Magnetic Measurements

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❑ Flux density

$$B = \frac{\phi}{A_s} = \frac{RK_q\theta_1}{2NA_s}$$

where, ϕ = Flux linking search coil
A_s = Cross-sectional area of specimen
R = Resistance of the ballistic galvanometer circuit
$K_q\theta_1$ = Charge indicated by ballistic galvanometer
N = Number of turns in the search coil

❑ Hysteresis loss per unit volume

$$p_h = \eta f B_m^k$$

where, η = Hysteresis coefficient
f = Frequency; Hz
B_m = Maximum flux density; Wb/m^2
k = Steinmetz coefficient

Note:

The value of k varies from 1.6 to 2.

❑ Eddy current loss per unit volume for laminations

$$p_e = \frac{4k_f^2 f^2 B_m^2 t^2}{3\rho}$$

where, k_f = Form factor
t = Thickness of laminations; m
ρ = Resistivity of material; Ω-m

❑ Total iron loss per unit volume

$$p_i = p_h + p_e = \eta f B_m^k + \frac{4k_f^2 f^2 B_m^2 t^2}{3\rho}$$

- **Maximum flux density**

$$B_m = \frac{E_2}{4k_f f A_s N_2}$$

- **For sinusoidal supply**

$$B_m = \frac{E_2}{4.44 f A_s N_2}$$

where, E_2 = Voltage induced in seconcary winding

$E_2 = 4k_f f \phi_m N_2$

k_f = Form factor (= 1.11 for sinusoidal supply)

f = Frequency

A_s = Cross-sectional area of specimen

N_2 = Number of turns in secondary winding

ϕ_m = Maximum flux linkage

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