

EXP. No. (2)

Delta-Open Delta Test on a 3-Phase Transformer

Theory:

The primary and secondary of the transformer are delta connected, and three phase rated supply is applied to the primary, with the secondary is open delta. Clearly the total supplied will then be the no-load losses (iron loss) of the transformer.

If the secondary delta is opened at one point. No fundamental voltage appears at these open ends, though any triple (third) harmonic voltage will appear. Since such voltages for the three phase are additive in all phases. If a single phase low voltage is applied to the open ends, a circulating current will flow round the delta and a compensating current will flow round the primary delta.

Full-load heat run test can be carried by circulating the full-load current in the secondary winding for enough time, and record the total iron loss is thus given by:

P_{iron} = Reading of primary side wattmeter

P_{cu} = Reading of secondary side wattmeter

The efficiency of three phase transformer is given by:

$$\eta = \frac{X(3VICOS\phi)}{X(3VICOS\phi) + P_{iron} + x^2 P_{cu}}$$

Where:

X = any load 25%, 50%, 75%, 100%, 125% of full-load

V = Secondary terminal phase voltage.

I = load current

$\cos\phi$ = power factor of the load.

P_{cu} = copper loss

P_{iron} = iron loss

Procedure:

- 1- Connect the circuit diagram as shown in fig. (1).
- 2- Switch off the secondary winding switch which is connected to open delta.
- 3- Connect the primary with power supply terminals. Apply rated primary voltage to its primary windings.

- 4- Connect a voltmeter across the secondary terminals, and measure the third harmonic voltage.
- 5- Increase the single phase secondary voltage (V_{sc}) step-by-step until (I_{sc}) reaches the rated current of transformer for each step record the reading of:

Primary side			Secondary side		
I_o	V_1	P_o	I_{sc}	V_{sc}	P_{sc}
	Rated		↓		
	=		↓		
	=				
	=		↓		
	=		↓		
	=				
	=		↓		
	=		rated		

Results:

- 1- From the recorded reading, plot the iron and copper loss against (I_{sc}).
- 2- Calculate the efficiency of the transformer at the following loads and power factor.
 - a- At 0.8 power factor at $x=0.25, 0.5, 0.75, 1, 1.25$ of full-load.
 - b- At unity power factor at $x=0.25, 0.5, 0.75, 1, 1.25$ of full-load.
- 3- Plot the efficiency against percentage load.

Question & Calculation:

- 1- Discuss the efficiency curve above.
- 2- Comment on the value of triple-frequency voltage. Explain why a fundamental frequency voltage does not appear at the o. c. secondary terminals.
- 3- What will be the magnitude of circulating current flowing in the primary circuit?
- 4- Open delta is fed with full-load current. What is the effect of it on the primary side?
- 5- Comment on the suitability of experiment for prediction of efficiency.

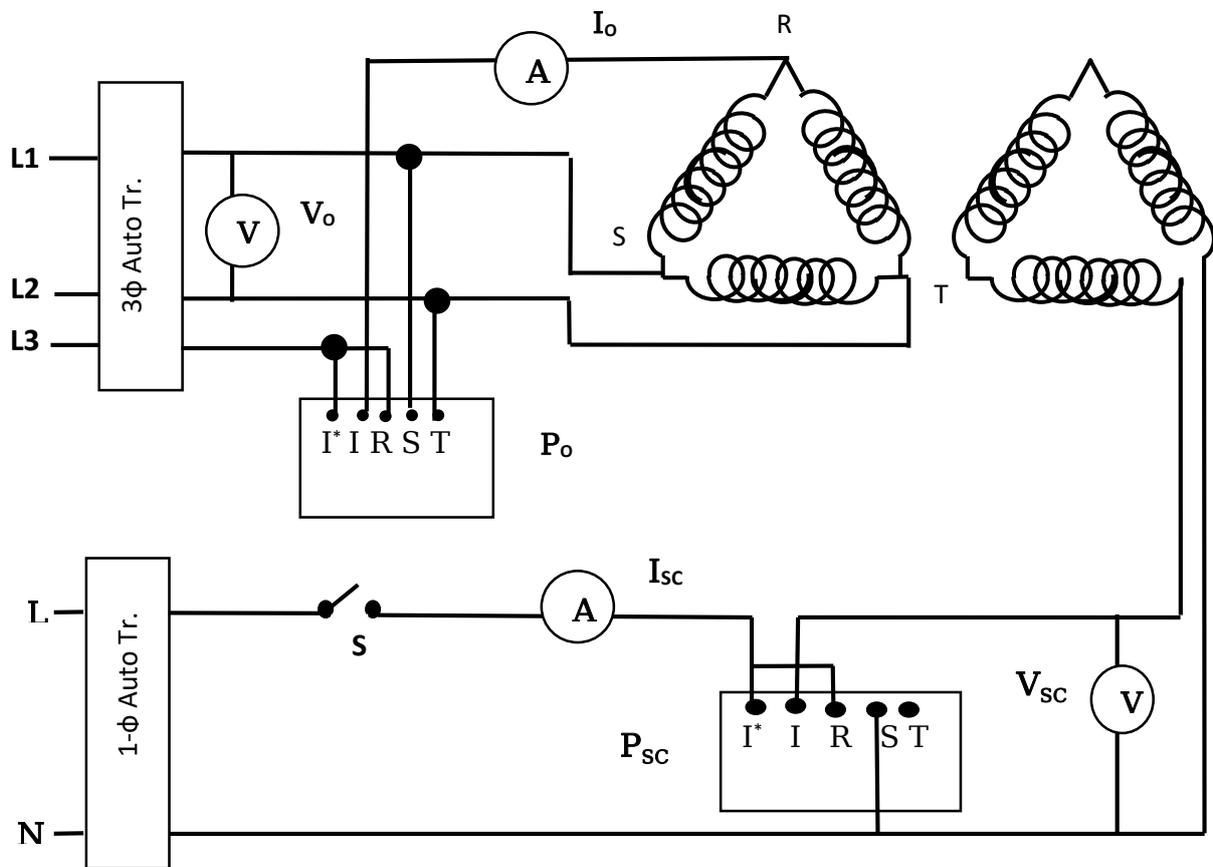


Fig. (1)