

Magnetic material measurement.

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Since many years the politics of Laboratorio Elettrofisico is aimed to expanding the measuring instrumentation suitable to survey the magnetic materials properties. We are now proud to introduce a new equipment suited to detect the magnetic permeability of the feebly magnetic materials. This type of instrumentation completes the range of equipment already in production as the hysteresisgraph, the permeameter, the coercimeter and the magnetic scanner.

The purpose of the **F.M.M Permeameter** (Feebly Magnetic Material Permeameter) is to detect very weak magnetic properties of materials that are generally considered as non-magnetic, like stainless steels.

When these materials are used in application that need very low interaction or interference with magnetic fields, it is necessary to control that properties like magnetization, susceptibility, permeability, are low enough.

Examples of such applications are materials for big electric machines, turbine generators, NMR instruments, electron or ion beam equipment, masses and precision weight, etc.

The equipment has been entirely projected and built in the laboratories of our company in accordance with the international regulation ASTM A342-84.

The range of measure of the relative permeability is between 1.001 up to 4, with a typical accuracy better than 2 %. This range is really very low, recalling that the permeability of the air is 1, and that the permeability of some magnetic materials, like permalloy, can reach values of 10^5 or 10^6 .

Measurable samples may be: a bar, a rod, a wire or a strip of uniform cross section, with a dimensional ratio that depends on its permeability. The maximum diameter (or transversal dimension) is 48 mm. The minimum length of the sample is 100 mm without maximum limitation, so that it is possible to measure also long bars in different positions without cutting them.

The measure is performed measuring the flux produced by

the sample under the excitation of an axial magnetic field. The intrinsic magnetization J is calculated dividing the flux by the number of turns of the measuring coil and the cross section of the sample.

The susceptibility χ is then calculated by the formula $\chi = J/\mu_0 H$; the relative permeability is then simply $\mu_{rel} = \chi + 1$.

The standard equipment consists of:

- **The solenoid:** suitable to produce a highly uniform axial field in its centre, with maximum intensity (for standard equipment) of 75 mT (750 Oe). The length is about 500 mm, and the useful diameter is 48 mm.

- **The measuring coil:** it is located in the internal centre of the solenoid. It consists of three different coils and of a resistive compensation system for the calibration. The three measuring coils are wound on three different diameters; the function of the two located more externally is to have a magnetic area equivalent to the magnetic area of the B-measuring coil without involving the sample. In this way, the total magnetic flux linked with the three coils (without any sample inside) is perfectly zero. Calling A_B, A_{J1}, A_{J2} the areas of the measuring and compensation coils and N_B and N_J the correspondent number of turns, the match to achieve is: $N_B A_B - N_J (A_{J2} - A_{J1}) = 0$.

- **The power unit:** very precise power supply with the current measuring system incorporated in it. Since the axial field inside the solenoid is directly proportional to the current flowing in the solenoid wiring, the value H is in fact determined by the measure of the current multiplied for the solenoid's coefficient.

- **The fluxmeter:** it is an electronic integrator that permits to measure magnetic flux with a maximum resolution of $1 \mu\text{Wb}$.



- **The personal computer + dedicated software:** to manage the measure and permits data storage, visualisation, printing, etc.

Besides manufacturing this equipment, Laboratorio Elettrofisico also offers the **measuring service** with the F.M.M Permeameter by its laboratories.

For any questions please contact Lionel GRAND: lionel.grand@cedrat.com



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