Electrical Engineering XYZ

Whitepaper

v 1.0

Transformer & its types

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Whitepaper

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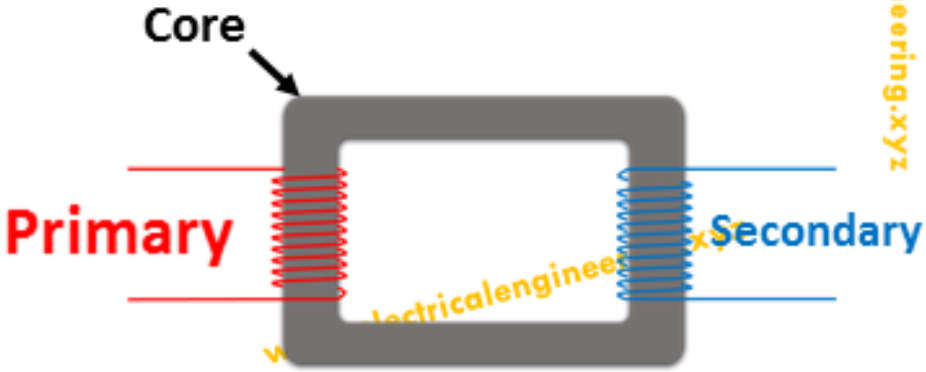
What is Transformer?

The electrical transformer is an ac device which converts ac voltages at one level to the other.

Construction

The electrical transformer is made up to two coils which are wrapped around a ferromagnetic core. Of the two coils, one coil connects with the ac input and other one provides output to the external circuit. First coil is known as primary coil and second one is know as secondary coil.



Types of Transformers

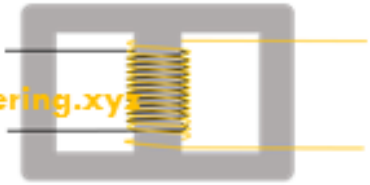
Electrical Transformers are divided in to many types on the basic of working, construction and design.

On the Basic of construction

Rectangular type

A rectangular core is the one on which two windings are wrapped on two opposite sides of core.

Shell type



A shell core is the one having three legs, windings are wrapped on the central leg of transformer.

Practically the shell type construction is employed, in this construction the winding with smaller turns is connected directly to the core. Direct connection also reduces the leakage flux.

Instrumentation transformers

The electrical power stations, buses, and gears are rated at very high voltages. The ordinary measurement and protection elements (relays, voltmeters, ammeters etc.) are rated at lower values. Here instrumentation transformers come handy. They are used to step down the large current and voltages to acceptable levels. Instrumentation transformers are of two types:

Potential transformers

The potential transformer steps down large potential values to smaller ones.

Current transformers

A current transformer steps down large current values to smaller ones.

Instrumentation transformers are also known as protection transformers since they protect CT's and PT's.

Power transformers

These transformers are used at the power stations and are used in stepping of electricity for the power transmission and distribution purposes. Power transformers are divided into three classes. Let's first understand the generation, transmission and distribution of electricity.

In electrical power station the electricity is generated at 16 kV's. This power is stepped up to 765 kV and is transmitted from generating station to the substation. At substation its levels are reduced from 765 kV to 66 kV. Then it is transmitted to distribution stations from where it is stepped down to 120 & 230 V. All this stepping is done via the power transformers.

Transformer	Detail
Unit	It steps up the generated power to 765 kV.
Substation	It takes 765 kV and steps it down to 66 kV.
Distribution	It takes 66 kV and steps it down to 230, 120.

The voltage values presented here are not fixed. Some station generate power at 18 or 11 or other values. Similarly sometimes power transmission voltages are 500 kV and sub distribution are 11 kV.

Autotransformers

Sometimes the electrical voltages require stepping of voltages by a small ratio. In such cases a special purpose transformer is used which is known as autotransformer. For example it can take 200 V and can provide 220 V.

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Cooling of transformers

A transformer has certain type of heat losses which are associated with it. These heat losses tend to raise the temperature of transformer and certain methods are employed to cool down the transformers. List of such methods are:

1. ONAN: Natural oil cooling (ON), Natural air cooling (AN)
2. ONAF: Natural oil cooling (ON), Forced air cooling (AF)
3. OFAF: Forced oil cooling (OF), Forced air cooling (AF)
4. ODAF: Directed oil cooling (OD), Forced air cooling (AF)
5. OFWF: Forced oil cooling (OF), Forced water cooling (WF)

While Choice of any method depends on the MVA ratings of transformers & place of installation. The key factor for selection of any method depends on the site factors. The table below displays the cooling data for a Hyundai transformer:

With 55° rise in temperature	
ONAN cooling	20 MVA
ONAF cooling	25 MVA

While this whitepaper presents general information on cooling methods, while working on power station, you should never rely on this guide or any other guide on the internet. Always use the official documents provided by the company.