Testing of Transformers

The structure of the circuit equivalent of a practical transformer is developed earlier. The performance parameters of interest can be obtained by solving that circuit for any load conditions. The equivalent circuit parameters are available to the designer of the transformers from the various expressions that he uses for designing the transformers. But for a user these are not available most of the times. Also when a transformer is rewound with different primary and secondary windings the equivalent circuit also changes. In order to get the equivalent circuit parameters test methods are heavily depended upon. From the analysis of the equivalent circuit one can determine the electrical parameters. But if the temperature rise of the transformer is required, then test method is the most dependable one. There are several tests that can be done on the transformer; however a few common ones are discussed here.

Winding resistance test

This is nothing but the resistance measurement of the windings by applying a small d.c voltage to the winding and measuring the current through the same. The ratio gives the winding resistance, more commonly feasible with high voltage windings. For low voltage windings a resistance-bridge method can be used. From the d.c resistance one can get the a.c. resistance by applying skin effect corrections.

Polarity Test

This is needed for identifying the primary and secondary phasor polarities. It is a must for poly phase connections. Both a.c. and d.c methods can be used for detecting the polarities of the induced emfs. The dot method discussed earlier is used to indicate the polarities. The transformer is connected to a low voltage a.c. source with the connections made as shown in the fig. 18(a). A supply voltage Vs is applied to the primary and the readings of the voltmeters V1, V2 and V3 are noted. V1 : V2 gives the turns ratio. If V3 reads

V1 −V2 then assumed dot locations are correct (for the connection shown). The beginning and end of the primary and secondary may then be marked by A1 −A2 and a1 −a2 respectively. If the voltage rises from A1 to A2 in the primary, at any instant it does so from a1 to a2 in the secondary. If more secondary terminals are present due to taps taken from the windings they can be labeled as a3, a4, a5, a6. It is the voltage rising from smaller number towards larger ones in each winding. The same thing holds good if more secondaries are present.

Load Test

Load Test helps to determine the total loss that takes place, when the transformer is loaded. Unlike the tests described previously, in the present case nominal voltage is applied across the primary and rated current is drown from the secondary. Load test is used mainly

1. To determine the rated load of the machine and the temperature rise

2. To determine the voltage regulation and efficiency of the transformer.

Rated load is determined by loading the transformer on a continuous basis and observ- ing the steady state temperature rise. The losses that are generated inside the transformer on load appear as heat. This heats the transformer and the temperature of the transformer increases. The insulation of the transformer is the one to get affected by this rise in the temperature. Both paper and oil which are used for insulation in the transformer start get- ting degenerated and get decomposed. If the flash point of the oil is reached the transformer goes up in flames. Hence to have a reasonable life expectancy the loading of the transformer must be limited to that value which gives the maximum temperature rise tolerated by the insulation. This aspect of temperature rise cannot be guessed from the electrical equivalent circuit. Further, the losses like dielectric losses and stray load losses are not modeled in the