Ferrite Test and Measurement

Your Signal Solution®
Introduction

FAIR-RITE PRODUCTS CORP.
ABOUT FAIR-RITE

Founded in 1952, family-owned and operated.

ISO9001:2015 and IATF16949:2016 certified

Providing ferrite components for the electronics industry for nearly 70 years.

– Component manufacturing in New York and Asia.
– Powder production and warehousing in Illinois.

Used for various applications:

– EMI Suppression
– RFID / Antenna
– Inductive
– Power
Ferrite Basics
What Is Ferrite?

Ferrite is a soft magnetic material formed by pressing and firing metal oxides into a ceramic material.

Two basic Materials: MnZn and NiZn

A ‘Soft’ magnetic material is one that can be both easily magnetized and demagnetized.
Application Areas of One Material

61 Material Permability vs Frequency

µ'
µ''

Power  Inductive  Suppressive

Frequency (Hz)

1,000,000  10,000,000  100,000,000  1,000,000,000
Testing Overview
Test & Validation

Ferrite production requires extensive quality control checks throughout the manufacturing process.

This starts during the production of the raw materials and ends with a final quality check immediately preceding packaging of the cores.
How Ferrite Is Made
Shapes & Materials

Basic testing of ferrite cores comes down to mechanical (dimensional) measurement and electrical performance characterization.

Electrical and mechanical characteristics are a function of both material input at the beginning of the process AND the various production steps following.

Process variation at any point in the process can have significant knock-on effects later and could result in unacceptable production parts.
Electrical Test Equipment

- LCR meters
- Impedance analyzers
- Network analyzers
- Ohm-meters
- AC Wattmeters
- Oscilloscopes
Mechanical Test Equipment

- Calipers, micrometers, depth/height gauges
- Pin/plug, go, no-go gauges
- Coordinate measuring machine
- Optical measuring machines
- Surface profilometers
Material Properties

- Much of the basic characterization done to ferrite cores is derived from the materials (nominal) characteristics
- These are back calculated to set specifications in measurable parameters for the individual part (ie. Measuring inductance to validate permeability)
Application Specific

- Some of the characteristics measured are a result of the use case of the core
- An example of this would be measuring impedance on a suppression core or core losses on a power rated part at levels or frequencies outside of the material property derived norms
Custom Tests

- In some cases (primarily in custom cores), tests are designed to accurately replicate very specific conditions the core will be subjected to.
- Simple ones might include mechanical strength or over temperature performance.
- More complex tests may involve multiple variable inputs.
Electrical Testing
Inductance and Quality Factor

• Inductance factor (Al) is a standard test carried out on inductive rated parts
• Cores are measured at 10kHz sinusoidal with a flux density of less than 1mT (same as initial permeability)
• Lead length is deliberately kept to minimum and turn count high enough to mitigate the inductance added by the wire
• Series inductance and quality factor will also be measured at some higher frequency to ascertain loss factor
• The frequency at which this is characterized will depend on the material and/or application
• Flux density is at or below 100μT
Impedance

- For cores that are used as suppression devices, the vector quantity of the impedance is characterized on an impedance analyzer.
- The frequency of the measurement will be determined by the effective suppression frequencies of the material and/or the application.
- Wire length being kept to a minimum is of critical importance here as the testing is generally carried out very low turn count (usually 1).
Core Loss

- In addition to Al and loss factor, parts that will be operating at high flux densities may be tested for core loss.
- This testing is performed with a sinusoidal excitation and a wattmeter (at low frequencies).
- The frequency and flux density are variable depending on the material and application.