oil testing

The testing of transformer oil is part of a preventative maintenance plan, also known as condition monitoring. The oil inside a transformer forms an integral part of the insulation system, but is unfortunately subject to quick deterioration if the preventative maintenance schedule is not adhered to. Adverse load conditions also affect the oil. It is therefore common practice to have the oil tested annually. Certain tests also give an indication of the condition of the transformer itself and, if interpreted correctly, and acted upon, can prevent catastrophic failure of a transformer. The laboratory is well equipped to perform all the important tests related to condition monitoring, using some of the best equipment available on the market.

Course Content

Day 5 of the course involves the following:

- Certifications and Accreditations
- Laboratory Services
- Calibration

The various laboratories which are available for:

- Material Testing
- Insulation
- Core Steel
- Winding Conductor
- Oil Testing
- Abbreviations used in Transformer Oil Testing
- Purpose of Transformer Oil in Transformers
- Shortening of the Transformer’s life

- Enhancing the life expectancy of a Transformer
- Pitfalls in Transformer Oil Testing
- Classification of Tests for Insulating Oils
- Classification of Transformers and Switchgear
- Oil Sampling
- Transformer Oil Tests - why, what and how
- Dissolved Gas Analysis
- Choosing a Laboratory
- Zero Tolerance
- Process Instrumentation
- Various types of Transformer Designs

Transformer R&D within Design

The development of cutting edge technology for transformers involves an in-depth understanding of the fundamental phenomena experienced by the transformer under normal, transient and fault conditions involving voltages and currents. These complex phenomena are extensively studied through the development of virtual prototype models and experiments (including FEM and 3D simulations). Essentially, the research teams continually assess the improvements of materials, test methods, manufacturing processes and design philosophies. Tools for computing the design parameters are being developed and verified using the virtual experimentation platforms based on numerical methods. The Technology Department participates in the development of international standards responsible for benchmarking the design of power transformers. This comes in a form of contributions to CIGRE and IEEE working groups. The following disciplines are covered under the R&D section:

- Magnetostatic Core and Acoustic performance
- Dielectric Integrity
- Short Circuit Durability
- Thermal Stability
Terms and Conditions

• All registrations will be deemed confirmed and subject to these terms and conditions.
• All pricing excludes VAT.
• A full refund is available for cancellations received in writing at least 15 working days’ prior to course commencement.
• The course fee is non-refundable if less than 15 working days’ notice of cancellation is given.
• Registrations received less than the 15 days prior to the course can therefore not be cancelled.

Powertech Transformers reserves the right to cancel any advertised course due to insufficient enrolments or to conditions beyond Powertech Transformers control.

Payment is required prior to the starting date of the course. Please send the payment advice to info@pttransformers.co.za