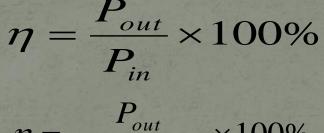
Transformer Efficiency

Transformer efficiency is defined as (applies to motors, generators and transformers):



$$\eta = \frac{P_{out}}{P_{out} + P_{loss}} \times 100\%$$

Types of losses incurred in a transformer: Copper I²R losses Hysteresis losses Eddy current losses

Therefore, for a transformer, efficiency may be calculated using the following:

$$\eta = \frac{V_S I_S \cos \theta}{P_{Cu} + P_{core} + V_S I_S \cos \theta} x100\%$$

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Condition for maximum efficiency

Culoss = $I_1^2 R_{01}$ or $I_2^2 R_{02} = W_{cu}$ Iron loss = Hysteresis loss + Eddy current loss = $W_h + W_e = W_i$ Considering primary side, Primary input = $V_1I_1 \cos \phi_1$ $\eta = \frac{V_1 I_1 \cos \phi_1 - \text{losses}}{V_1 I_1 \cos \phi_1} = \frac{V_1 I_1 \cos \phi_1 - I_1^2 R_{01} - W_i}{V_1 I_1 \cos \phi_1}$ $= 1 - I_1 R_{01}$ and W_i of the set of $V_1 \cos \phi_1 = V_1 I_1 \cos \phi_1$ Differentiating both sides with respect to I_1 , we get $\frac{d\eta}{dl_1} = 0 - \frac{R_{01}}{V_1 \cos \phi_1} + \frac{W_i}{V_1 l_1^2 \cos \phi_1}$ For η to be maximum, $\frac{d\eta}{dI_{\eta}} = 0$. Hence, the above equation becomes $\frac{R_{01}}{V_1 \cos \phi_1} = \frac{W_i}{V_1 I_1^2 \cos \phi_1} \quad \text{or} \quad W_i = I_1^2 R_{01} \quad \text{or} \quad I_2^2 R_{02}$ Cu loss = Iron loss or

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