APPLICATION NOTE

Magnetic Susceptibility Measurements Using the MS2/MS3 System

Principles of operation

The magnetic state of a specimen is generally described by the following equation:

$B = \mu_0 (H+M)$ ... (1)

where:

B is the flux density of the specimen in Tesla

μ_0 is the permeability of free space. This is a constant ($4\pi x10^{-7}$)

H is the applied field strength in A/m

M is the magnetisation of the specimen in Tesla.

Dividing through by H we get:

$\mu_r = \mu_0 + \mu_0\kappa$ ... (2)

where:

μ_r is the relative permeability of the specimen (dimensionless)

κ is the magnetic susceptibility of the specimen (dimensionless)

Rewriting, we get:

$\mu_0\kappa = \mu_r - \mu_0$ ... (3)

The MS2/MS3 system measures the magnetic susceptibility in the following way.

The sensor consists of a very high thermal stability oscillator for which a wound inductor is the principle frequency-determining component. When the inductor contains only air the value of μ_0 determines the frequency of oscillation. When the inductor is placed within the influence of the specimen to be measured, the value of μ_r determines the frequency of oscillation. The meter to which the sensor is connected digitises the μ_0 and μ_r dependant frequency values with a resolution of better than one part in a million and computes the value of magnetic susceptibility.

The value of μ_0 is constant but the variable of interest is relatively small. Therefore any thermally induced sensor drift needs to be eliminated by occasionally obtaining a new 'air' or μ_0 value. On the MS2 meter this is done by depressing the 'zero' button. The μ_r value is obtained by pressing the 'measure' button. The magnetic susceptibility value is displayed digitally and output via a serial interface.

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