
TERMS AND DEFINITIONS

1. Initial permeability μ_i

The limiting value of the amplitude permeability when the field strength is vanishingly small.

$$\mu_i = \lim_{H \rightarrow 0} \mu_a$$

2. Effective permeability μ_e

The permeability obtained by the self-inductance of magnetic core in a closed magnetic circuit where the flux leakage can be ignored.

$$\mu_e = \frac{L}{\mu_0 N^2} \cdot C_1$$

L: Self-inductance of coil

μ_0 : Permeability of vacuum magnetic constant

N: Number of winding turns

C_1 : Core constant

3. Amplitude permeability μ_a

The relative permeability obtained from the peak value of the flux density and the peak value of the applied field strength, at a stated amplitude of either, when the field strength is varying periodically with time with an average of zero, and the material is initially in a specified neutralized state.

4. Permeability of vacuum magnetic constant μ_0

The permeability in vacuum.

$$\mu_0 = 4\pi \times 10^{-7} \text{ (H/m)}$$

5. Saturation magnetic flux density **B_s**

The maximum intrinsic induction possible in a material.

6. Maximum magnetic flux density in a hysteresis loop **B_m (mT)**

The flux density at high field strength.

7. Remanent magnetic flux density **B_r (mT)**

The value of the remanent flux density when the material is brought from saturation by a monotonically changing field.

8. Coercivity **H_c (A/m)**

The magnetic field strength for which the flux density is zero.

9. Apparent permeability μ_{app}

The ratio of the inductance, L of a measuring coil when assembled in a specified position on a given core, to the inductance, L_0 of the same coil measured without the core.

$$\mu_{app} = \frac{L}{L_0}$$

10. Inductance factor **AL**

The inductance of a coil of specified geometry, placed on a given core in a specified position, divided by the square of the number of winding turns.

$$AL = \frac{L}{N^2}$$

N: Number of winding turns on the specified measuring coil

L: Inductance of the measuring coil when placed on the core

11. Loss factor **$\tan \delta$**

The sum of the hysteresis loss factor, eddy current loss factor and residual loss factor.

$$\tan \delta = \frac{R_m}{\omega L} = \frac{R_{eff} - R_w}{\omega L}$$

R_m : Loss resistance of magnetic core alone

ω : Angular velocity

L: Self inductance of core with coil)

R_{eff} : Resistance of core and coil

R_w : Resistance of coil

12. Relative loss factor **$\tan \delta / \mu_i$**

The ratio of loss factor to AC initial permeability.

$$\frac{\tan \delta}{\mu_i} = \frac{\mu''}{(\mu')^2}$$

Note: The following formula applies when the gap of magnetic circuit is small.

$$\frac{\tan \delta}{\mu_i} = \frac{\tan \delta}{\mu_e}$$

13. Core loss **P_c (W)**

The power absorbed by a magnetic core and dissipated as heat, when the core is subjected to an alternating magnetic field which results in a measurable temperature rise.

14. Core loss volume density) **P_{cv} (kW/m³)**

Core loss per unit volume of a magnetic core.

15. Quality factor **Q**

The reciprocal of the tangent of the loss angle.

16. Temperature coefficient of initial permeability **α_{μi}**

The fractional change of permeability per 1°C in a temperature range from T₁ to T₂.

$$\alpha_{\mu i} = \frac{\mu_{i2} - \mu_{i1}}{\mu_{i1}} \cdot \frac{1}{T_2 - T_1}$$

μ_{i1}: Permeability at temperature T₁

μ_{i2}: Permeability at temperature T₂

17. Relative temperature coefficient of initial permeability **α_{μir}**

The temperature coefficient per unit permeability.

$$\alpha_{\mu ir} = \frac{\alpha_{\mu i}}{\mu_{i1}}$$

18. Curie temperature **T_c (°C)**

The temperature below which a material is ferromagnetic or ferrimagnetic and above which it is paramagnetic.

19. Resistivity **ρ (Ω · m)**

The electrical resistance per unit length and cross-sectional area of a magnetic core.

20. Density **d (kg/m³)**

The density of magnetic core is calculated from its volume and weight.

$$d = \frac{W}{V}$$

21. Core factors

C_1 : For a core of given geometry, the summation of the quotients of the elements of the magnetic path length L measured along the assumed mean magnetic path by the corresponding cross-sectional area A of the magnetic path elements.

$$C_1 = \sum \frac{L}{A}$$

C_2 : For a core of given geometry, the summation of the quotients of the elements of the magnetic path length L measured along the assumed mean magnetic path by the square of the corresponding cross-sectional area A of the magnetic path elements.

$$C_2 = \sum \frac{L}{A^2}$$

22. Effective dimensions of a magnetic circuit

For a magnetic core of given geometry, the magnetic path length, the cross-sectional area and the volume that a hypothetical toroidal core of the same material properties and of radially thin uniform cross-section should possess to be magnetically equivalent to the given core, within the limit of the Rayleigh region.

Effective cross-sectional area **Ae**

$$Ae = \frac{C_1}{C_2}$$

Effective magnetic path length **Le**

$$Le = \frac{C_1^2}{C_2}$$

Effective volume **Ve**

$$Ve = Ae \cdot Le = \frac{C_1^3}{C_2^2}$$