

## Precision measurement of feebly magnetic materials

The model PFMM (Permeameter for Feebly Magnetic Materials) is an instrument to verify that a non-magnetic material (for example austenitic stainless steel) is really “non-magnetic”. The permeameter PFMM quantifies the magnetic “weakness” of the material by measuring its magnetization curve, relative permeability  $\mu_r$  and susceptibility  $\chi$ . When a non-magnetic material is used in an application where the interaction with magnetic fields must be very low, the control of its magnetization and permeability is fundamental. The permeameter PFMM measures the relative permeability in the range between 1.001 and 4, with a typical total accuracy less than  $\pm 2\%$ . When low values of permeability and susceptibility are required, the Laboratorio Elettrofisico PFMM is necessary tool. The sensitivity of the coil must be very high: for example, the PFMM can accurately measure the susceptibility of good stainless up to 108 times lower than the susceptibility of a typical Fe-Ni, that can be measured with a permeameter for ferromagnetic materials.

**Measurements are taken in compliance with ASTM 342 and IEC 60404-15 standards.**

### STANDARD CONFIGURATION

- Cabinet with fluxmeter and DC power supply
- Solenoid with positioning tool for samples
- Compensated measuring coil
- Dedicated software Rn-1.0
- PC and printer
- Instruction manual

## HOW IT WORKS

### Principles of operation

The Laboratorio Elettrofisico PFMM is based on the measurement of the magnetic polarization  $J$  of the material under an increasing external field  $H$ . The ratio between  $J$  and  $H$  provides the susceptibility  $\chi$  and relative permeability  $\mu_r = 1 + \chi$ . The accurate measurement of  $J$  it is critical: for example, for a material with  $\mu_r = 1.001$ , applying a field  $H$  of 10000 gauss, the polarization  $J$  will be 10 gauss only!

An extremely accurate compensation coil facilitates and performs automatically this measurement. The sample must be in the shape of a bar with a uniform cross-section and be placed inside a solenoid using a proper positioning tool (provided). The  $J$  field is measured with an inductive sensor, while the  $H$  field is determined by the current through the solenoid. With the standard diameter of the solenoid ( $\varnothing$  50 mm), the length of the specimen must be greater than 100 mm and the cross section not less than 20 mm<sup>2</sup>. The measurement of specimens that have different dimensions is possible with custom solenoids and measuring sensors, that are available on request.

## APPLICATION

- Turbo generators
- NMR instrumentation
- Ionic devices
- Electron beam devices
- Precision weights



MEASURABLE MATERIALS	Feebly Magnetic Materials
MEASURABLE SHAPES	Straight Bars, with regular cross section
MEASURABLE QUANTITIES	J vs. H curve, permeability $\mu_r$ , susceptibility $\chi$
$\mu_r$ range	1.001 ÷ 4
$\chi$ range	0.001 ÷ 3

**ACCURACY**

$\mu_r, \chi$	Better than $\pm 2 \%$
J	$\pm 1 \%$
H	$\pm 1 \%$

**SAMPLE SIZE**

Length	100 ÷ 200 mm
Cross section	490 mm <sup>2</sup>
Ratio length/diameter	Bigger than 10 for $\mu_r < 1.5$ Bigger than 15 for $1.5 < \mu_r < 2.0$ Bigger than 30 for $2.0 < \mu_r < 4.0$

TEST TIME	30 seconds (typical)
Frequency	DC
OPERATING TEMPERATURE RANGE	15 ÷ 40 °C

**MAIN ELECTRICAL CABINET**

Power Supply	220 Vac, 50-60 Hz, 16 A max absorption
Dimensions	535 x 655 x 550 mm (21 x 26 x 22")
Weight	50 kg (110 lb)

**FLUXMETER**

Model	Digital Flux
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**SOLENOID**

Max Field	750 Oe (60 kA/m)
Diameter	90 mm (3.54")
Useful diameter for sample	48 mm (1.89")
Length	500 mm (9.69")
1 % uniformity length	180 mm (7.09")
External dimensions	330 mm x 630 mm, H=300 mm (13 x 24.8 x 12")

**PC AND SOFTWARE**

PC	PC, monitor, printer and all connection cables
Operating system	Windows
Software	Rn-1.0 (English, French or Italian)
Connection	USB

**MANUALS AND DOCUMENTATION**

	Instruction manual (English, French or Italian)
	Calibration certificate
	CE mark

The software Rn-1.0 is an integrated element of the permeameter PFMM and manages the system and creates a user friendly interface between machine and user. It allows the setting of the measurement parameters and the view of the results at the end of the measurement.

The main features of this software are shown below.

The exclusive Laboratorio Elettrofisico Rn-1.0 software automatically controls the measurement process. Once the operator inputs the parameter settings, accurate measurements are made in less than 30 seconds: the PFMM displays the J vs. H curve and the permeability. The other available options are: integrated database, customizable print options and data management.

## FEATURES

### Type of measurement

- J vs. H, permeability  $\mu_r$ , susceptibility  $\chi$

### Results

- Hsat, Bsat, Jsat, Br, Hc, loop area, relative permeability, specific power losses, losses separation, Steinmetz coefficient and many advanced results
- Magnetic units in SI and CGS, measures in mm and inches, temperature in °C and °F

### Setting of measuring parameters

- Manual or automatic settings of parameters
- Setting of acceptance limit for direct quality control

### Data elaboration

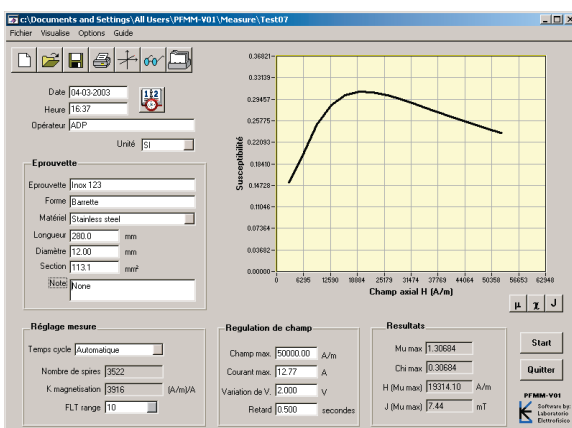
- Limit setting for good/rejected results
- Statistical evaluation of the results

### Printing a report

- Customized print options for information and language
- Direct printing of a graphs and data on printer or file
- The report can be opened and saved with other Word processor programs such as Microsoft Word

### Data base and file searching

- Data base of measuring file with fast search capability, ordering and selection
- Full compatibility with other spread sheet programs, such as Microsoft Excel™



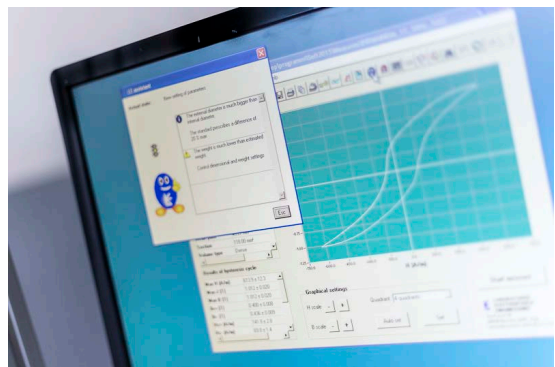
### Personalized training

Count on our team of experts for personal training during the acceptance period at Laboratorio Elettrofisico. After delivery, additional training may be arranged at your facility. We'll be happy to create a custom training plan to fit your needs.



### Real-time help

The LE Assistant monitors your system in real time and provides suggestions and error messages to improve performance. The LE Assistant is automatically activated if messages or warnings exceed a certain level.



### Seamless support

With LE, you're only one button away from expert help. Access support online through TeamViewer screen sharing, Skype us - or send a request for technical assistance directly through your equipment's software. Seamless support for LE equipment is built in.





## LABORATORIO ELETTROFISICO

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Founded in 1959, Laboratorio Elettrofisico is a global company specializing in engineering, designing, and manufacturing the world's most precise magnetizing and magnetic measuring equipment. Headquartered in Milan, LE has laboratories, testing facilities, support staff, and services centers in the United States, India, and China.

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For more details, visit: [www.laboratorio.elettrofisico.com](http://www.laboratorio.elettrofisico.com)